PROYECTO FUNDACIÓN LA CAIXA

PROYECTO DE ATENCIÓN INTEGRAL A LAS PERSONAS AFECTADAS DE SÍNDROMES DEMENCIALES

RESUMEN PROYECTO

Fundamentación:

El Alzheimer es una enfermedad neurodegenerativa caracterizada por la aparición lenta de síntomas que evolucionan a lo largo de los años. Afecta aproximadamente en Andalucía a 124.000 personas.

Es la forma más frecuente de demencia, produce una reducción progresiva de las capacidades cognitivas, ocasionando cada vez una mayor dificultad para cuidarse y dirigirse a sí mismo, lo que conlleva la dependencia de la persona afectada para las ABVD, tareas que recaen en las personas cuidadoras.

Objetivo general:

AFA pionera en España en ofrecer terapias a los familiares y programas de detección y estimulación a enfermos, tiene como objetivo general mejorar la asistencia y la calidad de vida de las personas afectadas por síndromes demenciales, es decir, a las personas enfermas, sus familias y la sociedad en general.

Los principios de la neuroplasticidad son la base de los tratamientos no farmacológicos de los síndromes demenciales que se realizan en la actualidad en nuestro centro de día.

Las actividades para la que solicitamos el proyecto nos permitirán implementar dichos programas. Se trata de ampliar la atención en todas las áreas fundamentales de la persona enferma según el grado de deterioro, a través de un conjunto de talleres adaptados a sus capacidades, coordinados por profesionales del área, que serán divulgados a través de nuestra web (YouTube).

Actividades y desarrollo:

Las actividades se llevarán a cabo mediante talleres grupales según las fases de la enfermedad, favoreciendo con ellos la socialización y la integración de las personas usuarias del programa.

Talleres:

1.Estimulación cognitiva con nuevas tecnologías y en la naturaleza **(Jardín de los sentidos).**
2.Taller de prevención y cuidado de úlceras por presión en fase avanzada.
3.Taller de estimulación psicomotriz y danza creativa.
4.Taller de musicoterapia y música pasiva reminiscente.

5.Taller multisensorial con elementos naturales y tecnología avanzada **(Sala Snoezelen, aromaterapia y cromoterapia).**
6.Taller de terapia de reminiscencia.
7.Taller de convivencia intergeneracional “Aprendemos juntos”.
8.Talleres ocupacionales y manualidades.

Resultados esperados:

Las investigaciones científicas y la evidencia basada en nuestra propia experiencia de más de 25 años nos permiten ser optimistas en cuanto a los resultados esperados, que serán evaluados mediante indicadores objetivos, evaluación continuada de las personas enfermas y la satisfacción de sus cuidadores.

Recursos para su ejecución:

Los recursos materiales necesarios para el desarrollo de los talleres serán detallados posteriormente.

Gestión del proyecto:

La realizará la dirección del centro de día en coordinación con los distintos departamentos: administración, trabajo social, psicología, enfermería, fisioterapia, terapia ocupacional, musicoterapia, gerocultura y cocina.

Objetivo General

Implementar con nuevas tecnologías y en conexión con la naturaleza los servicios a los afectados de síndromes demenciales favoreciendo su integración en el entorno vecinal y en la comunidad escolar.

Objetivos específicos

Detallados en los distintos talleres

1. Taller de estimulación cognitiva con nuevas tecnologías y en la naturaleza **(Jardín de los sentidos):**
   - Mantener funciones mentales superiores y ejecutivas: programas Gradior y Neuron-up.

Indicador de evaluación (I.E): Escala Likert de la valoración del desempeño.

2. Taller de prevención y cuidado de úlceras por presión en fase avanzada:
   - Implementar medidas preventivas para reducir incidencia de UPP.
   - Orientar a los cuidadores y profesionales en el uso de los recursos disponibles en función de la situación del paciente.
   - Brindar cuidado y tratamiento específico a UPP.

I.E: Escala Norton. Cuestionario de evaluación para profesionales y cuidadores.

3. Taller de estimulación psicomotriz y danza creativa:
    - Estimulación de las capacidades físicas.
    - Ralentizar el deterioro psicofuncional inherente a la demencia.
    - Descender los niveles de ansiedad y estrés del enfermo.
    - Potenciar la creación de lazos afectivos entre los componentes del grupo.

I.E: Escala de conducta patológica B-AD.
Valoración física: Escala de Tinetti.

4. Taller de musicoterapia y música pasiva reminiscente:
    - Desarrollar la imaginación y creatividad.
    - Ralentizar el deterioro de las capacidades cognitivas primarias.
    - Expresar sentimientos y emociones canalizándolas en el marco musical.

Recogida de información relevante a través del libro de vida. Evaluación mediante escala Likert de conductas significativas.

5. Taller multisensorial con elementos naturales y tecnología avanzada **(Sala Snoezelen, aromaterapia y cromoterapia):**
    - Reducir cambios y alteraciones conductuales.
    - Promocionar experiencias sensoriales estimulantes a través de los sentidos.

I.E: Escala de conducta patológica B-AD.

6. Taller de terapia de reminiscencia:
    - Estimular la memoria episódica autobiográfica y colateralmente la atención, el lenguaje expresivo y compresivo, la orientación en las tres esferas, memoria semántica y gnosias.
    - Mejorar el bienestar emocional.

I.E: MMSE de lobo.

7. Taller de convivencia intergeneracional “Aprendemos juntos”:
    - Combatir mitos y falsas creencias, así como el respeto a las personas con demencia.
    - Enriquecerse a través de la convivencia.
    - Intercambiar y compartir las actividades del centro.

I.E: Escala Likert de satisfacción.

8. Talleres ocupacionales y manualidades.
    - Estimulación sensorial, motricidad fina y praxia.
    - Mejorar atención y memoria procedimental.
    - Favorecer creatividad, autoestima y socialización.

I.E: MMSE de lobo**.**

Metodología y actividades

Es un proyecto que pretende la integración a través de actividades realizadas en talleres, dirigido a los que consideramos personas afectadas de demencia, que no son solo los usuarios de nuestros centros sino sus familias, cuidadores y sociedad en general.

Utilizaremos metodología grupal, lo cuál no es independiente de nuestro objetivo de adaptación a la persona.

Usando el GDS de Reisberg podemos graduar las fases de la demencia y distribuir las actividades por salas, las cuáles identificamos por colores (arcoíris) para más tarde personalizar cada actividad en función de la evaluación continuada de la persona enferma.

Con nuestros talleres queremos también formar y hacer participar a familias, cuidadores, voluntarios, escolares, estudiantes universitarios… ya que su novedad y nuestra dilatada experiencia hacen atractivo nuestro proyecto a los alumnos de los centros que forman a profesionales relacionados con nuestro campo.

Nuestro proyecto pretende, además, divulgar todos los talleres anteriormente expuestos a través de la creación de videos y tutorías para no solo llegar a usuarios de nuestro centro de día, si no a los familiares y cuidadores de las aproximadamente 124.000 personas afectadas de Andalucía y a todos los demás centros e instituciones interesados.

Actividades:

1. Taller de estimulación cognitiva con nuevas tecnologías y en la naturaleza **(Jardín de los sentidos):**
    - Terapia de Orientación a la Realidad, para mantener las coordenadas personales.
    - Terapia cognitiva: actividad grupal de mantenimiento de las funciones mentales superiores con lápiz y papel.
    - Terapia cognitiva con programa Gradior y Neuron-up.
    - Aromaterapia y horticultura en patios naturales y jardín de los sentidos.

2. Taller de prevención y cuidado de úlceras por presión en fase avanzada:
    - Educación sanitaria a cuidadores, familiares y profesionales.
    - Manejo de la presión (cambios posturales, tratamiento fisioterápico y uso de superficies específicas para el manejo de la presión (SEMP).
    - Cuidado integral del usuario en coordinación con familia y centro de salud de referencia.

3. Taller de estimulación psicomotriz y danza creativa:
    - Sesiones de mantenimiento o mejora de las capacidades físicas: movilidad articular, coordinación, equilibrio, conciencia corporal, reflejos, fuerza, resistencia y atención.
    - Juegos lúdicos deportivos.
    - Clases de danza creativa.

4. Taller de musicoterapia y música pasiva reminiscente:
    - Actividades de: ritmo, discriminación auditiva y lenguaje.
    - Aspectos lúdicos.
    - Improvisaciones musicales.

5. Taller multisensorial con elementos naturales y tecnología avanzada **(Sala Snoezelen, aromaterapia y cromoterapia):**

   Actividades:

   - Sensoriales: apagado y encendido de luces (tubo de burbujas), orientación, fijación y seguimiento visual vertical u horizontal, observar, tocar, manipular fibras ópticas y reconocimiento de olores y texturas.
   - Con proyector: verbalizar imágenes, realizar seguimientos y fijaciones.
   - Para disminuir la alteración de conducta.

6. Taller de reminiscencia:
   - Actividades relacionadas con la infancia, juventud, adolescencia (familia, colegio…).
   - Elaboración de sus propias cajas de recuerdo.
   - Collage de fotos evocando momentos laborales.
   - Teatro representado antiguos alumnos de escuela y profesor.
   - Taller de labores (costura, croché y punto).

7. Taller de convivencia intergeneracional “Aprendemos juntos”:
   - Reuniones conjuntas entre el equipo de profesores de los colegios y nuestros profesionales.
   - Evaluación del grado de conocimiento previo sobre la enfermedad
   - Sesiones de concienciación sobre la demencia y los conceptos básicos que fundamentan nuestra existencia y desempeño.
   - Realización de talleres por los alumnos (talleres de lengua, matemáticas y actividad física).
   - Valoración del grado de satisfacción.

8. Talleres ocupacionales y manualidades:
   - Ludoterapia.
   - Arteterapia.
   - Laborterapia.
   - Reciclaje.
   - Risoterapia.

Planificación de las actividades y recursos asociados

Este proyecto, ya en marcha, se ejecuta de forma continuada. Su evaluación es a través de test y cuestionarios y se realiza cada seis meses.

1. Taller de estimulación cognitiva con nuevas tecnologías y en la naturaleza **(Jardín de los sentidos):**

La frecuencia será diaria, según estadio de la enfermedad. Se realiza en diferentes salas y exteriores, durando 45´ la sesión. Los programas cognitivos con nuevas tecnologías serán de 20´.

Recursos humanos (RH): terapeuta ocupacional encargado de dirigir el taller, psicólogo/a responsable del taller y auxiliar.

Recursos materiales (RM):

Proyector1

Juegos didácticos19

Lienzos20

Semillas103

Regaderas20

Palas22

Azadas2

Guantes20

Bolsa capazo4

Bancos4

Huerto Venezia4

Utensilios jardinería7

Mangueras2

Insecticidas2

Mesas4 y sillas4

Sillas apilables10

Macetas20 y soportes4

Jardineras3

Plantas artifiales10

Cesta1

Mesas plagables2

2. Taller de prevención y cuidado de úlceras por presión en fase avanzada:

Frecuencia diaria. Realizada en sala acondicionada con sofás y camas articuladas. Los cambios posturales se harán cada dos horas y las sesiones de fisioterapia 2 veces en semana.

R.H: enfermera y fisioterapeuta encargadas de la prevención, la educación y el cuidado de las UPP. Auxiliares de enfermería encargados de los cambios posturales.

R.M:

Almohadas45
Fundas de almohada90
Bolsas22

3. Taller de estimulación psicomotriz y danza creativa:

Frecuencia diaria para las actividades físicas grupales, fisioterapia individual una vez por semana. Las sesiones grupales se llevan a cabo en sus respectivas salas y las de fisioterapia en sala específica con una duración de 45'.

R.H: técnico deportivo encargado de dirigir las sesiones grupales junto a auxiliar. 2 fisioterapeutas encargadas de las sesiones individuales y voluntario que dirige las sesiones de danza creativa.

R.M:

Vallas de salto3
Semiesfera2
Roundnet Pro1
Bandas15
Bicicleta1
Kettlebell10
Slam Ball Croos5
Mancuerna Hexagonal10

Juego 8 bolas Petanca3
Cintas GR15
Set de Voley1
Pack Speedball2
Juego bolos1
Cajón1
Pesas10
Juegos de mancuernas2
Aros15
Canasta1
Elásticos5

4. Taller de musicoterapia y música pasiva reminiscente:

3 sesiones grupales por semana de 45’ e individuales diarias en música pasiva reminiscente de 25’ en la sala de musicoterapia y en las distintas salas de trabajo.

R.H: Musicoterapeuta y auxiliar.

R.M:

Software2

Monitor1

Piano digital y banco1

Cables6

Instrumentos musicales36

Pie de micro2

Micrófonos3

Anti pop1

Auriculares10

Soportes de pared para guitarra4

Mesa de trabajo1

Paneles de absorción acústica3

Altavoces5 y soportes3

Proyectores3

5. Taller multisensorial con elementos naturales y tecnología avanzada **(Sala Snoezelen, aromaterapia y cromoterapia):**

2 sesiones por semana en grupos reducidos. En la sala Snoezelen durante 45'.

R.H: terapeuta ocupacional que organizará y dirigirá las sesiones y auxiliar.

R.M:

Sistema director1
Tubo de burbujas interactivo1
Abrazadera1 y Líquido de mantenimiento para tubo de burbujas1
Espejos acrílicos2
Mazo de fibra óptica Sense1
Botonera Sense1
Dado Sense1
Alfombra de fibra óptica1
Kit completo de aromaterapia1
Equipo de sonido, altavoces y micrófono1
Sistema videoproyección corta distancia1
Cama de agua vibroacústica1
Kit sensorial de masaje1
Instalación1
Formación inicial1

6. Taller de reminiscencia:

2 sesiones por semana, en las salas de trabajo durante 45'.

R.H: terapeuta ocupacional y terapeuta de reminiscencia.

R.M:

Pintura acrílica1
Pintura a dedos3
Pinceles5
Barras de pegamento11
Tijeras20
Fieltro4

7. Taller de convivencia intergeneracional “Aprendemos juntos”:

1 vez por semana, durante 9 meses. En las salas de trabajo, en el salón de actos y en algunas ocasiones en el colegio. Las sesiones durarán 50’

R.H: psicóloga, terapeuta ocupacional y técnico deportivo.

R.M:

Portátiles HP2
Instalaciones4
Ordenadores HP2
Monitor LENOVO1

8. Talleres ocupacionales y manualidades:

Frecuencia diaria en las distintas salas de trabajo con una duración de 45’.

R.H: terapeuta ocupacional y auxiliar.

R.M:

Bolsas de Goma EVA7

Cartulinas20
Juegos de mesa clásicos7
Juegos motricidad gruesa2
Puzzles13
Actividades para ensartado3
Bastidores de madera10
Telas para bordar12
Rotuladores gruesos para textil12
Agujas de tricotar4

<u>Acción social y divulgación</u>

Una vez al mes se realizará un video tutorial y se divulgará en nuestra web (YouTube).

Recursos materiales:

Cámara ZOOM1

Interfaz audio1

Sistema microfonía inalámbrica1

Kit iluminación1

Cables XLR2

Tarjetas memoria SD2

Personas destinatarias directas

Los síndromes demenciales afectan por lo general al colectivo de personas mayores de 65 años, en ocasiones, las demencias precoces aparecen incluso antes. En Andalucía esta población se estima en unos 124.000 personas enfermas.

El principal objetivo que pretendemos alcanzar en nuestra asociación es difundir y sensibilizar al resto de la población que en su mayoría puede ser un potencial afectado.

Los destinatarios directos del proyecto son personas afectas de Alzheimer o cualquier otra demencia que acuden a la asociación para recibir nuestras terapias y con ello estimular y ralentizar el proceso degenerativo inherente a sus patologías.

Las familias y los cuidadores padecen también lo que llamamos el "síndrome del cuidador", por lo tanto, consideramos beneficiarios directos de nuestros servicios a unas 500000 personas en nuestra comunidad autónoma.

Pretendemos, además, divulgar todos los talleres anteriormente expuestos a través de la creación de videos tutoriales que nos permitan informar y formar a otras personas afectadas en cualquier población andaluza o desde cualquier lugar desde el que se conecten a nuestra web.

Las características sociodemográficas de nuestros usuarios son 61 Hombres y 81 mujeres, la media de edad 79 años, su situación laboral es jubilados, ingresos medio/bajo y nivel educativo estudios primarios con excepciones.

El perfil del familiar (cuidador principal) es una mujer (83%) > de 50 años, cónyuge y/o hija, con estudios primarios o ama de casa. El resto de los miembros de la familia, especialmente de los convivientes también suelen estar afectados y nuestros servicios brindan salud y bienestar a todos ellos.

A nuestros servicios y por lo tanto al proyecto que presentamos accederán los usuarios de nuestro centro y los nuevos que soliciten ingreso en el futuro. Como hemos explicado en los párrafos anteriores, el alcance social de este proyecto nos permitirá ampliar

nuestros servicios a todos los interesados que accedan a nuestra web, la cuál es abierta y disponible las 24 horas del día.

Participación de las personas destinatarias directas en el proyecto

Los usuarios directos de los servicios que ofrece nuestra asociación anteriormente descritos son personas afectadas por el Alzheimer y otros síndromes demenciales, por lo tanto, no participarán ni en la gestión, ni en la planificación, ni en la evaluación de este proyecto, ellos serán los beneficiarios de los talleres descritos en los puntos 9 y 10 del presente formulario.

Personas destinatarias indirectas

La repercusión de la EA no sólo se limita a la pérdida de la independencia de la persona afectada, sino también afecta a las personas que lo/la cuidan.

La familia es la institución que sustenta el cuidado de las personas con Alzheimer, en la mayoría de los casos. Esto supone la alteración en roles y tareas, la necesidad de asumir nuevas exigencias económicas y la reorganización de la vida familiar. En resumen, el diagnóstico modifica la estructura y las relaciones familiares.

Esta difícil situación hace necesario el asesoramiento de profesionales y el trabajo de las AFAs, así como los servicios que en la actualidad ya se prestan desde nuestros centros de día.

Conocer las necesidades del enfermo y su cuidador, así como planificar las intervenciones para cubrirlas permiten que el cuidado sea más apropiado y efectivo ralentizando el deterioro del enfermo en la medida de los posible y evitando la carga excesiva que determinan la patología del cuidador.

Teniendo en cuenta que atendemos en la actualidad a más de 140 usuarios, consideramos destinatarios indirectos de este proyecto a unas 500 personas.

Otras acciones del proyecto “la difusión de las novedades terapéuticas en la web” van dirigidas a toda la población que lo necesite, por lo tanto, es difícil estimar el alcance, aunque el aumento de las visitas en la web nos dará un indicar de los posibles destinatarios indirectos del proyecto que solicitamos.

Trabajo en red

Afa Andalucía trabaja en red con las Afas de la provincia de Málaga (Feafa), además a nivel autonómico componemos la Confederación Andaluza de Alzheimer y otras demencias (ConFEAFA) y a nivel nacional la Confederación Española de Alzheimer (CEAFA).

Además, al tener plazas concertadas con la Junta de Andalucía también tenemos relaciones directas con ella, Con Dependencia (altas, bajas, seguimiento de los usuarios), como formación al personal técnico.

Con el Ayuntamiento de Málaga y la Diputación Provincial de Málaga, también tenemos una relación estrecha ya que también recibimos subvenciones.

Todas estas colaboraciones repercutirán en nuestros talleres, porque se les dará más difusión a nuestra labor y tendremos más repercusión en la ciudad de Málaga. Además, si obtenemos más financiación, ofreceremos mejores servicios a las personas con demencia.

Procesos comunitarios participativos

AFA Andalucía es una ONG de utilidad pública desde 1990, pionera en España en la atención a familiares, impulsora de la Confederación Nacional y las promotoras del primer Congreso Nacional de Alzheimer en España.

En la actualidad, contamos con un centro especializado de alto nivel, concertado con la Junta de Andalucía y desde el que pretendemos ser centro de referencia nacional dada nuestra dilatada experiencia y el buen hacer de nuestros profesionales.

Como hemos detallado en los distintos puntos del proyecto, esperamos un alto impacto entre nuestros usuarios, en la federación provincial, en la confederación de ámbito autonómico a la que pertenecemos, así como esperamos que se produzca un alto impacto en cualquiera de las AFAs que accedan a nuestros tutoriales en la web.

El factor diferencial que aporta nuestro proyecto es precisamente el fácil acceso a una formación muy visual, realizada en un espacio de actuación pionero, específico y novedoso ya que todos los talleres tienen como objetivo ser realizado en nuestras instalaciones e ir ampliándolas a través de nuestro proyecto de naturaleza terapéutica.

Justificación del gasto

1. Personal:

- Psicólogo contratado asumido por la asociación, contratado a jornada completa, con un coste anual bruto de 23870 €.
- Realizador audiovisual autónomo, contratado 60 horas anuales, con un coste anual bruto de 4500€ (solicitado a la cuantía del proyecto de fundación la Caixa).

2. Equipamiento:

Proyector 1

Juegos didácticos 19

Lienzos 20

Semillas 103

Regaderas 20

Palas 22

Azadas 2

Guantes 20

Bolsa capazo 4

Bancos 4

Huerto Venezia 4

Utensilios jardinería 7

Mangueras 2

Insecticidas 2

Mesas 4 y sillas 4

Sillas apilables 10

Macetas 20 y soportes 4

Jardineras 3

Plantas artifiales 10

Cesta 1

Mesas plagables 2

Almohadas 45

Fundas de almohada 90

Bolsas 22

Vallas de salto 3

Semiesfera 2

Roundnet Pro 1

Bandas 15

Bicicleta 1

Kettlebell 10

Slam Ball Croos 5

Mancuerna Hexagonal 10

Juego 8 bolas Petanca 3

Cintas GR 15

Set de Voley 1

Pack Speedball 2

Juego bolos 1

Cajón 1

Pesas 10

Juegos de mancuernas 2

Aros 15

Canasta 1

Elásticos 5

Software 2

Monitor 1

Piano digital y banco 1

Cables 6

Instrumentos musicales 36

Pie de micro 2

Micrófonos 3

Anti pop 1

Auriculares 10

Soportes de pared para guitarra 4

Mesa de trabajo 1

Paneles de absorción acústica 3

Altavoces5 y soportes 3

Proyectores 3

Sistema director 1

Tubo de burbujas interactivo 1

Abrazadera 1 y Líquido de mantenimiento para tubo de burbujas 1

Espejos acrílicos 2

Mazo de fibra óptica Sense 1

Botonera Sense 1

Dado Sense 1

Alfombra de fibra óptica 1

Kit completo de aromaterapia 1

Equipo de sonido, altavoces y micrófono 1

Sistema videoproyección corta distancia 1

Cama de agua vibroacústica 1

Kit sensorial de masaje 1

Instalación 1

Formación inicial 1

Pintura acrílica 1

Pintura a dedos 3

Pinceles 5

Barras de pegamento 11

Tijeras 20

Fieltro 4

Portátiles HP 2

Instalaciones 4

Ordenadores HP 2

Monitor LENOVO 1

Bolsas de Goma EVA 7

Cartulinas 20

Juegos de mesa clásicos 7

Juegos motricidad gruesa 2

Puzzles 13

Actividades para ensartado 3

Bastidores de madera 10

Telas para bordar 12

Rotuladores gruesos para textil 12

Agujas de tricotar 4

Cámara ZOOM 1

Interfaz audio 1

Sistema microfonía inalámbrica 1

Kit iluminación 1

Cables XLR 2

Tarjetas memoria SD 2

3. Infraestructuras: contamos con las infraestructuras necesareas para la realización de este proyecto.
4. Gestión:

- 30 voluntarios.
- 1.618,00 € incluidos en el apartado de gestión en la tabla que pueden observar a continuación. (Solicitado a la cuantía del proyecto de fundación la Caixa).

Coherencia presupuestaria y fuentes de financiación

El perfil y la vulnerabilidad del colectivo al que atendemos es lo que nos ha conducido a presentarles nuestro detallado proyecto, entendemos que todas las partidas de gastos incluidos en el están especificadas y asignadas de la forma más austera posible.

La fuente de financiación del mismo serán, como ha quedado descrito en la tabla, fundación la Caixa y propias. Las actuales fuentes de financiación que nos permiten los programas que desarrollamos, son la aportación de socios, proyectos municipales, concierto con la Junta de Andalucía, proyectos de diputación, fundación el Pimpi…

La amplitud de los retos que queremos alcanzar entendemos que ha quedado descrita en los apartados anteriores. Desde nuestro punto de vista, el coste-beneficio de este proyecto está muy justificado y es al mismo tiempo ambicioso.

Fundación La Caixa históricamente ha participado y financiado numerosos proyectos de apoyo a la enfermedad de Alzheimer, esperamos de su amabilidad y solidaridad que sigan en el apoyo a las familias y a los afectados de los síndromes demenciales.

Sostenibilidad futura del proyecto

El proyecto quedará implantado gracias a la plantilla actual de trabajadores que solo se implementará con un nuevo psicólogo/a y un realizador audiovisual (autónomo asignado al proyecto). El proyecto quedará pues implantado durante el año en curso y

continuará siendo financiado por fuentes de financiación propia. El impulso inicial del mismo es imprescindible para su futura sostenibilidad.

Por lo tanto, consideramos que la sostenibilidad y la viabilidad futura del proyecto estará garantizada.

Escalabilidad del proyecto

AFA Málaga forma parte de una organización federal (FeAFA) y confederal (CONFEAFA y CEAFA) que se extiende desde el ámbito municipal hasta alcanzar el ámbito nacional. Aprovecharemos esta implantación territorial para hacer uso de la difusión del proyecto y su replicabilidad en todo el territorio nacional. El uso de las nuevas tecnologías es lo que hará viable la escalabilidad del proyecto de forma práctica e inmediata. La información del mismo se difundirá en la web, en redes y se llevará a los congresos autonómicos y nacionales.

Anexos

1. Carta de Apoyo de la Administración Pública.
2. Presupuestos
3. Publicaciones científicas.

Diputación Provincial de Málaga

Tercer Sector y Atención a la Ciudadanía

Málaga, a 1 de junio de 2023.

Desde la Excma. Diputación Provincial de Málaga, y en representación de ésta D. Francisco José Martín Moreno, Diputado Delegado de Mayores, Tercer Sector y Cooperación Internacional, queremos expresar nuestro total apoyo al proyecto denominado ""Proyecto de Atención Integral a las personas afectadas de síndromes demenciales", llevado a cabo por la Asociación de Familiares de Personas con Alzheimer (AFA) de nuestra localidad. Somos conscientes de la importancia y necesidad de iniciativas como esta, que buscan mejorar la asistencia y la calidad de vida de las personas afectadas por síndromes demenciales, así como de sus familias y la sociedad en general.

Es importante destacar el compromiso de la AFA en ofrecer terapias a los familiares y programas de detección y estimulación a los enfermos refleja su dedicación y preocupación por brindar un apoyo integral a quienes más lo necesitan.

Es importante destacar que este proyecto basado en tratamientos no farmacológicos de los síndromes demenciales, permitirá ampliar la atención en todas las áreas fundamentales de la persona enferma, considerando su grado de deterioro.

Estamos convencidos de que estas prácticas son esenciales para mejorar la calidad de vida y el bienestar de las personas afectadas por estas condiciones, aun más con la difusión a través de su página web de los talleres y actividades que se ofrecen contribuyen a visibilizar el trabajo realizado y a facilitar el acceso a estas terapias por parte de un público más amplio.

Deseando que otras instituciones puedan apoyar en el desarrollo del proyecto, por su alto valor social, reciban un cordial saludo.

Francisco José Martín Moreno

DIPUTADO DELEGADO DE MAYORES,
TERCER SECTOR Y COOPERACIÓN INTERNACIONAL

Diputación Provincial de Málaga

Hacienda electrónica local y provincial
DIPUTACIÓN DE MÁLAGA

DOCUMENTO ELECTRÓNICO

CÓDIGO DE VERIFICACIÓN DEL DOCUMENTO ELECTRÓNICO

7eaa3da34d3de9620cde72276d31bcfe040de032

Dirección de verificación del documento: **https://sede.malaga.es**

Hash del documento: c67ebeff06811e19d6a656f9bf2c5ba0649616e1fd972bd20cdab11b3f80707503da00688f634208ef7b1
01c48bc21a33575da9fd9e3ab5b54065b33d2d51345

METADATOS ENI DEL DOCUMENTO:

Version NTI: http://administracionelectronica.gob.es/ENI/XSD/v1.0/documento-e

Identificador: ES_LA0007610_2023_00000000000000000000015931364

Órgano: L02000029

Fecha de captura: 01/06/2023 14:55:04

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Tipo Documental: Otros

Tipo Firma: XAdES internally detached signature

Valor CSV: 7eaa3da34d3de9620cde72276d31bcfe040de032

Regulación CSV: Decreto 3628/2017 de 20-12-2017

Código QR para validación en sede

Código EAN-128 para validación en sede

Ordenanza reguladora del uso de medios electrónicos en el ámbito de la Diputación Provincial de Málaga:
https://sede.malaga.es/normativa/ordenanza_reguladora_uso_medios_electronicos.pdf

Política de firma electrónica y de certificados de la Diputación Provincial de Málaga y del marco preferencial para el sector público provincial (texto consolidado):
https://sede.malaga.es/normativa/politica_de_firma_1.0.pdf

Procedimiento de creación y utilización del sello electrónico de órgano de la Hacienda Electrónica Provincial:
https://sede.malaga.es/normativa/procedimiento_creacion_utilizacion_sello_electronico.pdf

Acuerdo de adhesión de la Excma. Diputación Provincial de Málaga al convenio de colaboración entre la Administración General del Estado (MINHAP) y la Comunidad Autónoma de Andalucía para la prestación mutua de soluciones básicas de Administración Electrónica de fecha 11 de mayo de 2016:
https://sede.malaga.es/normativa/ae_convenio_j_andalucia_MINHAP_soluciones_basicas.pdf

Aplicación del sistema de Código Seguro de Verificación (CSV) en el ámbito de la Diputación Provincial de Málaga:
https://sede.malaga.es/normativa/decreto_CSV.pdf

DECATHLON PRO
CLUBES | COLEGIOS | EMPRESAS

Nº FACTURA PROFORMA: EM-20230530/001

DECATHLON ESPAÑA S.A.U.
CIF : A-79935607
Calle Salvador de Madariaga, s/n
28700 San Sebastián de los Reyes (Spain)
IBAN: ES39 0049 9645 09 2925140581

680862155
DECATHLONPRO.MALAGA@decathlon.com
680862155
@decathlonprospain

CLIENTE

Fecha: 30/05/2023
Nombre: AFA MALAGA
CIF:
Contacto: sergiocanillas78@hotmail.com
Mail:
Teléfono:

DIRECCIÓN DE FACTURACIÓN	DIRECCIÓN DE ENVÍO
Cam. de los Almendrales, 35, 29013 Málaga	Cam. de los Almendrales, 35, 29013 Málaga

CÓDIGO	DESCRIPCIÓN	CANTIDAD	PRECIO UNIT SIN IVA	IVA UNIT	PRECIO UNIT CON IVA	PRECIO CON IVA
	Vallas de Salto VS Bodytones	3	26,45 €	5,55 €	32,00 €	96,00 €
	Vimas Sport. Semiesfera Bosu	2	61,98 €	13,01 €	74,99 €	149,98 €
	Roundnet Pro - RN90 - con tres bolas y bolsa de alma	1	47,89 €	10,06 €	57,95 €	57,95 €
	Banda resistencia Fitness Gorila Sport Azul. 0,8 mm	15	4,12 €	0,87 €	4,99 €	74,85 €
	Assault AirBike. Bicicleta Clásica	1	739,67 €	155,33 €	895,00 €	895,00 €
	Kettlebell (Pesa Rusa) 4Kg. (Cross Training) Muscula	10	12,39 €	2,60 €	14,99 €	149,90 €
	Slam Ball Croos Training 4 Kg. Viok Sport	5	15,69 €	3,29 €	18,98 €	94,90 €
	Mancuerna Hexagonal 2,5 Kg dumbell musculación c	10	9,91 €	2,08 €	11,99 €	119,90 €
	Juego 8 bolas Petanca de plástico. Geologic	3	6,60 €	1,39 €	7,99 €	23,97 €
	Cintas Gimnasia Rítmica (GR) Rosa 4 metros	15	9,91 €	2,08 €	11,99 €	179,85 €
	Set (Red y postes) de Voley playa iniciación BV100	1	20,65 €	4,34 €	24,99 €	24,99 €
	Pack Speedball (1 Mátil, 2 raquetas y una pelota). tur	2	40,49 €	8,50 €	48,99 €	97,98 €
	Juego bolos Filandeses Compactos.	1	18,17 €	3,82 €	21,99 €	21,99 €
	Cajón Salto Pliométrico soft 40x50x60 Viok Sport	1	102,47 €	21,52 €	123,99 €	123,99 €
	Pesas 0.5 Kg. de vinilo fitness gimnasia en casa Pilat	10	4,12 €	0,87 €	4,99 €	49,90 €
	Juego de mancuernas 15 Kg. Barra con pesas - Barra	2	54,50 €	11,45 €	65,95 €	131,90 €
	Aro Pilates Ring Nyamba	15	12,39 €	2,60 €	14,99 €	224,85 €
	Canasta de Baloncesto Ajustable 1,60 - 2,20 m. Tarm	1	61,98 €	13,01 €	74,99 €	74,99 €
	Elástico de Spring 300cm. Boomfit	5	18,93 €	3,97 €	22,90 €	114,50 €
	[1141] Figura escalera 3 peldaños forrado Piel	2	62,60 €	13,15 €	75,75 €	151,50 €
	[1158] Barra equilibrio Foam Infantil Piel	2	107,31 €	22,54 €	129,85 €	259,70 €
	Lote 5 pelotas decaoradas muktiactividades Amaya (	4	14,83 €	3,12 €	17,95 €	71,80 €
	[0220] Set Palas Sólidas - Cesta punta Softlacrosse c	5	5,91 €	1,24 €	7,15 €	35,75 €
	[0873] Set 6 Islas de Equilibrio	2	24,59 €	5,16 €	29,75 €	59,50 €
	[1230] Set mini Boccia Iniciación	1	64,17 €	13,48 €	77,65 €	77,65 €
	[1228] Boccia Rampa ded lanzamiento	1	64,21 €	13,49 €	77,70 €	77,70 €
	[1231] Boccia Diana de Competición Aprendizaje	1	58,97 €	12,38 €	71,35 €	71,35 €

TOTAL SIN IVA	2.902,76 €
IVA 21%	609,58 €
TOTAL CON IVA	**3.512,34 €**

Compra en línea

1 **CREAR UNA CUENTA PROFESIONAL** EN WWW.DECATHLON.ES (Durante la creación marque 'Soy un Club / Empresa / Educación'.)

2 **AÑADE TUS PRODUCTOS DEPORTIVOS** A TU CESTA

3 **ELIGE LAS CANTIDADES** EN LA CESTA DE COMPRA

4 **SELECCIONA EL MÉTODO DE ENVÍO** PUEDE SER A DOMICILIO O A TIENDA (Descúbre aquí los gastos y plazos de envío)

5 **SELECCIONA EL MÉTODO DE PAGO** QUE PREFIERAS (Descúbre aquí los método de pago)

6 **DESCARGA LA FACTURA DE TU COMPRA** DESDE TU ESPACIO PERSONAL

La aventura B2B de Decathlon es...

POSIBILIDAD DE **PERSONALIZACIÓN**

CADA 400 PUNTOS OBTÉN **UN CHEQUE REGALO DE 6 €**

ENTREGA **GRATUITA EN TIENDA**

DEVOLUCIÓN **GRATUITA EN UN PLAZO DE 60 DÍAS** (EN NUESTROS PRODUCTOS PASIÓN)

INMEJORABLE **RELACIÓN CALIDAD-PRECIO**

MÁS DE **100 DEPORTES**

Gastos de transportes no incluidos en la factura proforma
Presupuesto válido para compra online en los próximos 7 días.
No se garantiza el stock presupuestado hasta no recibir el pago del pedido realizado.

Eneso Tecnología de Adaptación S.L.
Marie Curie 10. Parque Tecnológico de Andalucía.
29590 - Málaga (España)
ES-B93026045

Presupuesto 23050154

Fecha: 30/05/2023

Válido hasta: 29/06/2023

Fecha de caducidad:
29/06/2023

Dirección de envío y facturación:

AFA Málaga
Camino de los Almendrales, 35
29013 Málaga
España
G29477924

Ref.	Producto	Cant.	Precio unitario	Precio	IVA
002145	Sistema Director - Teatro Sensorial	1	2,180.00	2,180.00 €	21%
002111	Tubo de burbujas interactivo Sense	1	1,200.00	1,200.00 €	21%
000661	Abrazadera para tubo de burbujas	1	57.90	57.90 €	21%
000734	Líquido de mantenimiento para tubo de burbujas	1	43.90	43.90 €	21%
001484	Espejo acrílico de seguridad 150 x 100 cm	2	165.00	330.00 €	21%
002133	Mazo de fibra óptica Sense 200-3m	1	1,100.00	1,100.00 €	21%
002115	Botonera Sense	1	500.00	500.00 €	10%
002030	Dado Sense	1	420.00	420.00 €	21%
002114	Alfombra de fibra óptica Sense	1	1,000.00	1,000.00 €	21%
000116	Kit completo de iniciación aromaterapia	1	94.00	94.00 €	21%
001257	Equipo de sonido, altavoces y micrófono	1	385.25	385.25 €	21%
00311/	Sistema videoproyección corta distancia	1	720.00	720.00 €	21%
000232-XX	Cama de agua vibroacústica (- Color a elegir -)	1	2,535.00	2,535.00 €	21%
000462	Kit sensorial de masaje	1	124.45	124.45 €	21%
002003	Desplazamiento, material de montaje e instalación	1	500.00	500.00 €	21%
002000	Gastos de envío	1	0.00	0.00 €	21%
002065	Formación inicial en sala Sense	1	0.00	0.00 €	0%

Total sin IVA:	11,190.50 €
Total:	**13,485.50 €**

Base imponible	IVA	Total IVA
10,690.50 €	21%	2,245.00 €
500.00 €	10%	50.00 €

Eneso Tecnología de Adaptación S.L.
Marie Curie 10. Parque Tecnológico de Andalucía.
29590 - Málaga (España)
ES-B93026045

0.00 €	0%	0.00 €

Términos y condiciones

Para el uso del sistema Teatro Sensorial es necesario un ordenador con las siguientes características mínimas recomendadas: Ordenador portátil con windows 10/11 con procesador Intel i3 o equivalente, 8GB de RAM y puerto HDMI.

Datos bancarios para transferencias:

IBAN: ES83-3058-0854-81-2720020950 (Cajamar)
BIC-SWIFT: CCRIES2AXXX

Cualquier incidencia en la recepción de este envío, tanto por mercancía faltante como por estar dañada o golpeada, debe ser comunicada a Eneso en el plazo máximo de 24 horas. En caso contrario Eneso o el transportista no se hará cargo de la misma. Al firmar el albarán del transportista indique cualquier anomalía: cajas abiertas, golpeadas, reprecintadas, falta de bultos, etc. El no indicar esta información en el albarán de transporte anulará la posibilidad de reclamar cualquier falta y/o daño de la mercancía. En caso de falta o daño en alguna mercancía nunca tire los embalajes y conserve las etiquetas de transporte pegadas en las cajas, pues le serán solicitadas para cualquier reclamación. La notificación debe realizarse a través del correo electrónico pedidos@eneso.es.

DISTRIBUIDORA ANRO S.L.
C/ La Boheme, 12. Pgno. Alameda
29006 Málaga
Tfno: 952431833
Fax: 952439801-952363501
B29416575

Visite www.anrosl.es

ASOC FAMILIARES CON ALZHEIMER
MALAGA
AFA MALAGA
CAMINO DE LOS ALMENDRALES, Nº35
29013 MALAGA
MALAGA

FECHA	FRA. PROFOR.	CLIENTE	N.I.F.	TELÉFONO	PÁG.
31/05/23	AL 23000372	430462200	G29477924	952390902	1

CÓDIGO	DESCRIPCIÓN	CAJAS	UNIDADES	PRECIO	IMPORTE	% IVA
87934035	BINGO TRADICIONAL		1.00	16.4500	16.45	21.00
525241	DOMINO JUNIOR		1.00	10.5400	10.54	21.00
879904	MIS PRIMEROS JUEGOS DE MESA PARCHIS		1.00	10.4100	10.41	21.00
879788	MIS PRIMEROS JUEGOS DE MESA SERPIENTES Y ESCALERAS		1.00	10.4100	10.41	21.00
525158	OCA DE SUELO		1.00	9.5000	9.50	21.00
88980451	TRIPOLO		1.00	11.8600	11.86	21.00
280640201	JUEGO LANZAMIENTO AROS		1.00	25.4950	25.50	21.00
88841388	TIRA ANILLAS		1.00	11.2400	11.24	21.00
89057405	ENCAJE CARPINTERO		1.00	8.5950	8.60	21.00
29052215	PACK 4 PUZZLES MADERA BANDEJA 15 P. ESTACIONES AÑO		1.00	27.7482	27.75	21.00
29050221	MAXI PUZZLES ANIMALES REALES		1.00	13.3643	13.36	21.00
29052235	PACK PUZZLES MADERA BANDEJA 35 PZAS. TRANSPORTES		1.00	27.7482	27.75	21.00
879259	PUZZLE ENCAJE ENTORNOS GRANJA		1.00	8.1400	8.14	21.00
879258	PUZZLE ENCAJE ENTORNOS SAFARI		1.00	8.1400	8.14	21.00
879260	PUZZLE ENCAJE ENTORNOS TRANSPORTES		1.00	8.1400	8.14	21.00
45553085	PUZZLE PRIMAVERA		1.00	7.0300	7.03	21.00
45553025	PUZZLE SILUETAS GRANJA		1.00	10.3300	10.33	21.00
45553024	PUZZLE SILUETAS IN & OUT		1.00	10.3300	10.33	21.00

235.48

TOTAL IMP.	%	IMPORTE	BASE	%	IVA	%	REC.	TOTAL (€)

Forma de Pago:

Banco:

DISTRIBUIDORA ANRO S.L.
C/ La Boheme, 12. Pgno. Alameda
29006 Málaga
Tfno: 952431833
Fax: 952439801-952363501
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ASOC FAMILIARES CON ALZHEIMER
MALAGA
AFA MALAGA
CAMINO DE LOS ALMENDRALES, Nº35
29013 MALAGA
MALAGA

FECHA	FRA. PROFOR.	CLIENTE	N.I.F.	TELÉFONO	PÁG.
31/05/23	AL 23000372	430462200	G29477924	952390902	2

CÓDIGO	DESCRIPCIÓN	CAJAS	UNIDADES	PRECIO	IMPORTE	% IVA
			- SUMA ANTERIOR			235.48
45553086	PUZZLE VERANO		1.00	7.0300	7.03	21.00
879222	PUZZLES BANDEJA MADERA 9 PIEZAS ANIMALES SALVAJES		1.00	8.2250	8.23	21.00
879270	PUZZLES BANDEJA PANORAMICOS 24 PIEZAS EN EL ZOO		1.00	11.3600	11.36	21.00
879267	PUZZLES BANDEJA PANORAMICOS 24 PIEZAS EN LA PLAYA		1.00	11.3600	11.36	21.00
16531730	BOLAS PLASTICO 20MM 100UDS		1.00	12.8513	12.85	21.00
16531742	BOLAS PLASTICO 35 MM 60 UND.		1.00	18.0165	18.02	21.00
16531715	BOTONES 40 MM 140 PZAS +10 CORDONES		1.00	16.1150	16.12	21.00
88980800	BATALLA DE GENIOS ORIGINAL		1.00	20.4550	20.46	21.00
29030642	SECUENCIAS MAXI FOTOS PROCESOS DE PRODUCCION		1.00	13.5754	13.58	21.00
5258106	DOMINO REVERSIBLE XXL		1.00	10.1200	10.12	21.00
29020553	EL SEMAFORO DE LA BUENA ALIMENTACION		1.00	22.2995	22.30	21.00
29020551	¿DE DONDE VIENEN LOS ALIMENTOS?		1.00	16.8096	16.81	21.00
29020050	AUTODICTADO SUSTANTIVOS		1.00	30.3438	30.34	21.00
29020600	EL OLFATO: LAS FRUTAS Y SUS AROMAS		1.00	24.1329	24.13	21.00
16597922	LETRAS MAGNETICAS JUMBO		1.00	16.6529	16.65	21.00

474.84

TOTAL IMP.	%	IMPORTE	BASE	%	IVA	%	REC.	TOTAL (€)

Forma de Pago:

Banco:

DISTRIBUIDORA ANRO S.L.
C/ La Boheme, 12. Pgno. Alameda
29006 Málaga
Tfno: 952431833
Fax: 952439801-952363501
B29416575

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29013 MALAGA
MALAGA

FECHA	FRA. PROFOR.	CLIENTE	N.I.F.	TELÉFONO	PÁG.
31/05/23	AL 23000372	430462200	G29477924	952390902	3

CÓDIGO	DESCRIPCIÓN	CAJAS	UNIDADES	PRECIO	IMPORTE	% IVA
			- SUMA ANTERIOR			474.84
	MAYUSCULAS 74 PZAS					
29020532	¿QUE TIENEN EN COMUN?		1.00	12.4321	12.43	21.00
619306	BRAINOMETRY		1.00	17.2700	17.27	21.00
280411395	JARDIN DE FLORES		1.00	18.1400	18.14	21.00
38017820	DADOS GIGANTES DE ESPUMA NUMEROS. SET 2 UND.		1.00	9.1736	9.17	21.00
2818697	APRENDER ES DIVERTIDO: PRIMERAS PALABRAS		1.00	8.1000	8.10	21.00
29020090	AUTODICTADO VERBOS		1.00	30.3438	30.34	21.00
29020507	FOTOGRAFIA ALIMENTOS		1.00	22.4746	22.47	21.00
40068952	FORMAR PALABRAS		1.00	12.1900	12.19	21.00
88980305	PALABREA		1.00	11.8600	11.86	21.00
430825	SHOPPING		1.00	22.7300	22.73	21.00
16530596	SURTIDO ALIMENTOS ENVASADOS 12 PZAS.		1.00	19.6281	19.63	21.00
5257003	MI MIC		1.00	9.6300	9.63	21.00
43014	LIENZO CON BASTIDOR LIDERCOLOR 22X33CM		20.00	3.9250	78.50	21.00

TOTAL IMP.	%	IMPORTE	BASE	%	IVA	%	REC.	TOTAL (€)
747.30			747.30	21.00	156.93			904.23 €

Forma de Pago:

Banco: ES13 3183 2900 5600 00** ****

JYSK DBL IBERIA, S.L.U.
C/ Alto Gaspar Haro, 15
46380 Cheste

Teléfono 96 013 13 18 / customerservicees@jysk.com
www.JYSK.es

Enviar a:

Asociación de Familiares de Alzheimer AFA Málaga
Camino de los
Almendrales,
35
29013 Málaga
G29477924

FECHA: 01/06/2023
Nº de Proforma: T-E100-583

Nº DE TICKET		FECHA TICKET

COD. ARTÍCULO	DESCRIPCIÓN	CANTIDAD
S370381	Mesa RANGSTRUP Ø110 natural/negro + 4 sillas NABI	4
3700246	Silla apilable NABE	10
6400033	Maceta para balcón BILLE Ø12xA19	20
6432900	Jardinera balcón VIPE A18xL59xA18	3
6400029	Soporte para maceta LJUM A11xL50xA50	4
6435600	Planta artificial DVERGLO A90	3
6400039	Planta artificial TJELD A125cm palmera areca	3
4911493	Planta artificial ARVID A70 cm verde	2
6403500	esta SVARTBAK Ø42xA36 natural	1
6440000	gable VANDREFALK 64x63 madera dura	2
6400038	nta artificial HAVHEST A125cm olivo	2

JYSK DBL IBERIA, S.L.U.: N.I.F. B64935604
Inscrita en el RM de Valencia, al Tomo 9116, Libro 6400, Folio 82, Hoja

Domicilio Social: C/ Alto Gaspar Haro, 15
46380 Cheste, Valencia

PRESUPUESTO

Mail: tocupacional@afamalaga.org
Tel.: 952390902

PRECIO	SUBTOTAL	
505.00 €	2,020.00 €	
70.00 €	700.00 €	
		Solo en tienda
10.00 €	30.00 €	
		Solo en tienda
25.00 €	75.00 €	
		Solo en tienda
		Solo en tienda
20 €	20 €	
125 €	250 €	
		Solo en tienda
Subtotal	3,036.31 €	
Tipo impositivo	2,509.35 €	

IVA	526.96 €
Total	3,036.31 €
Total con descuento 6%	2,854.13 €

V-136637, Inscripción 2

Dirección de Facturación:
[834964] ASOCIACIÓN ALZHEIMER ANDALUCÍA
952390902

[834964] ASOCIACIÓN ALZHEIMER ANDALUCÍA
DNI/CIF: G29477924

Factura Pro-Forma # S133017

Fecha del presupuesto:
30/05/2023

Fecha de validez:
29/06/2023

Comercial:
INMACULADA ORTEGA NARANJO

Articulo	Descripción	Cant.	Prc. ud.	IVA	Total sin IVA
174.375	[174.375] Hoja goma EVA adhesiva 40x60cm FIXO Kids negro Bolsa: 5	1	8.81 €	21 %	8.81 €
174.376	[174.376] Hoja goma EVA adhesiva 40x60cm FIXO Kids verde claro Bolsa: 5	1	8.81 €	21 %	8.81 €
174.379	[174.379] Hoja goma EVA adhesiva 40x60cm FIXO Kids rojo Bolsa: 5	1	8.81 €	21 %	8.81 €
174.380	[174.380] Hoja goma EVA adhesiva 40x60cm FIXO Kids amarillo Bolsa: 5	1	8.81 €	21 %	8.81 €
174.376	[174.376] Hoja goma EVA adhesiva 40x60cm FIXO Kids verde claro Bolsa: 5	1	8.81 €	21 %	8.81 €
174.391	[174.391] Hoja goma EVA corrugada 40x60cm Fixo Kids azul Bolsa: 5	1	9.29 €	21 %	9.29 €
174.393	[174.393] Hoja goma EVA corrugada 40x60cm Fixo Kids rojo Bolsa: 5	1	9.29 €	21 %	9.29 €
176.1009	[176.1009] Cartulina de color 50x65cm Iris Canson rosa chicle	5	0.62 €	21 %	3.10 €
176.465	[176.465] Cartulina de color 50x65cm Iris Canson mandarina	5	0.66 €	21 %	3.30 €
176.897	[176.897] Cartulina de color 50x65cm Iris Canson azul maldivas	5	0.66 €	21 %	3.30 €

Articulo	Descripción	Cant.	Prc. ud.	IVA	Total sin IVA
176.392	[176.392] Cartulina de color 50x65cm Iris Canson verde manzana	5	0.52 €	21 %	2.60 €
1168.415	[1168.415] Pintura acrílica Jovidecor Acryl 250ml azul ultra	3	4.14 €	21 %	12.42 €
1168.416	[1168.416] Pintura acrílica Jovidecor Acryl 250ml negro	3	4.14 €	21 %	12.42 €
1168.406	[1168.406] Pintura acrílica Jovidecor Acryl 250ml amarillo	1	4.14 €	21 %	4.14 €
1168.190	[1168.190] Pintura a dedos Jovi amarillo 500ml False	1	4.92 €	21 %	4.92 €
1168.189	[1168.189] Pintura a dedos Jovi blanco 500ml False	1	4.92 €	21 %	4.92 €
1168.339	[1168.339] Pintura a dedos Jovi naranja 500ml naranja	1	4.92 €	21 %	4.92 €
2177.33	[2177.33] Pinceles Giotto Serie 400 n°3	5	0.30 €	21 %	1.50 €
41.1061	[41.1061] Barras pegamento silicona para goma EVA Apli False Blíster: 10	10	1.56 €	21 %	15.60 €
3025.492	[3025.492] Tijeras escolares Faibo diestros	20	0.44 €	21 %	8.80 €
1230.578	[1230.578] Fieltro 50x70 liderpapel 160g/m2. rojo	1	3.64 €	21 %	3.64 €
1230.580	[1230.580] Fieltro 50x70 liderpapel 160g/m2. verde	1	3.64 €	21 %	3.64 €
1230.537	[1230.537] Fieltro 50x70 liderpapel 160g/m2. blanco	1	3.64 €	21 %	3.64 €
1230.697	[1230.697] FIELTRO Manualidades 50X70 CARNE carne	1	3.64 €	21 %	3.64 €

Subtotal	159.13 €
IVA 21%	33.42 €
Total	192.55 €

Las Tijeras Mágicas

FACTURA PROFORMA / PRO FORMA INVOICE

Fecha / Date 30/05/2023

No. Factura / Invoice No. 321

Remitente/Sender

Nombre / Name : Grupo Las Tijeras Mágicas 2006
Dirección / Address: Capitán Antonio Mena 150
Código Postal / Postal Code 03204
Ciudad/City Elche
País / Country España
C.I.F. / V.A.T. Num. B54974217
Teléfono / Phone number 626577487

Destinatario/Consignee

Nombre / Name: Asoc. Familiares de Alzheimer AFA Málaga
Dirección / Address: Camino de los Almendrales
Código Postal / Postal Code: 29013
Ciudad/City: Málaga
País / Country: España
C.I.F. / V.A.T. Num. G29477924
Teléfono / Phone number: 952390902

Cantidad Item num.	Descripción de la mercancía y cod arancelario Description of the goods and HC code.	Valor € Value	Total
10	Bastidor de madera con pie - Diámetro : 25 cm	22,95 €	229,50€
2	Tela para Bordar Lugana - Lisa - Zweigart – Color 100	11,49 €	22,98€
5	Tela para Bordar Lugana - Lisa - Zweigart – Color 274	11,49 €	57,45€
5	Tela para Bordar Lugana - Lisa - Zweigart – Color 305	11,49 €	57,45€
3	Rotulador Grueso para Textil Javana Sunny – Color Negro	2,95 €	8,85€
1	Rotulador Grueso para Textil Javana Sunny – Color Amarillo	2,95€	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Naranja	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Rojo	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Color carne	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Azul Claro	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Violeta	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Verde Claro	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Rosa Neón	2,95 €	2,95€
1	Rotulador Grueso para Textil Javana Sunny – Color Marrón	2,95 €	2,95€
2	Agujas de Tricotar Trendz - KnitPro - Medida : 6,5	5,25 €	10,50€
2	Agujas de Tricotar Trendz - KnitPro - Medida : 6 m	4,75 €	9,50€
	Total IVA Incluido		**422,78 €**

Nombre / Name

SAUL SOLER MARCO

Puesto / Position

CEO

Firma y fecha / Signature and date

GRUPO LAS TIJERAS MÁGICAS 2006, S.L.
B54974217
C/ Capitán Antonio Mena, nº 150
03203 ELCHE (Alicante)
Tel. 96 665 64 52

Cesta de la compra

¿Cómo te gustaría recibir tu pedido?

Envío a Domicilio | Click & Collect

STORSTOMMA — 2,97€
Bolsa, grande, 71 l
0,99 €/ud
Disponible para entrega en 29013
3 Eliminar

VINTERFINT — 6,00€
Bolsa, grande, 55x37x35 cm/71 l
2,00 €/ud
No disponible para entrega en 29013
3 Eliminar

BASTUA — 4,47€
Bolsa, grande, 55x37x35 cm/71 l
1,49 €/ud
Disponible para entrega en 29013
3 Eliminar

SÄCKKÄRRA — 0,99€
Bolsa de la compra, 37x57x39 cm/71 l
Precio normal: ~~1,99 €~~
Disponible para entrega en 29013
1 Eliminar

BASTUA — 4,47€
Bolsa, grande, 55x37x35 cm/71 l
1,49 €/ud
No disponible para entrega en 29013
3 Eliminar

GÖRSNYGG — 2,99€
Bolsa, grande, 57x37x39 cm/71 l
Disponible para entrega en 29013
1 Eliminar

GURLI — 87,78€
Funda de cojín, 50x50 cm
3,99 €/ud
Disponible para entrega en 29013
22 Eliminar

ÖMSESIDIG — 5,97€
Bolsa de la compra, 55x37x37 cm/71 l
1,99 €/ud
Disponible para entrega en 29013
3 Eliminar

ÖMSESIDIG — 5,97€
Bolsa de la compra, 55x37x37 cm/71 l
1,99 €/ud
No disponible para entrega en 29013
3 Eliminar

SÄCKKÄRRA — 1,98€
Bolsa de la compra, 37x57x39 cm/71 l
Precio normal: ~~1,99 €~~
0,99 €/ud
No disponible para entrega en 29013
2 Eliminar

Precio de montaje estimado — **0,00 €**
Coste de montaje no incluido en el subtotal

Precio estimado de montaje: **Primeros 100 €** en artículos **te cuestan 35 €** y las siguientes **franjas de 100 € te cuestan 15 €.**

Resumen del pedido

Precio con impuestos

Subtotal	102,16 €
IVA incluido	21,43 €
Precio total	**123,59 €**

¿Tienes un código de descuento?

Entrega disponible a partir del 13 de junio

Algunos de tus artículos no están disponibles, compra ahora o haz una petición de stock y te avisaremos.

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Castellano

ALTAIS
SUMINISTROS INTEGRALES

SUMINISTROS DE PRODUCTOS Y ARTÍCULOS DE LIMPIEZA, PISCINA, CELULOSA, MATERIAL UN SOLO USO, ASEO PERSONAL, MENAJE, TEXTIL, UNIFORMES, ELECTRODOMÉSTICOS, MAQUINARIA INDUSTRIAL HOSTELERÍA, MOBILIARIO, ESCOLAR, ORTOPÉDICO, CLÍNICO Y MATERIAL SANITARIO

607 624 164 - 676 681 508
info@altaissuministros.es www.altaissuministrosintegrales.es

DGE Data

PRESUPUESTO: 2300209

FECHA: 30/05/2023

COD. CLIENTE: 5077

C.I.F./D.N.I.: G-29.477.924

ASOC. DE FAMILIARES DE ENF. DE ALZEHIMER
ASOC. DE FAMILIARES DE ENF. DE ALZHEIMER DE ANDALUCIA
CAMINO DE LOS ALMENDRALES, 35. MALAGA - 29013
29013 MALAGA
MALAGA

REFERENCIA	DESCRIPCIÓN	UDS.	PRECIO	DTO.	IMPORTE
710123	ALMOHADA VISCO 70CM	4,00	21,5760	12,00	75,95
713022	ALMOHADA MICRO HOSTEL 70CM	30,00	7,1920	12,00	189,87
0400041TC10K	CUADRANTE MASH TOP 40X40	11,00	6,3000	12,00	60,98
493114	FUNDA ALMOHADA 50/50 45X90 PAQT 10UND	70,00	2,0300	12,00	125,05
9691422	FUNDA CUTI 100% ALGODON 70CM	68,00	3,6000	12,00	215,42

SUMAS IMPORTES	% DTO	IMPORTE DTO.	BASE IMPONIBLE	%	I.V.A. IMPORTE	% REC.	EQUIVALENCIA IMPORTE	TOTAL A PAGAR
758,26		90,99	667,27	21,00	140,12			**807,40 €**

FORMA DE PAGO: TRANSFERENCIA ES70 0049 5708 1921 1628 8580

Altais Suministros Integrales S.C. J 93740231 . Ctra A7000 Km 555 , Los Montes Valseca 61 B 29013 , Málaga

Factura Proforma

Maxvisual Equipos Audiovisuales s.l.
Reales Alcazares 27
29130 Alhaurin de la Torre
CIF B92868637

Número: **62225**
Fecha: **29/05/2023**

Cliente: **Asociación de familiares de enfermos de Alzheimer de Andalucía** Camino de los almendrales, 35
Cif: **G-29477924** **29013** **Málaga**
Email: delegadospersonal@afamalaga.org Málaga

Descripción General:

material de proyeccion

Productos	Unidades	Precio Unitario	Importe	IVA %	Total con IVA
Epson EB-695Wi -Proyector LCD-3500 lúmenes-1280x800 -16:10-	3	1.445,45 €	4.336,35 €	21,00%	**5.246,98 €**
Total			**4.336,35 €**		**5.246,98 €**
Portes				21,00%	

Total Presupuesto				
Total sin IVA			**4.336,35 €**	
Base imponible			**4.336,35 €**	
I.V.A.	4,00%	8,00%	21,00%	
Total I.V.A.			910,63 €	**910,63 €**
			Total Presupuesto	**5.246,98 €**

Forma de Pago:

TRANSFERENCIA BANCARIA LA CAIXA Nº Cuenta: 2100 2582 55 02 10087653

Observaciones

INFORMATICA IMPOSIVLE - INFO@IMPOSIVLE.COM
CARRIL DEL MOLINO 59
29190 Málaga
Luis Arozamena Ramos
74883824X
TEL951931801

ASOCIACION DE FAMILIARES DE ENFERMOS DE ALZHEIM
CAMINO DE LOS ALMENDRALES Nº35
29013 MALAGA
MALAGA 38322

DOCUMENTO	NÚMERO	PÁGINA	FECHA
Presupuesto	1 009723	1	30/05/2023

N.I.F.	AGENTE	FORMA DE PAGO
G29477924	22 CESAR MP	TRANSFERENCIA

ARTÍCULO	DESCRIPCIÓN	CANTIDAD	PRECIO UD.	SUBTOTAL	DTO. %	TOTAL
POR01735	PORTATIL HP 15S-FQ5075NS 5,45€ COM 9/3/23	2,00	428,93	857,86		857,86
SF0008	Instalación/Configuración+	2,00	24,79	49,58		49,58
ORD0994	PC AIO HP 27-CB0000NS LPI 5,45€ COM 19/1/23	2,00	600,00	1.200,00		1.200,00
SF0008	Instalación/Configuración+	2,00	24,79	49,58		49,58
TFT0452	MONITOR 27" LENOVO C27-30	1,00	120,57	120,57		120,57

TIPO	IMPORTE	DESCUENTO	PRONTO PAGO	PORTES	FINANCIACIÓN	BASE	I.V.A.	R.E.
21,00 10,00 4,00	2.277,59					2.277,59	478,29	

No se admiten devoluciones. Productos de reestreno (2ª mano) garantía 1 año.
Baterías y cargadores poseen 6 meses de garantía. Pantalla rotas o rajadas carecen de garantía.
Los productos que presenten golpes, humedades o signos de manipulación carecen de garantía.

TOTAL: 2.755,88

*** Información protección de datos ***

Le informamos que los datos personales facilitados serán responsabilidad de Luis Arozamena Ramos con la finalidad de gestionar la relación entre nuestra entidad y sus clientes o interesados en relación al servicio que prestamos o al ejercicio de nuestra actividad, todo ello bajo la legitimación otorgada por su consentimiento expreso o bien del propio interesado y/o con motivo de la ejecución de un contrato de servicios. No se cederán datos a terceros salvo obligaciones legales. En cuanto a sus derechos podrá acceder, rectificar y suprimir los datos, limitarlos o incluso oponerse a su tratamiento.
Más información sobre protección de datos en http://www.imposivle.com

th•mann

Pro forma invoice: 88358

MUSIC IS OUR PASSION

Thomann GmbH, Hans-Thomann-Str. 1, D-96138 Burgebrach

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Delivery address:

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Pro forma invoice: 88358

Date: 30.05.2023
Your customer no.: 9958587

Order No.: **202322.464616 / 2195**

Sales Person: Christian Carrión Pérez
Telephone: 0049 9546 / 9223 644
Method of Shipment: Freight
Your Reference:

Please include your customer no.: 9958587 with payment by bank transfer!

Pos.	Article	Amount	Unit	Unit Price	Total Price
001.00	**489256**	**2**	**piece**	**15,90 EUR**	**31,80 EUR**
	Roland RIC-G5A Instrument Cable; Length: 1,5 m (5 ft.); Gold Series; custom 24K gold-plated connectors; cloth wrapped; oxygen-free copper core; low-capacitance; Connectors: from 1/4" angled Jack Plug to 1/4" Jack Plug; Colour: Black				
002.00	**418236**	**1**	**piece**	**115,00 EUR**	**115,00 EUR**
	Thomann KB-247WHM double piano bench, frame color: white matt, double cross precision lifting mechanism, seats separately adjustable in height: 485 - 560 mm, 2 seats with 435 x 285 mm each, dimensions (D x L) 325 x 960 mm + approx. 40 mm button per Side, seat padding: black velor, weight: 14 kg, material: solid beech wood, suitable for children and adults				
003.00	**101217**	**8**	**piece**	**6,90 EUR**	**55,20 EUR**
	Gewa Fingercymbals 5,5cm Crotales, Pair, Metal				
004.00	**489106**	**2**	**piece**	**15,90 EUR**	**31,80 EUR**
	Roland RIC-B10A Instrument Cable; Length: 3 m (10 ft.); Black Series; high-quality connectors; oxygen-free copper core; high-density spiral shielding; low-capacitance; Connectors: from 1/4" angled Jack Plug to 1/4" Jack Plug; Colour: Black				

Amount carried forward : **233,80 EUR**

Pos.	Article	Amount	Unit	Unit Price	Total Price
005.00	**377193**	**4**	**piece**	**3,90 EUR**	**15,60 EUR**
	Gravity GS 08 WMB, universal Guitar Wall Hanger, suitable for acoustic-, electric- and bass guitars, steel, Soft-Touch rubber surface, not for guitars with nitro laquer, incl. black rings, screws and wall plugs are not included				
006.00	**105767**	**2**	**piece**	**109,00 EUR**	**218,00 EUR**
	Shure SM58 LC, dynamic vocal microphone, cardioid, frequency response 50-15000 Hz, sensitivity -56 dBV / Pa (1.85 mV), suitable for vocals, dimensions: 23 x 162 x 51 mm, 298 g, including microphone bag, microphone clamp, 3/8" thread adaptor, optional accessories: windscreen item number 135783, replacement grill item number 183069				
007.00	**501872**	**3**	**Box**	**145,00 EUR**	**435,00 EUR**
	t.akustik Highline A1 Silver Spruce Wood; Absorber Modules Set for optimizing room acoustics; set contains 4 single Modules; main effect range approx. 400 to 3150 Hz; absorber material is polyester acoustic foam; flame-retardant according to FMVSS 302 (<100 mm/min); dimensions per single unit: 600 x 600 x 70 mm each Module; Colour: Grey/Silver Spruce Wood				
008.00	**358094**	**2**	**piece**	**18,90 EUR**	**37,80 EUR**
	Thomann Tibetan Singing Bowl No2, 200g. weight 150g - 249g, diameter approx 11cm, handmade, incl. cushion and mallet (Color can vary)				
009.00	**195009**	**2**	**piece**	**18,50 EUR**	**37,00 EUR**
	Goldon Metalophone, Model 11030, Children Starter Instrument, Tonal Range c3 - G4, 12 colored Tone Bars, included presentation Box,				
010.00	**160750**	**4**	**piece**	**14,90 EUR**	**59,60 EUR**
	Behringer HPS 3000 - studio headphones with high dynamic range, closed-back, 20Hz-20kHz, 100mW maximum power handling, 64ohm impedance, 110dB sensitivity (@ 1kHz), 1/4" TRS stereo jack connector. Weight: 300g (including cable). Cable length: 2m				

Amount carried forward : **1.036,80 EUR**

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Pos.	Article	Amount	Unit	Unit Price	Total Price
011.00	**429470**	**1**	**pair**	**98,00 EUR**	**98,00 EUR**
	Presonus Eris E3.5, active studio monitors, 3.5 "woofer with Kevlar cone, 1" tweeter, frequency range 80 Hz - 20 kHz, sound pressure: 100 dBA SPL (peak), inputs: TRS jack (L/R, balanced), cinch pair (L/R), treble control, bass control (-6 to +6dB each), front-side aux input (stereo mini jack) for smartphone, etc., Front headphone jack (stereo mini stereo jack), front volume control with on/off switch and operating LED, Class-AB output stage (2x 25 W sinus), shielded against RF interference, switch-on delay and output current limiter, overheating protection and subsonic filter, incl. Mini jack cable (TRS to TRS), 1.5 m, adapter cable (mini jack TRS to 2x cinch), 1.5 m and connecting cable from left to right box, dimensions (HWD): 210 x 141 x 162 mm, weight: 2.9 kg				
012.00	**137121**	**2**	**piece**	**19,40 EUR**	**38,80 EUR**
	Cordial CFM 10 FM black, professional female to male XLR microphone cable with mit Neutrik/Rean-Stecker (REAN is a registerd trademark of Neutrik AG), Cable length: 1000cm. Colour: Black.				
013.00	**219039**	**2**	**piece**	**38,00 EUR**	**76,00 EUR**
	Startone CG-851 1/4 Classical Guitar, Basswood Body, Nato Neck, Maple Fingerboard, Scale 480mm, Nut Width 43 mm, Black Body Binding, Nylon Strings, Total Length: 75,8 cm, Finish Satin Light Brown, no gigbag included, optinal gig bag 198578				
014.00	**489716**	**2**	**piece**	**59,00 EUR**	**118,00 EUR**
	Thomann BN23 Djembe, head diameter about 23cm, height about 50cm, hand made in Bali, body made of Mahogany (Swietenia spp. mahagoni, origin: Indonesien), rawhide goat skin, 4mm nylon rope tuning,				
015.00	**437640**	**8**	**piece**	**16,30 EUR**	**130,40 EUR**
	Millenium 08" Hand Drum Tunable, wodden frame with rawhide drum head, diameter 20,3cm, tuneable, including beater and drum key,				
016.00	**118100**	**8**	**piece**	**7,90 EUR**	**63,20 EUR**
	Millenium Beggar Drum - natural skin, 10.5cm diameter, 3.5cm frame height, wooden handle.				
017.00	**133136**	**2**	**piece**	**16,90 EUR**	**33,80 EUR**
	Millennium MS 2003 Microphone stand with Boom-Arm, die-cast metal base. metal T-screw on upper hinge, Dimensions: Height adjustable from 105 to 170cm, arm: length 75cm. Colour: Black, 3/8" thread with 3/8" to 5/8" thread adapter				

Amount carried forward : **1.595,00 EUR**

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Pos.	Article	Amount	Unit	Unit Price	Total Price
018.00	**141195**	**1**	**piece**	**14,90 EUR**	**14,90 EUR**
	the t.bone MS 180 pop shield (clip on) with 20cm elastic arm. Diameter: 15,5cm (incl. border), 14cm (nylon screen).				
019.00	**396068**	**1**	**piece**	**48,00 EUR**	**48,00 EUR**
	Marantz MPM-1000; condensator microphone; cardioid polar pattern; 18 mm capsule; 136 dB SPL; Frequency range: 20 Hz to 20 kHz; impedance: 200 Ohms ±30% (@ 1kHz); SNR: 77 dB; Phantompower: 9-48 V DC; includes: shockmount, windshield, tripod stand & XLR male to XLR female cable; Dimensions: 165 x 48 mm; Weight: 0,3 kg				
020.00	**347195**	**1**	**piece**	**439,00 EUR**	**439,00 EUR**
	Thomann DP-33 WH Compact Digital Piano - 88 hammer action weighted keys with sensitive touch, 26 sounds, 64 notes polyphony, 60 Songs, dual and split mode, Reverb, Chorus, metronome, transpose function, Master EQ (3 Types), Music Library with 60 preset songs, 2x 15 W speaker system, 3 pedals, connections: 2x headphone output, stereo aux in/out, USB Midi 2.0 (Windows compatible), dimensions L/W/H: 1365 x 330 x 790 mm, Weight: 37 kg. Design: White Satin				
021.00	**515102**	**2**	**piece**	**28,00 EUR**	**56,00 EUR**
	Harley Benton World-C Deep Ocean Concert Ukulele; concert size ukulele, linden body, illustrated top with artist motif, okoume neck, Purple Heart fretboard, fret marker positions 5/7/10/12/15, nut width 35mm, 17 frets, natural headstock, DLX chrome tuners with white button, Graph Tech nut and saddle, Purple Heart bridge, matt finish, Aquila strings; Design: Deep Ocean				
022.00	**515094**	**2**	**piece**	**28,00 EUR**	**56,00 EUR**
	Harley Benton World-C Passion Concert Ukulele; concert size ukulele, linden body, illustrated top with artist motif, okoume neck, Purple Heart fretboard, fret marker positions 5/7/10/12/15, nut width 35mm, 17 frets, natural headstock, DLX chrome tuners with white button, Graph Tech nut and saddle, Purple Heart bridge, matt finish, Aquila strings; Design: Passion				
023.00.	**10**	**1**	**piece**	**15,00 EUR**	**15,00 EUR**
	International Shipping Rate				

Amount carried forward : **2.223,90 EUR**

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Pos.	Article	Amount	Unit	Unit Price	Total Price

Value of goods:	**2.223,90 EUR**
Net amount:	1.837,93 EUR
21,00% Vat.:	385,97 EUR
Total amount:	**2.223,90 EUR**

Method of payment:

Bank transfer	2.223,90 EUR

Thank you for your purchase!

Please see overleaf for our standard terms and conditions.
Unless otherwise specified the invoice date accounts for the date of payment /delivery.

Participation in the OSS procedure.

Thomann GmbH
Hans-Thomann-Str. 1
D-96138 Burgebrach

info@thomann.de
Tel +49 (0)9546 9223-66
Fax +49 (0)9546 9223-24

Geschäftsführer: Johann Thomann
Amtsgericht Bamberg: HRB 5862
Sitz der Gesellschaft: Burgebrach

USt.-IdNr.: DE 257375233
Steuernummer: 207/132/90050
WEEE-Reg.-Nr.: DE 18280160

Bank Sparkasse Bamberg
IBAN DE97 7705 0000 0000 1030 85
BIC BYLADEM1SKB

Raiffeisenbank Burgebrach
DE58 7706 2014 0000 0056 30
GENODEF1BGB

Postbank Nürnberg
DE41 7601 0085 0283 5648 54
PBNKDEFF

Deutsche Bank 24
DE19 7607 0024 0811 5008 00
DEUTDEDB760

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Pro forma invoice: 88359

MUSIC IS OUR PASSION

Thomann GmbH, Hans-Thomann-Str. 1, D-96138 Burgebrach

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Delivery address:

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Pro forma invoice: 88359

Date: 30.05.2023
Your customer no.: 9958587

Order No.: **202322.464634 / 2195**

Sales Person: Christian Carrión Pérez
Telephone: 0049 9546 / 9223 644
Method of Shipment: UPS
Your Reference:

Please include your customer no.: 9958587 with payment by bank transfer!

Pos.	Article	Amount	Unit	Unit Price	Total Price
001.00	**554423**	**1**	**piece**	**298,00 EUR**	**298,00 EUR**
	Thomann Studio Table L Wood; recording workstation; compact work table for small studios for recording and composition; made of plastic-coated MDF board; rotating monitor base plates; integrated 19" rack with 2 x 3U incl. M5 rack screws; 2x headphone holder; dimensions upper shelf: 1510 x 300 x 18 mm (WxDxH); dimensions worktop: 1510 x 415 x 25 mm (WxDxH); dimensions keyboard pull-out: 1040 x 340 x 18 mm (WxDxH); Overall dimensions: 1510 x 704 x 973 mm (WxDxH); Worktop height: 780 mm; Keyboard pull-out can be loaded up to max. 10 kg and can be extended by approx. 30 cm; Weight: 47,5 kg; Color wood decor				
002.00	**516414**	**10**	**piece**	**28,00 EUR**	**280,00 EUR**
	Roadworx Wallmount 3, Wall Mount Support, wall mount for studio monitors, universal mount for nearfield monitors and installation speakers, very helpful together with speakers coming without any mounting points, tray width: 170 mm, tray angle adjustable from 0° to 10°, depth adjustable from 95 to 175 mm, max. load capacity: 18 kg, colour: black, Note: Screws and wall plugs not included.				
003.00	**565028**	**5**	**piece**	**129,00 EUR**	**645,00 EUR**
	JBL 104-BT White, compact reference monitors with Bluetooth 5.0, includes Master and Slave speaker, 1x 4,5" Low Frequency Driver, 1x 0,75" High Frequency Driver, 60 Watt Class D power amplifier (30 Watt/speaker), Frequency range 60 Hz - 20 kHz, dispersion 120° x 120°, max SPL 104 dB, 1x Cinch, 2x balanced jack inputs on back, 1x 3,5 mm Aux-inputs on front, 1x 3,5mm jack headphone output on fron, dimensions (HxWxD) 247 x 153 x 124 mm, total weight 3,79 kg, colour white				

Amount carried forward : **1.223,00 EUR**

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Pos.	Article	Amount	Unit	Unit Price	Total Price
004.00	**160731**	**6**	**piece**	**12,30 EUR**	**73,80 EUR**
	Behringer HPM1000 stereo headphones - excellent dynamic range, closed back, frequency response: 20Hz-20kHz, max. power handling: 100mW, impedance: 32ohms, sensitivity: 105dB @ 1 kHz, Cable length: 2mtrs. 3,5mm jack, adapter to 6,3mm jack inluded.				

Value of goods:	**1.296,80 EUR**
Net amount:	1.071,74 EUR
21,00% Vat.:	225,06 EUR
Total amount:	**1.296,80 EUR**

Method of payment:

Bank transfer	1.296,80 EUR

Thank you for your purchase!

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Participation in the OSS procedure.

Thomann GmbH
Hans-Thomann-Str. 1
D-96138 Burgebrach

info@thomann.de
Tel +49 (0)9546 9223-66
Fax +49 (0)9546 9223-24

Geschäftsführer: Johann Thomann
Amtsgericht Bamberg: HRB 5862
Sitz der Gesellschaft: Burgebrach

USt.-IdNr.: DE 257375233
Steuernummer: 207/132/90050
WEEE-Reg.-Nr.: DE 18280160

Bank Sparkasse Bamberg
IBAN DE97 7705 0000 0000 1030 85
BIC BYLADEM1SKB

Raiffeisenbank Burgebrach
DE58 7706 2014 0000 0056 30
GENODEF1BGB

Postbank Nürnberg
DE41 7601 0085 0283 5648 54
PBNKDEFF

Deutsche Bank 24
DE19 7607 0024 0811 5008 00
DEUTDEDB760

Pro forma invoice: 88393

Thomann GmbH, Hans-Thomann-Str. 1, D-96138 Burgebrach

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Delivery address:

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Pro forma invoice: 88393

Date: 30.05.2023
Your customer no.: 9958587

Order No.:	**202322.471146 / 2195**
Sales Person:	Christian Carrión Pérez
Telephone:	0049 9546 / 9223 644
Method of Shipment:	Courier
Your Reference:	

Please include your customer no.: 9958587 with payment by bank transfer!

Pos.	Article	Amount	Unit	Unit Price	Total Price
001.00	**527079**	**1**	**piece**	**438,00 EUR**	**438,00 EUR**

Reason Studios Reason 12 (ESD); audio MIDI sequencer (DAW); fast and easy to use music making software suitable for creating, recording and mixing music; contains all needed tools, effects and instruments for music creation; high resolution, scalable user interface with zoom feature for ReasonRack and Extensions; virtual studio rack allows to use instruments and effects in a simple way and can be integrated as a VST3 / AU / AAXnative plugin with compatible DAWs; fully equipped virtual mixing console features parallel tracks and group tracks; unlimited number of audio and instrument tracks; pitch edit for professional vocal processing - including control of pitch, vibrato and pitch drift; audio-to-midi converts monophonic audio to midi notes; high quality realtime time stretch and audio transpose; audio slicing and audio quantize; audio to rex function; bounce-in-place function; player modules for scales/chords, touch echo and dual arpeggio; controls external MIDI devices incl. MIDI clock; Ableton link function; arranger window features quickzoom function; comp editor; blocks mode; 29 effects like master bus compressor, amps and speakers modeled by Softube, reverbs, delays, distortion/overdrive, phaser, chorus etc.; incl. 18 instruments like Mimic Creative Sampler, Europa, Grain, Klang, Pangea, Humana, Radical Piano, Monotone, Rytmik, Malström, Redrum and more; 3 MIDI effects and 8 utilities; 11 GB sound library with over 29000 patches, loops and drums; GUI features different themes

Amount carried forward : **438,00 EUR**

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Pos.	Article	Amount	Unit	Unit Price	Total Price
002.00	**494667**	**1**	**piece**	**95,00 EUR**	**95,00 EUR**
	Celemony Melodyne 5 essential (ESD); pitch and timing correction plugin; extensively free frequency editing of monophonic audio files in an outstanding quality; improves intonation and timing but preserves vitality and naturalness; creates doubling and additional voices; different algorithms for different sources: melodic with Sibilant Detection, percussive and universal; allows to edit pitch center, position, length and note separations; macros for pitch- and timing-correction as well as quantization and scale correction; Chord Track and Chord Grid with automatic chord recognition; tempo detection				

Value of goods:	**533,00 EUR**
Net amount:	440,50 EUR
21,00% Vat.:	92,50 EUR
Total amount:	**533,00 EUR**

Method of payment:

Bank transfer 533,00 EUR

Thank you for your purchase!

Please see overleaf for our standard terms and conditions.
Unless otherwise specified the invoice date accounts for the date of payment /delivery.

Participation in the OSS procedure.

Thomann GmbH
Hans-Thomann-Str. 1
D-96138 Burgebrach

info@thomann.de
Tel +49 (0)9546 9223-66
Fax +49 (0)9546 9223-24

Geschäftsführer: Johann Thomann
Amtsgericht Bamberg: HRB 5862
Sitz der Gesellschaft: Burgebrach

USt.-IdNr.: DE 257375233
Steuernummer: 207/132/90050
WEEE-Reg.-Nr.: DE 18280160

Bank Sparkasse Bamberg
IBAN DE97 7705 0000 0000 1030 85
BIC BYLADEM1SKB

Raiffeisenbank Burgebrach
DE58 7706 2014 0000 0056 30
GENODEF1BGB

Postbank Nürnberg
DE41 7601 0085 0283 5648 54
PBNKDEFF

Deutsche Bank 24
DE19 7607 0024 0811 5008 00
DEUTDEDB760

Pro forma invoice: 88426

Thomann GmbH, Hans-Thomann-Str. 1, D-96138 Burgebrach

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Delivery address:

AFA Málaga G29477924
Alberto García Conejo
Camino de los Almendrales, 35

E-29013 Málaga

Pro forma invoice: 88426

Date: 31.05.2023
Your customer no.: 9958587

Order No.: **202322.485408 / 2069**

Sales Person: Mario Godinez
Telephone: 0049 9546 / 9223 644
Method of Shipment: UPS
Your Reference:

Please include your customer no.: 9958587 with payment by bank transfer!

Pos.	Article	Amount	Unit	Unit Price	Total Price
001.00	**509544**	**1**	**piece**	**329,00 EUR**	**329,00 EUR**
	Varytec VP-m20 Stand & Bag 2in1 Bundle containing				
001.01	**492099**	**2**	**piece**	**0,00 EUR**	**0,00 EUR**
	Varytec VP-m20 Mobile Video BiLight Panel; compact video light with variable colour temperature and integrated rechargeable battery; perfect for mobile video recording, streaming, photography; also ideal as a flexibly positionable light for video conferencing; high CRI > 95; colour temperature can be continuously adjusted on the device; USB port for charging smartphones or other devices with 5V supply voltage; mounted hinged door; easy operation via two rotary controls and on/off switch on the back; bracket for mounting on a tripod; battery life: 4 hours (both colors full on) / 7,5 hours (one color full on); adjustable colour temperature from 2850 K to 5700 K; light output at 1 m distance: 850 lux; light source: 300 SMD LEDs; including power supply unit; power supply unit: 100 - 240 V ~ 50 / 60 Hz; power consumption power supply unit: 2. 0 A; Power supply LED spotlight: 15 V DC; Power consumption LED spotlight: max. 5 A; Weight: 1.5 kg; Dimensions with bracket: 182 x 182 x 71 mm (WxHxD); including adaptor for 16 mm / 5/8" joint; suitable bag: #496006				
001.02	**115224**	**2**	**piece**	**0,00 EUR**	**0,00 EUR**
	Manfrotto 1051BAC Aluminium Stand - 4x sections, 3x risers. Height: 210cm. Weight: 1.1kg. Colour: Black				

Amount carried forward : **329,00 EUR**

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Pos.	Article	Amount	Unit	Unit Price	Total Price
001.03	**496006**	**1**	**piece**	**0,00 EUR**	**0,00 EUR**
	Flyht Pro Bag for VP-m20 2in1; Bag suitable for 2x Varytec VP-m20; two compartments with partition wall (removable); robust fabric with light padding for protection during transport and storage; two accessory compartments with zip; dimensions bag total: 220 x 220 x 180 mm (WxHxD); inner dimensions: 210 x 190 x 110 mm (WxHxD); inner dimensions accessory compartments: 170 x 165 x 20 mm (WxHxD); weight: 0.26 kg;				
002.00	**445929**	**1**	**piece**	**293,00 EUR**	**293,00 EUR**
	the t.bone freeU Twin PT 823 Bundle containing				
002.01	**432869**	**1**	**piece**	**0,00 EUR**	**0,00 EUR**
	the t.bone freeU Twin PT 823, 2 channel UHF Wireless-System with bodypack transmitter and guitar cable, 60 - 17.000 Hz, 10 groups with each 10 channels, Auto Squelch, frequencyscan, adjustable AF out, 30 mW transmitted power, Infra Red transmitter to transfer the settings between receiver ad transmitter, pilottone, 80 kHz steps, modulation type F3E, 9,5" 1U housing with 2x BNC connectors for the antennas, 2x XLR out and 1x Jack out, works with 12 V 1 A DC powersupply (+ interior), bodypack transmitter in plastic housing, belt clip, LCD Display, works with 2x AA Batteries or rechargeable batteries, frequencyrange 823 - 832 MHz, optional antenna converters: 177448 (not included), incl. guitar cable, antennas, EU powersupply and rackkit for one receiver on 1U, Note: up to 2 systems (4 channels in total) can operate simultaneously in this frequency range.				
002.02	**349296**	**2**	**piece**	**0,00 EUR**	**0,00 EUR**
	the t.bone EarmiKe - O AKG, lightweight single ear microphone, condenser capsule, fits for any size of ears, omni-directional, 50 - 20.000 Hz, 4,0 mV / Pa, -47,9 dB re 1 V / Pa, 115 dB SPL max, 750 Ohm, 3-pol Mini XLR plug for AKG Bodypack Transmitter, colour light tan, length of cable 120 cm, incl. cable clip and foam windscreen				
003.00	**551627**	**2**	**piece**	**77,00 EUR**	**154,00 EUR**
	SanDisk Extreme Pro SDXC 256 GB; Secure Digital Card SDXC; Class 10 & UHS-I Class 3 (U3) rating; Performance/speed: Up to 200 MB/s read speed, up to 140 MB/s write speed; 4K Ultra HD-ready; recommended for Multitrackrecorders, DSLR and Video Cameras with 4K Ultra HD				

Amount carried forward : **776,00 EUR**

Pos.	Article	Amount	Unit	Unit Price	Total Price
004.00	**555701**	**1**	**piece**	**422,00 EUR**	**422,00 EUR**
	SSL 12; 12/8 USB-C audio interface; 32-bit/192kHz AD/DA converter; 4 mic preamps (62dB gain range, 130.5dBu ON, high pass filter); legacy "4K" switches per channel for sound coloration modeled by the legendary SSL 4000 series; 5-digit level meter for each input; 3 user-assignable switches (CUT/ALT/DIM as default); programming via free SSL 360° software; integrated talkback microphone; power supply via USB with ON/OFF switch; connectors: 4x Mic/Line combo input XLR / 6.3 mm jack, 2x Hi-Z input 6.3 mm jack, 4x monitor output balanced 6.3 mm jack, 8-channel ADAT input, 2x separately adjustable stereo headphone outputs (each also usable as mono or stereo line output), MIDI in/out, USB-C connector; incl. SSL Vocalstrip 2 & Drumstrip, IK Multimedia Amplitube 5 SE, Celemony Melodyne Essential, Native Instruments Hybrid Keys & Komplete Start, Ableton Live 11 Lite, AAS Session Bundle, 1.5 GB Loopcloud Samples				
005.00	**133747**	**2**	**piece**	**15,50 EUR**	**31,00 EUR**
	Cordial CTM 3 FM-BK - professional 3m black microphone cable, male->female XLR, Neutrik connectors.				
006.00	**537194**	**1**	**piece**	**389,00 EUR**	**389,00 EUR**
	Zoom Q8n-4K; Handy Video Recorder; 4K video and 4-track audio recorder; interchangeable mic capsule; XYQ-8 stereo XY microphone (120° recording angle, 120dB max. SPL); 2 mic/line inputs (XLR, switchable +48V phantom power); High Dynamic Range (HDR) shooting to reduce black and white blur; F2.8 lens with 150° wide angle for brighter, wider images; 5 scene settings (Auto / Indoor / Outdoor / Night / Concert Light) and 3 brightness settings; 2" full-color LCD monitor, rotatable by 180°; 5 effects to enhance recording quality (Limiter / Compressor / Leveler / DeEsser / NoiseGate) and switchable low-cut filter; USB interface for use as a PC/Mac webcam for live streaming (HD1080p quality, 16bit/48kHz audio quality); HDMI output (supports NTSC and PAL); Video resolution: 4K, HD1080p, HD720p; Video format: MPEG-4 AVC / H.264 (MOV); Audio format: WAV, max. 24Bit/96kHz; line/headphones stereo output (3.5mm jack); USB-C port; build-in loudspeaker (300mW); powered via rechargeable lithium-ion battery (Zoom BT-03) or external power supply (Zoom AD-17, not included); supports microSD / microSDHC / microSDXC cards (max. 512GB); remote control via iOS app "Q8n Control" (requires Zoom BTA-1 Bluetooth adapter, not included); dimensions (LxWxH, with mic arm retracted): 159 x 68 x 65mm; weight (including batteries): 367g; incuding rechargeable battery, windscreen, lens protection cap, anti-flare hood, USB cable (type A to C)				

Amount carried forward : **1.618,00 EUR**

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MUSIC IS OUR PASSION

Pos.	Article	Amount	Unit	Unit Price	Total Price

Value of goods:	**1.618,00 EUR**
Net amount:	1.337,19 EUR
21,00% Vat.:	280,81 EUR
Total amount:	**1.618,00 EUR**

Method of payment:

Bank transfer	1.618,00 EUR

Thank you for your purchase!

Please see overleaf for our standard terms and conditions.
Unless otherwise specified the invoice date accounts for the date of payment /delivery.

Participation in the OSS procedure.

Thomann GmbH
Hans-Thomann-Str. 1
D-96138 Burgebrach

info@thomann.de
Tel +49 (0)9546 9223-66
Fax +49 (0)9546 9223-24

Geschäftsführer: Johann Thomann
Amtsgericht Bamberg: HRB 5862
Sitz der Gesellschaft: Burgebrach

USt.-IdNr.: DE 257375233
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Bank Sparkasse Bamberg
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Raiffeisenbank Burgebrach
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GENODEF1BGB

Postbank Nürnberg
DE41 7601 0085 0283 5648 54
PBNKDEFF

Deutsche Bank 24
DE19 7607 0024 0811 5008 00
DEUTDEDB760

PROPUESTA 79 · 01 JUNIO 2023

AFA · Málaga

SERVICIOS VIDEOGRÁFICOS · TUTORIALES

	1 TUTORIAL	12 TUTORIALES
• **GRABACIÓN x 12 TUTORIALES**		
1 OPERADOR CÁMARA FIJA + EQUIPO*	**176.88**	**2122.64**
• **EDICIÓN + POSTPRODUCCIÓN x 12 TUTORIALES**		
Tutorial COMPLETO	**176.88**	**2122.64**

(*2 SONY A7 4 4K 10 BITS, OPTICAS FIJAS, ZOOMS, RONINS, TRIPODES)

BASE 4245.28
21% IVA 891.51
SUBTOTAL 5136.79
-15%IRPF 636.79
TOTAL 4500.00€

JORGE AGÓ PEINADO · 25694769C · Hinestrosa, 1 · 29012 · Málaga. 607280080 ·

CONDICIONES DE PAGO DE ALQUILER ILUMINACIÓN: 100% DÍA ANTES DEL RODAJE

Presupuesto

Fecha	Número	Cliente
30/05/2023	002300905008008	AFA MALAGA

VERDECORA MALAGA
CIMODIN SL **CIF: B87966891**
AVENIDA ENRIQUE GRANADOS Nº3
29004 MALAGA
Tel : 951204449
Fax :
Email : malaga@verdecora.es

AFA MALAGA
Camino de los Almendrales, 35
29013
Tel : 952390902

Articulos	Cantidad	Imp.unit	IVA	PVP unit	dto.	PVP neto	Total
336240 8414934103720 MELON ARIZO VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
328985 8414934951413 ROMERO	3.00	1.99	10.00	2.19		2.19	6.57
328991 8414934951819 TOMILLO	3.00	1.99	10.00	2.19		2.19	6.57
328968 8414934056613 ENELDO	3.00	1.99	10.00	2.19		2.19	6.57
328969 8414934950614 ESTRAGON	3.00	1.99	10.00	2.19		2.19	6.57
328974 8414934054817 MELISSA	3.00	1.99	10.00	2.19		2.19	6.57
328980 8414934951314 PERIFOLLO COMUN	3.00	1.99	10.00	2.19		2.19	6.57
328967 8414934950515 COMINO	3.00	1.99	10.00	2.19		2.19	6.57
336226 8414934103584 BERENJENA LARGA NEGRA VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336303 8414934104345 HABA AGUADULCE ECO VERDECORA	3.00	1.63	4.00	1.69		1.69	5.08
336304 8414934104352 JUDIA SLENDERETTE ECO VERDECORA	3.00	1.63	4.00	1.69		1.69	5.08
336308 8414934104390 PEPINO MARKETMORE ECO VERDECORA	3.00	1.54	10.00	1.69		1.69	5.07
336263 8414934103959 FRESON 4 ESTACIONES VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336271 8414934104031 PEREJIL HOJA LISA VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336298 8414934104307 CALABAZA BUTTERNUT ECO VERDECORA	3.00	1.54	10.00	1.69		1.69	5.07

Articulos	Cantidad	Imp.unit	IVA	PVP unit	dto.	PVP neto	Total
336251 8414934103836 TOMATE MARMANDE RAF VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336247 8414934103799 RABANITO REDONDO ROJO VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336249 8414934103812 SANDIA SUGAR BABY VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336245 8414934103775 PIMIENTO LARGO DE REUS VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336244 8414934103768 PIMIENTO DULCE ITALIANO VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47

	IVA 10%	IVA 4%
Base	87.55	9.76
IVA	8.78	0.41

TOTAL IE	97.31 €
IVA	9.19 €
TOTAL II	**106.50 €**

Términos legales

"Estos precios serán válidos durante un plazo de 15 días naturales a contar desde la fecha del presente presupuesto. Transcurrido el plazo indicado VERDECORA no se compromete a mantener los precios incluidos en el presente documento.

Los precios referidos podrán variar según las necesidades del establecimiento para el que han sido calculados."

Presupuesto

Fecha	Número	Cliente
30/05/2023	002300904008008	AFA MALAGA

VERDECORA MALAGA
CIMODIN SL **CIF: B87966891**
AVENIDA ENRIQUE GRANADOS Nº3
29004 MALAGA
Tel : 951204449
Fax :
Email : malaga@verdecora.es

AFA MALAGA
Camino de los Almendrales, 35
29013
Tel : 952390902

Articulos	Cantidad	Imp.unit	IVA	PVP unit	dto.	PVP neto	Total
356216 8003916071029 REGADERA NAU 2 LIMA	20.00	3.71	21.00	4.49		4.49	89.79
236113 8413491003252 PALA LIGERA 70CM	2.00	10.74	21.00	12.99		12.99	25.98
349553 8003916080502 PALITA D/MANO ESTRECHA	20.00	4.12	21.00	4.99		4.99	99.80
150046 3272370006815 AZADILLA D/ MANO	2.00	11.56	21.00	13.99		13.99	27.98
312894 8015358049009 GUANTES DE JARDIN	20.00	1.64	21.00	1.99		1.99	39.80
349548 8003916081165 BOLSA CAPAZO 3.5L OLIVA	4.00	4.54	21.00	5.49		5.49	21.96
366569 8720194556214 BANCO METAL ROSMIE	4.00	142.14	21.00	171.99		171.99	687.96
371406 5600442815061 HUERTO VENEZIA 100CM ANTRACITA	4.00	74.37	21.00	89.99		89.99	359.96
343554 8414299185539 ESCOBA CÉSPED METÁLICA C/MANGO	1.00	19.83	21.00	23.99		23.99	23.99
392829 3295075518223 RASTRILLO MANO MANGO MADERA	1.00	6.60	21.00	7.99		7.99	7.99
388955 8435201903935 TIJERA DE PODAR 2 MANOS VERDECORA	2.00	24.79	21.00	29.99		29.99	59.98
388954 8435201903928 TIJERA DE PODAR 1 MANO CORTE BYPASS VERDECORA	2.00	11.56	21.00	13.99		13.99	27.98
358105 4078500049481 SET DE RIEGO AQUABLOOM 20M	1.00	103.30	21.00	124.99		124.99	124.99
362327 4078500002318 MANGUERA CLASSIC 19 MM X 20 METROS	2.00	45.45	21.00	54.99		54.99	109.98
322879 8426584306116 TRIPLE ACCIÓN PULV AFIDOR 1L	2.00	8.26	21.00	9.99		9.99	19.98

Articulos	Cantidad	Imp.unit	IVA	PVP unit	dto.	PVP neto	Total
367490 4005240180259 JABON POTÁSICO LISTO USO 500 ML	2.00	10.74	21.00	12.99		12.99	25.98
256661 0842751404450 CUBO CONICO 10" ASA D25X19CM	10.00	9.91	21.00	11.99		11.99	119.90
336270 8414934104024 OREGANO VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336269 8414934104017 MEJORANA VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336267 8414934103997 MENTA VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336265 8414934103973 LAVANDA VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336262 8414934103942 CILANTRO VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336261 8414934103935 CEBOLLINO ANUAL VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336257 8414934103898 MAIZ DULCE VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336253 8414934103850 TOMATE ROMA VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336243 8414934103751 PIMIENTO PADRON VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336252 8414934103843 TOMATE MONTSERRAT VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47
336242 8414934103744 PEPINO MARKETMORE VERDECORA	3.00	1.35	10.00	1.49		1.49	4.47

	IVA 10%	IVA 21%
Base	44.66	1 548.75
IVA	4.50	325.27

TOTAL IE	1 593.41 €
IVA	329.77 €
TOTAL II	**1 923.18 €**

Términos legales

"Estos precios serán válidos durante un plazo de 15 días naturales a contar desde la fecha del presente presupuesto. Transcurrido el plazo indicado VERDECORA no se compromete a mantener los precios incluidos en el presente documento.

Los precios referidos podrán variar según las necesidades del establecimiento para el que han sido calculados."

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SYSTEMATIC REVIEW
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Technologies for Cognitive Training and Cognitive Rehabilitation for People With Mild Cognitive Impairment and Dementia. A Systematic Review

Eider Irazoki[1,2], Leslie María Contreras-Somoza[1,2], José Miguel Toribio-Guzmán[2], Cristina Jenaro-Río[1], Henriëtte van der Roest[3] and Manuel A. Franco-Martín[1,4,5]*

[1] Faculty of Psychology, University of Salamanca, Salamanca, Spain, [2] Department of Research and Development, Iberian Research Psycho-Sciences Institute, INTRAS Foundation, Zamora, Spain, [3] Department on Aging, Netherlands Institute of Mental Health and Addiction (Trimbos-Institute), Utrecht, Netherlands, [4] Department of Psychiatry, University Rio Hortega Hospital, Valladolid, Spain, [5] Zamora Hospital, Zamora, Spain

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****Correspondence:***
Eider Irazoki
eider.irazoki@usal.es

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Due to the growing number of older adults with cognitive impairment, it is essential to delay the onset and progression of cognitive decline and promote a healthy lifestyle. The rapid growth of technology has considerably advanced the field of computerized cognitive interventions. Consequently, traditional cognitive interventions are being adapted and new multimedia systems are being developed to encourage health and independent living in old age. The primary objective of this review was to identify cognitive stimulation, training and rehabilitation programs aimed at older people with mild cognitive impairment (MCI) and dementia. PsycINFO, Medline, CINAHL, Web of Science, PubMed, and CORDIS databases were searched from January 2008 to August 2018. Two researchers reviewed the potential studies individually for eligibility. Studies of computerized cognitive interventions for people with dementia and cognitive impairment were included if they clearly described objectives, users and functioning. A systematic review of the studies was carried out, providing a qualitative synthesis of the features and study characteristics of each software. Nineteen studies met the inclusion criteria, and 11 different cognitive stimulation, training, and rehabilitation programs were identified. The studies found on cognitive intervention software indicate the existence of various technological programs for people with MCI and dementia. On the overall, the programs were aimed at people with different clinical conditions, able to create specific treatments and personalized training, optimized for portable devices, and user-friendly. However, the selected programs differ from each other in terms of objectives, usage mode and characteristics, even if they were used for the same purposes. Therefore, the information obtained in the review may be relevant to distinguish between programs and select the one that best suits each user. Thus, more information about the features and context of use is needed as well as more clinical studies to be able to compare among computerized cognitive programs.

Keywords: cognitive training, cognitive rehabilitation, software, cognitive impairment, dementia, systematic review

INTRODUCTION

Despite the advances in treatments of chronic diseases related to old age, dementia is considered one of the most significant public health challenges (Nemeth et al., 2017). It is estimated that 74.7 million people around the world will be living with dementia by the year 2030 (Alzheimer's Disease International., 2015). In Spain alone, currently, over 800.000 people are affected by dementia (Alzheimer-Europe, 2013). This number will rise, since it is estimated that in 2050, Spain will be one of the oldest countries in the world, with 40% of the population being over 60 years by then (United Nations, 2015).

Mild cognitive impairment (MCI), an intermediate stage between healthy aging and dementia, is also a common condition in older people (Petersen et al., 2001). It is estimated that 10–20% of the population over 65 are affected by MCI (Petersen, 2011). MCI can be amnesic (aMCI), non-amnesic (naMCI) and the impairment could affect a single cognitive domain (sdMCI) or multiple domains (mdMCI) (Petersen et al., 2014). Alzheimer's Disease has been frequently associated with aMCI (Lange et al., 2018), while naMCI may increase the risk for other dementias such as frontotemporal dementia and dementia with Lewy bodies (Ferman et al., 2013).

Since there is no cure for dementia, attempts have been made to identify factors that may delay the onset and slow progression of cognitive decline in people with cognitive impairment. Similarly, in order to hamper the course of dementia for as long as possible and to enable people to age in place, many different types of psychosocial approaches that aim to improve and maintain cognitive ability have been developed in the last decades (Klimova and Maresova, 2017; Wei et al., 2020).

The concepts of cognitive reserve and neuroplasticity have gained attention as potential factors for delaying cognitive decline (Soldan et al., 2017). Cognitive reserve has been described as the structural and dynamic capacity of the brain to cope with changes associated with natural aging or injuries. Due to this pre-existing cognitive processing approach, people with higher cognitive reserve deal better with pathologies, atrophies, or injuries (Stern, 2012). Following this reasoning, a recent review demonstrates that cognitive reserve might be linked to dementia prevalence and specific cognitive domain performance (Lavrencic et al., 2018). Conversely, neuroplasticity is the brain's ability to generate morphological changes in response to an environmental stimulus (Shaffer, 2016). Due to this ability, our brain can adjust and compensate for cognitive alterations by strengthening existing connections or creating new ones. Brain's cognitive reserve and plasticity are influenced across the lifespan by several factors such as genetics, educational level, occupation, socioeconomic factors, physical health, lifestyle, and mental activity (Sampedro-Piquero and Begega, 2017).

The limited efficacy of pharmacological therapies and the neuronal plasticity of our brain are the main reason for the growing interest in non-pharmacological treatments (Takeda et al., 2012). For improvement of cognitive functioning in people with cognitive impairment and dementia, three types of non-pharmacological cognitive interventions have been developed over time. Cognitive stimulation refers to a wide variety of non-specific exercises focused on cognitive and social functioning reinforcement (Clare et al., 2003). Discussions, reminiscence therapy (Irazoki et al., 2017) and reality orientation (apart of other features) are examples of stimulation techniques that are mostly administered in a group setting. Cognitive stimulation was found to have a positive effect on cognition of people with mild to moderate dementia (Streater et al., 2016). Cognitive training aims to maintain or improve a particular aspect of cognitive functioning (e.g., memory or attention) through structured and guided practice carried out individually or in a group (Bahar-Fuchs et al., 2019). The difficulty level of activities can be adapted to individual functioning. Regarding efficacy, it has been demonstrated that cognitive training can improve the general cognitive functioning of people with mild dementia (Tsantali et al., 2017). Finally, cognitive rehabilitation is an individualized intervention explicitly focusing on a person's needs (Clare et al., 2013). The emphasis is on improving or maintaining cognitive abilities related to everyday task performance, compensating impairments and supporting and enhance independent living (NCC for Mental Health., 2007). It is considered as one of the most effective interventions since it has shown to be able to slow down the progression of cognitive decline in people with dementia (Amieva et al., 2016). All intervention types must be executed under the control of a professional therapist.

Many traditional cognitive interventions have been adapted for use on current technological devices such as smartphones, tablets and computers, as they are considered a cost-effective alternative as compared to conventional cognitive interventions (Meiland et al., 2017).

Cognitive training, stimulation, and rehabilitation provided via digital devices are promising strategies for maintaining the cognitive function of healthy older adults and people with MCI (Zhang et al., 2019). Computerized cognitive interventions are not only useful for improving cognition, memory, and attention but also have a positive influence on the psychosocial functioning of older adults with MCI (Hill et al., 2017). Similarly, it was demonstrated that computerized cognitive training's beneficial effects remained on both short-term and long-term in people with preserved cognitive function (Ten Brinke et al., 2018).

The computerized cognitive intervention has several advantages over traditional techniques (García-Casal et al., 2016). Zokaei et al. (2017) identified that training tasks are useful because they (a) can be directed to a specific cognitive function (e.g., memory, attention); (b) can be continually adjusted based on the participant's performance; (c) can be designed to be highly immersive and enjoyable; (d) provide instant quantitative feedback; and (e) are actively accessible on portable digital devices. Indeed, in the computer approaches for improving cognitive function is possible to apply a mix up of cognitive stimulation, cognitive training and cognitive rehabilitation with the same devices or computer (González-Palau et al., 2014).

Consequently, the field of computerized cognitive interventions is growing steadily, as well as the research projects related to these technologies. The recently published studies focus on the effectiveness of computer-based cognitive

intervention for people with dementia (Gates et al., 2019a,b). Still, little is known about the individual characteristics of each computerized program. So far, the computerized programs for improving the cognitive function have been considered as part of the same therapy without taking into account the significant differences between each other. The present review aims to identify and compare computerized cognitive stimulation, training, and rehabilitation software for older adults with MCI and dementia. Specifically, it is intended to determine the characteristics and the differences and similarities between the diverse computerized programs, as all programs are similar but not identical even though they are used for the same purposes.

METHODS

Materials

Details for this systematic review were registered on PROSPERO (CRD42019117531)[1]. The study was performed considering PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for bibliographic reviews (Urrútia and Bonfill, 2010) and included randomized controlled trials, study protocols, and pilot studies regarding cognitive stimulation, cognitive training and cognitive rehabilitation software for older adults with dementia and MCI.

Procedure

PROSPERO (https://www.crd.york.ac.uk/prospero/) was searched to ensure that no other systematic review had been registered previously on this topic. No such study was identified.

The databases PsycINFO, Medline, CINAHL, Web of Science and PubMed were searched from January 1, 2008, to August 31, 2018. The following search terms were used in combination: ("comput*" OR "computer software") AND ("brain training" OR "cognitive training" OR "memory training" OR "cognitive rehabilitation") AND ("Alzheimer" OR "frontotemporal dementia" OR "vascular dementia" OR "cognitive impairment"). Additionally, we searched the Commission database of EU-funded research and innovation projects (CORDIS) for "computer-based cognitive rehabilitation" and "computer-based software for cognitive impairment." The searches were filtered by health domain of application and project collection. We also searched for gray literature using Google Scholar looking for "computer-based software" AND "cognitive training and cognitive rehabilitation" AND "dementia". The research was limited to the years 2008–2018. Additionally, the reference lists of available studies were screened for further potentially eligible articles.

Studies were included if they described: (1) software for people over 60 years; (2) computer-based cognitive stimulation, cognitive training and cognitive rehabilitation programs; (3) technologies aimed at people with Alzheimer's Disease, frontotemporal, or vascular dementia, or people with mild cognitive impairment (amnestic, non-amnestic and multiple domain); (4) technologies with clear descriptions of the objective, users and functioning; (5) were published between 2008 and 2018 and (6) written in English or Spanish.

Exclusion criteria were: (1) technologies exclusively aimed at healthy people; (2) technologies aimed at people with other types of dementia as described above (e.g., Lewy bodies, Pick's disease) or other clinical populations; (3) games, assistive technology, robots and virtual reality; (4) programs that do not require a therapist; (5) systematic reviews, meta-analysis and editorials.

Procedure Study Selection

Two researchers independently reviewed the titles and abstracts of identified studies for eligibility and screened the full text of potentially available studies (E.I. and LM. C-S.). The researchers compared their reviews and agreed upon inclusion by consensus. In case of disagreement, a third reviewer (JM. T-G.) was consulted. No metric of inter-rater reliability was kept. **Figure 1** summarizes the process of selecting studies.

Data Extraction

Data collection included the individual characteristics of all computerized programs. Initial data extraction was based on the information available in the selected studies. Subsequently, every technology was looked upon on the web, as a secondary source for additional information. The features to analyze were chosen considering the basic requirements for technology to have clinical usefulness (Franco-Martín et al., 2002) and are shown in **Table 1**. Once the identification of the articles was completed, we analyzed the characteristics of these studies considering the number and type of studies, participant demographic characteristics, intervention details, and the main results.

Data Analysis

As a result of the different features of the technologies and methodological differences of the studies, we provide a qualitative synthesis of the results considering Cochrane guidelines for data synthesis and analysis (Ryan, 2013). First, we provide a brief description of the feature of the software. Secondly, we summaries the characteristics of the selected studies and mention the studies found concerning these computerized programs.

RESULTS

Characteristics of Computerized Programs

A total of 2,650 articles and 531 projects were obtained from the search. 2,176 studies remained after the exclusion of duplicates, and the titles and abstracts of identified papers were first reviewed for elimination. The identified documents were classified according to inclusion and exclusion criteria, leaving 105 potential articles to include in the review. Finally, 19 studies were selected to perform the analysis (**Figure 1**).

The identified cognitive stimulation, training, and rehabilitation software for people with MCI and dementia are shown in **Table 2**. A total of 11 computerized computer programs were identified, precisely four programs for cognitive rehabilitation (Brainer, GRADIOR, NeuronUp, ComCog), six for cognitive training (Captain's Log, Cogmed, CogniFit, CogniPlus, COGPACK, SOCIABLE) and one for cognitive stimulation

[1]It can be accessed at http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42019117531

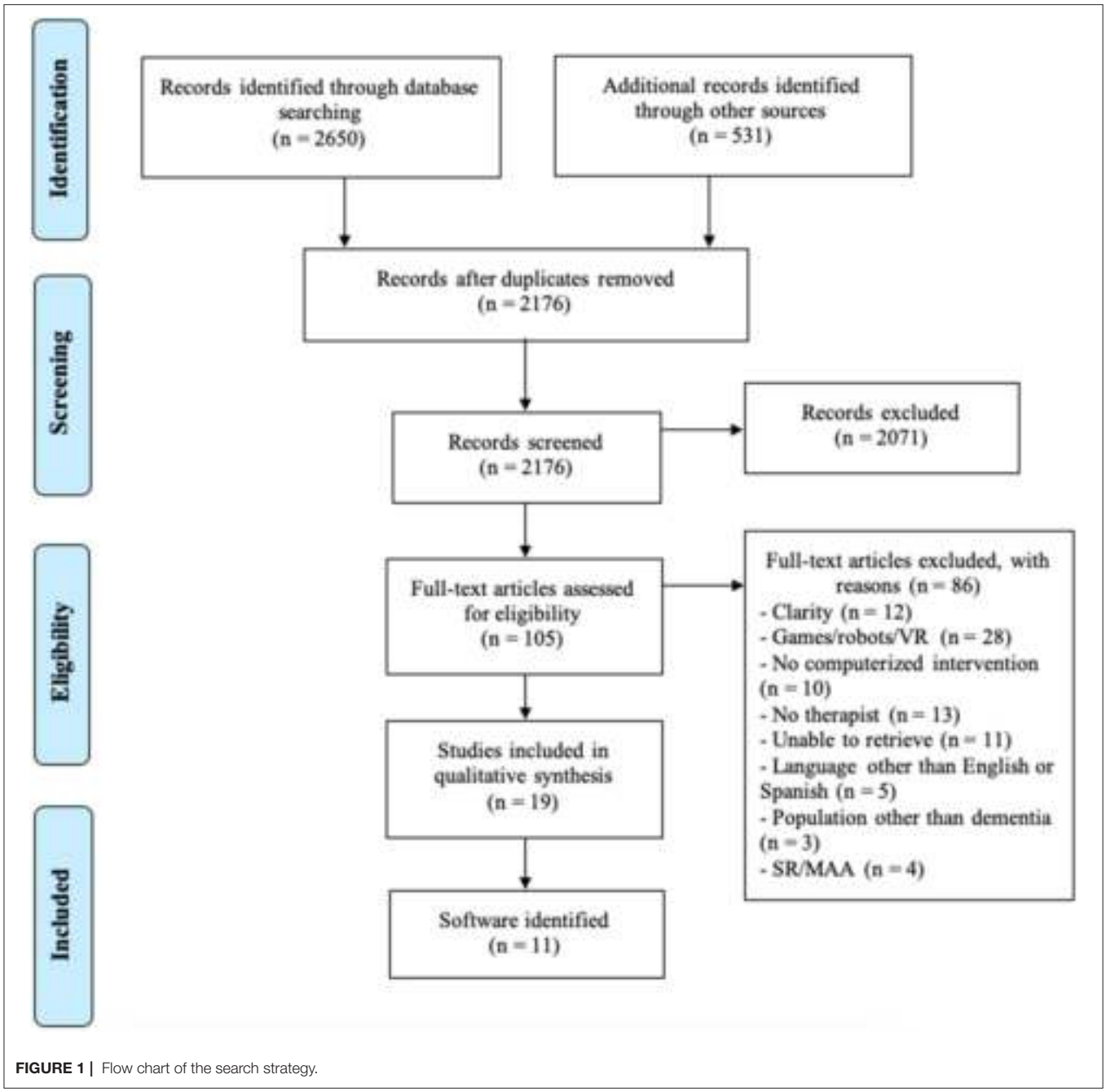

FIGURE 1 | Flow chart of the search strategy.

(FesKits). It is necessary to take into account that in many cases, the computer programs mix up the different cognitive approaches and consequently, they were classified considering the primary strategy used.

Overall, the identified technologies were flexible tools for each end user's cognitive profile. The programs allowed therapists to create tailored treatments and to adjust the difficulty level of exercises to every user (Brainer, Captain's Log, CogniFit, COGPACK, FesKits, GRADIOR, NeuronUp, ComCog), even automatically (Cogmed, CogniPlus, ComCog). Programs were usable for other clinical groups in addition to people with MCI and dementia. People with disorders such as dyslexia, insomnia, multiple sclerosis, Parkinson's disease and brain damage could also benefit from the majority of identified cognitive software. Moreover, four technologies could be used by healthy people as a way to prevent cognitive decline (CogniFit, FesKits, GRADIOR, SOCIABLE). Regarding usefulness, most of the identified programs targeted multiple cognitive domains, while just one was specifically designed to enhance working memory (Cogmed).

Six web-type technologies (Brainer, Cogmed, CogniFit, FesKits, NeuronUp, ComCog) and four native applications

TABLE 1 | The individual characteristics for analysis of computerized programs.

Variables	Description
Intervention type	Cognitive stimulation Cognitive training Cognitive rehabilitation
Usefulness	Stimulated cognitive functions
Flexibility with each user	Program capacity to personalize and adapt the content to the specific cognitive profile of the end-users
Disease flexibility	Competency to be used by people with different clinical conditions (mild, moderate, or severe degree of dementia)
Accessibility	Remote applicability Internet connection Application type (native or web app)
Portability	Device type
User-friendliness	Input/output device
Content	Exercises or tasks Progress report Additional features

(Captain's Log, CogniPlus, COGPACK, GRADIOR) were found (designed for specific mobile platforms). One technological program was available in both native and web-based applications (Cogmed), and another computerized program offered a web-based application for users and a native application for professionals (Brainer). Internet connection was required for most of the programs, while only two native apps worked off-line (COGPACK, CogniPlus). Furthermore, eight computerized programs enabled remote use (Brainer, Captain's Log, Cogmed, CogniFit, FesKits, GRADIOR, NeuronUp, SOCIABLE), whereas, for the rest of the programs, this was not specified.

Most programs were optimized for both personal computers and laptops (Brainer, Captain's Log, Cogmed, CogniFit, CogniPlus, COGPACK, FesKits, GRADIOR, SOCIABLE), computers with touch screen (GRADIOR), and iPad, tablet or smartphones (Brainer, Cogmed, CogniFit, ComCog, SOCIABLE). Keyboard (CogniFit, CogniPlus, COGPACK, FesKits) and mouse (Brainer, Captain's Log, Cogmed, CogniFit, CogniPlus, FesKits, CogniFit) were the most common input devices. However, mouse use was set as optional (COGPACK, GRADIOR, SOCIABLE). One technology program can function with a standard computer keyboard or with SCHUHFRIED's Basic response panel, a particularly suitable keyboard for individuals with restricted hand movement (CogniPlus). Additionally, most of the programs required the use of headsets (Captain's Log, Cogmed, CogniFit, CogniPlus, FesKits, GRADIOR).

The content of the programs varied in terms of the number of tasks and exercises. Some programs contained 15–25 activities, and others had over 2,000 exercises. It was also found that the 11 programs generated progress reports of users' cognitive performance. Another significant feature was that three of the software included neurocognitive assessment tools (Captain's Log, CogniFit, GRADIOR). Finally, one of the software combined cognitive tasks with physical exercises (CogniPlus), and another could also be used for individualized and group cognitive training as well as to reinforce social interactions (SOCIABLE).

Table 3 summarizes the differences and similarities between computerized cognitive programs according to the characteristics considered most appropriate to make such technology as useful as possible for both users (in this case, older people with MCI and dementia) and therapists.

Characteristics of the Selected Studies

Table 4 summarizes the selected studies classified by the identified computerized programs for the current systematic review. We found 19 studies in which 11 digital cognitive training programs for older people with cognitive impairment and dementia were mentioned. The selected papers consisted of ten RCTs (Gaitán et al., 2012; Zaccarelli et al., 2013; Fiatarone Singh et al., 2014; Barban et al., 2015; Cavallo et al., 2016; Hyer et al., 2016; Suo et al., 2016; Bahar-Fuchs et al., 2017; Hagovská et al., 2017; Cavallo and Angilletta, 2018), five pre-post studies (Gigler et al., 2013; González-Palau et al., 2014; Hwang et al., 2015; Vermeij et al., 2017; Mendoza Laiz et al., 2018), two studies with repeated measures design (Eckroth-Bucher and Siberski, 2009; Vermeij et al., 2016), one pilot study (Danassi, 2015), and one study protocol for an RCT (Vanova et al., 2018).

The study participants were between 60 and 91 years and people with MCI (mean age: 73.5 ± 5.3), an early stage of AD (mean age: 76.4 ± 3.35), moderate cognitive impairment (mean age: 78.6 ± 8.43) or with Alzheimer's Disease (mean age: 76.2 ± 1.1), and healthy older people (mean age: 72.2 ± 2.9). The number of individuals included in each study varied, ranging from 17 to 348. In general, more women participated in the studies, and no differences between arms were found.

Regarding the intervention characteristics, the duration of the interventions varied considerably between 4 and 26 weeks. There was also substantial heterogeneity in both the number and length of the sessions. On average, the interventions were provided 2–3 times per week for 46 min.

Scientific Studies for Computerized Programs

Analyzing the effectiveness of cognitive intervention software was not the objective of the review because there are currently papers doing it (Gates et al., 2019a,b). Nevertheless, it was considered essential to mention the characteristics of the population and the principal findings of the included studies.

Cognitive Stimulation Program

A 12-months intervention with the cognitive stimulation software FesKits was evaluated in an RCT in comparison to a traditional cognitive training program (Gaitán et al., 2012). The study was carried out with people with MCI and Alzheimer's Disease and showed that the group receiving both traditional and computer-based cognitive training improved in the performance of executive function tasks.

TABLE 2 | Characteristic of identified computerized cognitive programs.

Program and Website	Type of intervention	Target group	Device	Targeted cognitive functions	Input device	Output device	Application type	Remote application	Internet connection required	Flexibility	Content	Progress report	Additional features
Brainer www.brainer.it	CR	Neurological disorders	PC, tablet*	VP, AP, attention, R&W, language, calculus, logic and deduction, memory, SMS	Mouse, touch screen*	NA	Web Native*	Yes*	Yes*	Yes	78 exercises	Yes*	NA
Captain's log www.braintrain.com/captains-log-mindpower-builder	CT	CI, TBI, MI, ADHD*	PC*	Memory, attention, perception, reasoning, planning, judgment, EF*	Mouse*	Headset*	Native*	Yes*	Yes*	Yes*	2000 exercises*	Yes*	Entertaining Games Assessment battery
Cogmed® www.cogmed.com	CT	ADD, LD, TBI, CI, stroke	PC, iPad/tablet*	WM	Mouse*	Headset	Web Native	Yes*	Yes	Yes*	25 training session	Yes*	Cogmed Coach
CogniFit www.cognifit.com	CT	HOP, ADHD, depression, PD, stroke, dyscalculia, dyslexia, insomnia, fibromyalgia	PC, iPad/tablet, smartphone	Attention, memory, EF, perception, reasoning coordination	Keyboard, mouse	Headset*	Web	Yes	Yes	Yes	33 tasks	Yes*	Assessment tools
CogniPlus www.schuhfried.com	CT	BD, ADHD, MCI*	PC*	Attention, memory, SP, planning, visuomotor skills	Mouse, keyboard, Schuhfrieds Basic response panel*	Headset*	Native*	NA	No*	Yes	15 tasks*	Yes*	Physical exercises
COGPACK www.cogpack.com	CT	PD, neurological disorders*	PC	Visuomotor skills, logic, language, orientation, comprehension, memory, problem-solving*	Keyboard, mouse or touch screen	NA	Native *	NA	No*	NA	537 task sets*	Yes*	NA
FesKits www.feskits.com	CS	HOP, stroke, TBI, tumors, dementia, MS, PD, DS, ID schizophrenia	PC, laptop	Attention, memory concentration, EF, perception, recognition, language, calculus, spatial and temporal orientation	Keyboard, mouse	Headset*	Web	Yes*	Yes*	Yes	> 5,000 exercises*	Yes*	NA

(Continued)

TABLE 2 | Continued

Program and Website	Type of intervention	Target group	Device	Targeted cognitive functions	Input device	Output device	Application type	Remote application	Internet connection required	Flexibility	Content	Progress report	Additional features
GRADIOR www.intras.es	CR	HOP, NDD, MI, NPD, BD, cerebral palsy, dementia	Touchscreen computer	Attention, perception, memory, orientation, calculation, language, EF, reasoning	Mouse (optional)	Headset*	Native	Yes	Yes*	Yes	>12,500 exercises	Yes*	Assessment tools
NeuronUp www.neuronup.com	CR	AD, MS, PD, stroke, ADHD, dementia, MI, NDevD, ID*	NA	Memory, attention, gnosis, EF, praxis, language, social cognition and visuospatial skills*	NA	NA	Web*	Yes*	Yes*	Yes*	> 6,000 activities*	Yes*	Serious Games and additional resources
ComCog https://home.neofect.com/blog/tag/rapael-comcog	CR	AD, Dementia, Stroke, TBI*	Tablet*	Attention and memory	NA	NA	Web*	NA	Yes*	Yes*	> 20 exercises*	Yes*	NA
SOCIABLE www.cognitivetraining.eu	CT	MCI, mAD, HOP	Multi-touch surfaces (tablet, PC)	Memory, orientation, attention, EF, language, praxis, reasoning	Multitouch surfaces*	NA	NA	Yes*	Yes*	Yes*	25 exercises*	Yes*	Social interaction tasks

**, information obtained in the web; AD, Alzheimer Disease; ADD, Attention Deficit Disorder; ADHD, Attention Deficit Hyperactivity Disorders; ADL, Activities of Daily Living; AP, Auditory Perception; BD, Brain Damage; CI, Cognitive Impairment; CR, Cognitive Rehabilitation; CS, Cognitive Stimulation; CT, Cognitive Training; DS, Down Syndrome; EF, Executive Function; HOP, Healthy Older People; ID, Intellectual disabilities; LD, Learning Disorders; mAD, Mild Alzheimer Disease; MCI, Mild Cognitive Impairment; MI, Mental Illness; MS, Multiple Sclerosis; NA, Not Available; NDD, Neurodegenerative Disorders; NDevD, Neurodevelopmental Disorders; NPD, Neuropsychiatric Disorders; PC, Personal Computer; PD, Parkinson's Disease; PS, Processing Speed; R&W, Read & Write; SMS, Sensory Motor Skills; SP, Spatial Processing; TBI, Traumatic Brain Injury; VP, Visual Perception; WM, Working Memory.*

TABLE 3 | Differences and similarities between the reviewed tools.

	Multiple target group	Touchscreen device	Multiple target function	Accessories	Headset	Web application	Remote application	Internet connection	Flexibility	Progress report	Additional features
Brainer	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes
Captain's Log	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Cogmed	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CogniFit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CogniPlus	Yes	No	Yes	Yes	Yes	No	NA	NA	Yes	Yes	Yes
COGPACK	Yes	No	Yes	No	NA	No	NA	NA	NA	Yes	NA
FesKits	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
GRADIOR	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes
NeuronUp	Yes	NA	Yes	NA	NA	Yes	Yes	Yes	Yes	Yes	Yes
ComCog	Yes	Yes	Yes	NA	NA	Yes	NA	Yes	Yes	Yes	NA
SOCIABLE	Yes	Yes	Yes	No	NA	NA	Yes	Yes	Yes	Yes	Yes

NA, Not Available.

Cognitive Training Programs

Captain's Log is a computerized program for cognitive training. No other details about this cognitive software were described in the identified studies. Captain's Log was part of an Integrated Cognitive Stimulation and Training Program intervention, in which a combination of other stimulation techniques was used (Eckroth-Bucher and Siberski, 2009). A repeated measures experimental study was carried out with participants with mild and moderate cognitive impairment and healthy older adults. The results showed that people with mild and moderate impairment receiving a combination of stimulation techniques enhanced the logical memory domain and that these improvements remained 8 weeks after the intervention.

Three studies were identified regarding the use of the computer-based cognitive training program Cogmed (Hyer et al., 2016; Vermeij et al., 2016, 2017). Hyer et al. (2016) conducted an RCT that examined the effectiveness of Cogmed in older adults with MCI. The study found that non-verbal working memory and subjective memory complaints of participants improved after 5–7 weeks of cognitive training. In a repeated measure design study, Cogmed was used to analyze the transfer effects of working memory (Vermeij et al., 2016) and the prefrontal activation after training in a pre-post study (Vermeij et al., 2017). In both studies, people with MCI and healthy older adults were included. The main results showed improvements in working memory tasks and maintenance of these effects 3 months post-intervention.

CogniFit cognitive training software was evaluated in an RCT (Bahar-Fuchs et al., 2017) in people with MCI and people with mood-related neuropsychiatric symptoms (MrNPS). The study showed that people with MrNPS performed overall better than participants with MCI in global cognitive ability. Another study aimed to explore the potential of CogniFit in people with MCI and healthy adults (Gigler et al., 2013). The pre-post study found that participants in the cognitive training condition improved on global cognition and memory after the intervention.

CogniPlus is computerized software for cognitive training. Its effectiveness was compared in an RCT study to a traditional group-based program in older adults with MCI (Hagovská et al., 2017). The study showed that the group receiving computerized training performed better on cognition, attention and had a better quality of life.

Two studies were found regarding the use of the cognitive training software COGPACK (Fiatarone Singh et al., 2014; Suo et al., 2016). Fiatarone Singh et al. (2014) carried out an RCT regarding the Study of Mental and Resistance Training (SMART) with people with MCI. The study showed that the group receiving computerized training improved memory function after 6 months of training while the group receiving resistance training showed significant improvements in cognition and executive functions as compared to control conditions. Similarly, the RCT conducted by Suo et al. (2016) aimed to examine structural and functional brain changes after cognitive training and resistance training in people with MCI. The study showed significant improvements in cognition for the resistance training group and better memory performance for the computerized training group.

Two RCT studies were found in which the cognitive training program SOCIABLE was evaluated (Zaccarelli et al., 2013; Barban et al., 2015). Barban et al. (2015) examined the effects in combination with group Reminiscence Therapy in people with MCI, mild Alzheimer's Disease and healthy subjects. The results showed that people with MCI and mild Alzheimer's Disease maintained cognitive function after the intervention. Furthermore, the study of Zaccarelli et al. (2013) found that cognition, memory, executive functions, language and praxis were improved after the intervention with this program. A pilot study was also carried out with SOCIABLE in four European countries (Danassi, 2015). This study involved participants with MCI, mild Alzheimer's

TABLE 4 | Details of the studies that support the use of the identified computerized cognitive programs.

Name	References	Study design	Participants	Intervention	Duration	Primary outcomes	Main results
Brainer	Cavallo et al., 2016	RCT	Early stage of AD EG: 76.5 ± 2.88 CG: 76.33 ± 3.83 29 M, 31 F	Individual EG: CT ($n = 40$) CG: leisure activities ($n = 40$)	F: 3 t/w D: 30 m/s; 12w	Cognition, memory, semantic knowledge, language, visuospatial abilities, EF	- EG significant effects on short-term memory; WM; oriented memory; language comprehension and EF - Improvements remained at 6 months follow up
	Cavallo and Angilletta, 2018	RCT	Early stage of AD EG: 76.5 ± 2.88 CG: 76.33 ± 3.83 29 M, 31 F	Individual EG: CT ($n = 40$) CG: leisure activities ($n = 40$)	F: 3 t/w D: 30 m/s; 12 w	Cognition, memory, semantic knowledge, language, visuospatial abilities, EF	- Significant effects on short-term memory; WM; oriented memory immediate and delayed; language comprehension; EF
Captain's Log	Eckroth-Bucher and Siberski, 2009	Repeated measures	NI, MI and MoI 78.6 ± 8.43 5 M, 27 F	Individual EG: CT+P&P ($n = 17$) CG: —($n = 20$)	F: 2 t/w D: 45 m/s; 6 w	Cognition, logical memory	- MI and MoI groups show significant improvements in DRS and logical memory— Improvement maintained after 8 weeks
Cogmed®	Hyer et al., 2016	RCT	aMCI and naMCI EG 75.1 ± 7.4 CG 75.2 ± 7.8 32 M, 36 F	Individual EG: CT adapted ($n = 34$) CG: CT no-adapted ($n = 34$)	F: - D: 40 m/s; 5–7 w	WM, IADL, subjective memory complaints	- Significant changes in non-verbal WM and subjective memory complains - IADL improved for EG at the follow up (12 weeks)
	Vermeij et al., 2016	Repeated measures	HOA, aMCI and a-md MCI 67.8 ± 2.4 23 M, 12 F	Individual CT (n = 47)	F: 5 t/w D: 45 m/s; 5 w	WM	- HOA perform better than people with MCI - Both groups improved on the Digit Span and Spatial Span and maintained at follow-up (3 months)
	Vermeij et al., 2017	Pre-post	HOA, aMCI and a-md MCI 67.8 ± 2.4 23 M, 12 F	Individual CT ($n = 47$)	F: 5 t/w D: 45 m/s; 5 w	WM	- MCI group improved WM performance after training
CogniFit	Bahar-Fuchs et al., 2017	RCT	MCI, NPS and NPS+MCI 74.6 ± 6.8 24 M, 20 F	Individual EG: personalized ($n = 21$) CG: pre-determined ($n =23$)	F: 3 days/week; 2 session/day D: 20–30 m/s; 8–12 w	Cognition	- MrNPS performed better than MrNPS + MCI in cognition; delayed memory; learning and memory; and non-memory composite
	Gigler et al., 2013	Pre-post	HOA and aMCI 89.33 ± 16.33 5 M, 13 F	Individual CT (n = 18)	F: 2 t/w D: 20–30 m/s; 8–10 w	Cognition, everyday task, QoL, IADL	- Higher scores for HOA in an auditory memory span, visual memory and WM
CogniPlus	Hagovská et al., 2017	RCT	MCI Group A: 67.8 ± 6.5 Group B: 68.2 ± 4.2 29 M, 31 F	Individual Group A: CT ($n = 30$) Group B: TCT ($n = 30$)	F: 2 t/w D: 30 m/s; 10 w	Functional activities, QoL, cognition, attention	- Group A performed better on QoL, cognition and attention - No differences were found on functional activities
COGPACK	Fiatarone Singh et al., 2014	RCT	MCI 70.1 ± 6.7 -	Individual TG1: CT ($n = 24$) TG2: PRT ($n = 22$) TG3: CT+PRT ($n = 27$) CG: videos, stretching; toning ($n = 27$)	F: 2 t/w D: 60–100 m/s; 26 w	Cognition, IADL, EF, memory and attention	- TG2 significantly improved cognition at 6 months and executive function across 18 months. TG1 only attenuated the decline in Memory Domain at 6 months

(Continued)

TABLE 4 | Continued

Name	References	Study design	Participants	Intervention	Duration	Primary outcomes	Main results
	Suo et al., 2016	RCT	MCI 70.1 ± 6.7 32 M, 68 F	Individual TG1: CT (n = 24) TG2: PRT (n = 22) TG3: CT+PRT (n = 27) CG: videos, stretching; toning (n = 27)	F: 2 t/w D: 90 m/s; 26 w	Cognition, IADL, EF, memory and attention	- Significant results for TG2 on cognition - TG1 improved results on overall memory performance
FesKits	Gaitán et al., 2012	RCT	a-md MCI and AD G1: 76 ± 6.61 G2: 74.87 ± 4.89 19 M, 20 F	Individual G1: CBCT+TCT (n = 37) G2: TCT (n = 23)	F: 2-3 t/w D: 60 min; 12w	Attention, PS, memory, EF, praxis, gnosis and cognition	- A nearly significant interaction for EF in G1. Results remained at 12 months follow up
GRADIOR	González-Palau et al., 2014	Pre-post	aMCI, a-md MCI and HOA 73.43 ± 7.51 10 M, 40 F	Individual CT and Physical training (*n* = 50)	F: 3 t/w D: 40 m/s; 12 w	Cognition, mood	- Improvement of cognitive function and verbal and episodic memory in both groups; and decreased symptoms of depression
	Vanova et al., 2018	Study protocol	aMCI and mD -	Individual G1: CT (*n* = 100) G2: PSS (*n* = 100) G3: CT+PSS (*n* = 100) G4: TAU (*n* = 100)	F: 3–4 t/w D: 30 m/s; 12 months	Cognition, QoL, ADL, mood, Patient-carer relationship	-
NeuronUp	Mendoza Laiz et al., 2018	Pre-post	MCI 68.18 ± 4.28 14 M, 18 F	Individual NFT and WMT (*n* = 32)	F: 1 t/w D: 80 m/s; 5 w	Attention, intellectual process, memory, spoken language and visuospatial ability	- G1 improved on VP; spatial orientation; receptive speech; expressive speech; memory; picture recognition; concepts - G2 improved on picture recognition; concepts
ComCog	Hwang et al., 2015	Pre-post	AD 14 M, 21 F	Individual CT (*n* = 35)	F: 5 t/w D: 30 m/s; 4 w	Cognition	- A significant decrease in recognition and increase on orientation, registration and recall
SOCIABLE	Barban et al., 2015	RCT	HE, MCI, mAD T1: 74 ± 2.92 T2: 73.93 ± 2.6 129 M, 172 F	Individual or in group T1: pb/CT+RT/Rest (*n* = 149) T2: Rest/pb/CT+RT (*n*= 152)	F: 2 t/w D: 60 m/s; 12w	Memory and EF	- Significant effects on memory and in HE groups on EF -The effects remained at 6 months follow up on MCI and HE groups
	Danassi, 2015	Pilot study	HE, MCI, mAD -	Individual or in group CT (*n* = 315)	F: 2 t/w D: 3 months	Cognition, affection, functional abilities	- Significant improvement on cognition and functionality; depression unchanged -Improvements remained at 3 months follow up
	Zaccarelli et al., 2013	RCT	HE, aMCI and mAD -	Individual or in group EG: CT (*n* = 174) CG: - (*n* = 174)	F: 2 s/w D: 60 m/s 12w	Cognition, memory, praxis, EF, attention, language	- Significant results on cognition; memory and EF; constructional praxis and language

AD, Alzheimer Disease; ADL, Activities of Daily Living; aMCI, amnestic Mild Cognitive Impairment; a-md MCI, amnestic-multiple domain Mild Cognitive Impairment; CBCT, Computer-Based Cognitive Training; CT, Cognitive Training; CG, Control Group; D, Duration; DRS, Dementia Rating Scale; EG, Experimental Group; EF, Executive Function; F, Frequency; G, Group; HE, Healthy Elderly; HOA, Healthy Older Adults; IADL, Instrumental Activity of Daily Living; m/s, Min/session; mAD, Mild Alzheimer's Disease; MCI, Mild Cognitive Impairment; mD, mild Dementia; MI, Mild Impairment; MoI, Moderate Impairment; MrNPS, Mood-Related Neuropsychiatric Symptoms; na-MCI, non-amnestic Mild Cognitive Impairment; NFT, Neurofeedback Training Sessions; NI, No Impairment; NPS, Neuropsychiatric Symptoms; pb-CT, Process-Based Cognitive Training; PRT, Progressive Resistance Training; PS, Processing Speed; PSS, Psychosocial Stimulation; P&P, Paper & Pencil; QoL, Quality of Life, RCT= Randomized Controlled Trial; RT, Reminiscence Therapy; T, Treatment; TAU, Treatment As Usual; TCT, Traditional Cognitive Training; TG, Treatment Group; t/w, times/week; VP, Visual Perception; W, Weeks; WM, Working Memory; WMT, Working Memory Training.

Disease and healthy older adults and the results showed positive effects for people with MCI and healthy older adults in cognition and functional abilities while mood state did not change.

Cognitive Rehabilitation Programs

The cognitive rehabilitation program Brainer was evaluated in two RCT studies in people with early-stage Alzheimer's Disease (Cavallo et al., 2016; Cavallo and Angilletta, 2018). The

studies found that the intervention influenced working memory, language comprehension and executive functions positively and that these effects remained 6 months after the intervention but decreased after 12 months.

The cognitive rehabilitation software GRADIOR was part of The Long Lasting Memories European project that aimed to validate an integrated technology platform combining cognitive exercises with physical activity (González-Palau et al., 2014). A pre-post study was carried out with people with MCI and healthy subjects, and the results showed significant improvements in global cognitive function and symptoms of depression. Also, a study protocol regarding the efficacy of GRADIOR was identified (Vanova et al., 2018). The study protocol described an RCT with an envisaged total of 400 people with MCI and mild dementia to determine the effectiveness of the cognitive rehabilitation program GRADIOR and the ICT platform ehcoBUTLER, separately and in combined treatment.

NeuronUp is a program for cognitive rehabilitation. Its effectiveness was evaluated in a pre-post study that aimed to analyze the improvements in the neurological profile of people with MCI and Alzheimer's Disease (Mendoza Laiz et al., 2018). The study found an increase in picture recognition and concepts in both groups.

Hwang et al. (2015) conducted a pre-post study to examined the effects of the cognitive rehabilitation program ComCog on the global cognition of people with Alzheimer's Disease and concluded that participants performed better on orientation and information registration while no improvements in recognition were observed.

DISCUSSION

This systematic review discloses the state of the art on cognitive intervention software providing cognitive stimulation, training, or rehabilitation for older adults with MCI and dementia. The review aimed to check the characteristics of computer-based cognitive programs and the differences and similarities between the existing software, avoiding considering that all computer programs working for cognitive improvement are identical. We focused the study on the software used in regular computers, considering that they are more used than others. Probably in the future, tablets, smartphones, or other devices can be used more often, but currently, the usability of computers is higher than the other technologies for people with dementia (Góngora Alonso et al., 2019). We identified 19 studies that used 11 different cognitive software programs for the treatment of people with MCI and dementia independently if they were used for cognitive stimulation, training, or rehabilitation.

Like traditional cognitive interventions (Lobbia et al., 2018), most identified computerized programs were aimed to improve multiple cognitive domains, where memory and attention were the most stimulated cognitive functions. The review identified computerized programs with standardized training sessions as well as software that enables to create new treatments, define training goals and customize training parameters such as difficulty level, session duration and session frequency. Programs with standardized training sessions are unable to modify or adapt treatments to the cognitive profile of end-users (e.g., Cogmed, Brainer, CogniPlus, FesKits). This non-flexibility of programs is a significant disadvantage since the training is the same for everyone, even if the difficulty level of the exercise changes. It was also found that some programs can automatically propose exercises of the most appropriate cognitive difficulty level.

In this study, software aimed at people with Alzheimer's Disease were mainly included since it is the most common type of dementia (Garre-Olmo, 2018). Vascular dementia and frontotemporal dementia were also considered because of their high prevalence (Hogan et al., 2016; Wolters and Arfan Ikram, 2019). In general, cognitive intervention programs are not explicitly aimed at people with dementia, but also to other clinical conditions. None of the identified technologies was designed expressly for dementia alone, as many targeted a broad range of disorders causing cognitive impairment. The fact that programs are suitable for many clinical conditions can be seen as an indicator of the strength and flexibility of the programs. Even more, in most cases, they have been designed to improve the cognitive functions independently of the origin of the problem. It means that they consider mainly the cognitive function and less the special features of every disease.

This review found two native apps that did not require an internet connection (CogniPlus and COGPACK) and eight programs that allowed the remote use of cognitive software (Brainer, Captain's Log, Cogmed, CogniFit, FesKits, GRADIOR, NeuronUp, SOCIABLE). Online platforms force users to have an internet connection, a requirement that native applications might not have. The need for internet connection may be inconvenient, especially for older people who do not have access to the internet at home or in nearby facilities. This is the case of people living in further rural areas without access to the internet. However, programs working through the internet enable remote applicability, which may be a potential approach to improve the availability of treatments of people who live in rural areas and experience difficulties in accessing health care services. Furthermore, online platforms allow users to work on different devices, participation in treatment programs regardless of location, and even facilitate data sharing. Applications that do not require internet connection cannot be used remotely, the therapist cannot supervise treatment, and the settings/levels cannot be automatically tailored.

All computerized cognitive training (CCT) were available on conventional (portable) digital devices, which facilitates the uptake and implementation of the intervention. Similarly, it was found that the interaction between programs and end-users slightly differ within programs. Half of the tools were developed for use with a touch screen or an adapted keyboard, which makes it easy for people with computer illiteracy to use them because the similarity with TV is high. Almost all computer-optimized technologies can also be used with a mouse, although mouse usage requires a higher cognitive level than touch screens or other devices. As keyboard and mouse control can be a barrier for older people, the need for designing user-friendly programs that do not require lots of accessories is logical. Therefore, programs optimized for touch screen devices could encourage people

with dementia to participate in computer-based interventions (Joddrell and Astell, 2016). Older people may experience fear of using computers due to a lack of experience or familiarity (Góngora Alonso et al., 2019). Training people with dementia in the use of technologies and providing support during the interventions might be effective strategies to promote the use of technological devices (Meiland et al., 2017).

All programs generated reports of treatment results. This feature provides the opportunity to monitor improvement, performance and evolution of each user. In this sense, computer programs facilitate data management and making an adequate follow-up of the intervention. However, it was not possible to check the differences among them in the accuracy of the reports.

Another characteristic of computerized programs is that they are designed to be enjoyable and fun. The identified digital software contained a wide variety of exercises that stimulate engagement and avoid repetition. Moreover, some software even combined entertaining games and motivating video games to enhance the user's performance in the intervention. It has been proven that brain games or cognitively stimulating leisure activities may also help to prevent or delay the effects of aging (Yates et al., 2016). However, most of these cognitive enhancement activities are easily accessible and regularly performed for entertainment with no need for any professional monitoring. Therefore, these types of brain games are designed with a completely different purpose and should not be considered as treatments for people with cognitive decline and dementia.

According to this systematic review and the identified software, all features might have advantages and disadvantages. Also, depending on the context of use and the characteristics of each person, one computerized program might be more suitable than another. In our opinion, web-based software working through an internet connection would facilitate the implementation of the intervention since it could be applied in any device with an internet connection and would facilitate the remote applicability. In terms of content, we believe that the more cognitive exercises the program contains, the easier it will be to maintain users motivated. It would also be considered favorable if the software contained evaluation tools and progress reports that would help the therapists to personalize and monitor the intervention. Besides, touch screen computers may be most suitable for use with older people with MCI and dementia (Lim et al., 2013). While computers may be less portable than other devices such as tablets, the size of the screen may seem more appropriate for use by older people who may feel more comfortable with this type of equipment. It is also recommended to designed simple intervention programs and that do not require too many accessories (Van der Roest et al., 2017).

Analyses of the characteristics of these programs showed that the identified strengths and weaknesses of cognitive intervention software are in line with previous studies comparing online neuropsychological rehabilitation platforms (Guerrero-Pertíñez and García-Linares, 2015). The authors concluded that online platforms should consider the possibility of comparing results between people with similar characteristics, create personalized exercises or task as well as making computers more accessible for people with sensory-motor deficits. Similarly, interventions should be as simple as possible and more tailored to the needs of people with dementia (Van der Roest et al., 2017).

Although it was not one of the main objectives of the review, the studies selected for the review were examined regarding the methodology used for proving their usefulness. Half of the studies were RCTs, with relatively small sample sizes. Additionally, five pre-post studies, two studies with a repeated measures design, a pilot study and study protocol were identified. The size of the study samples varied between 17 and 348 participants, though most of them included fewer cases than required to offer robust evidence. Considering the number and the study type of each software, SOCIABLE was the one that was most correctly evaluated, with two RCTs and acceptable sample sizes.

Additionally, almost half of the studies were conducted with two intervention groups, CCT for the experimental group and traditional cognitive training, leisure activities, stretching and toning exercises, or pre-determined computerized training tasks for the control group. Only two programs were compared against conventional cognitive intervention (CogniPlus and FesKits). These studies found nearly significant results on quality of life, cognition, attention (Hagovská et al., 2017) and executive functions (Gaitán et al., 2012). Three studies provide combined treatments in the intervention condition, and eight studies did not consider any control group. Consequently, we cannot find strong evidence in all these studies. It is essential to conduct more RCTs on the effectiveness of the computerized cognitive intervention and long-term follow-ups to reach more robust conclusions (Gates et al., 2019a,b).

Some limitations should be considered concerning the conclusions of this review. First, studies published longer than 10 years ago were not considered, since they probably studied outdated technologies or programs not functioning anymore. Secondly, computer-applied software were only explored, excluding researches using other devices such as a smartphone or tablet. In general, the usability of those devices in dementia is lower than the computer and currently, it is advisable to use a computer with big touch screens (Góngora Alonso et al., 2019). Thirdly, the effectiveness of the computerized programs was not analyzed since the aim of the study was not to establish the usefulness of the software. Several recent systematic reviews concerning the efficacy of cognitive computer software are available (García-Casal et al., 2016; Gates et al., 2019a,b; Hu et al., 2019; Zhang et al., 2019). Furthermore, due to the lack of cost-effectiveness information, it was not possible to compare the programs with this respect. Besides, the specific outcome measures used in the studies were not taken into account and the risk of bias of the studies was not assessed since the objective of this review was not to analyze the potential efficacy of these multimedia resources. Finally, the identified cognitive intervention software were similar but not the same in terms of characteristics such as objectives and function, which made it challenging to compare the programs.

It also should be noted that the information obtained from the selected studies was considered as the primary source. However, almost the studies offered only an elementary description of cognitive training programs, and in some cases, the characteristics of the technologies were not even reported. It

is recommended to add a more comprehensive description of the computer programs since they are an essential part (intervention) of the studies. Given the limited information available in the identified studies, it was necessary to search for information on the website of each technology.

One of the strengths of this systematic review is that it offers an understanding of the different cognitive intervention software for people with MCI and dementia. The study also provides details of the main characteristics and requirements of each technological program, which allows comparing among different software. In this way, it becomes clear that computerized cognitive intervention programs are similar but not the same. Moreover, although studying the effectiveness of computer programs was not one of our objectives, the review provides an overview of the studies related to each program, as well as the results obtained in terms of computerized intervention effects on aspects such as cognition, mood and quality of life. The information collected in this review may also be relevant for health care providers who want to implement a computerized cognitive intervention in the clinical setting. However, it is necessary to clarify that these technological programs are only supportive tools for the assessment and treatment of the cognitive functions, but in no case, replace the role of the therapist in the intervention. Computer-based cognitive interventions should always be monitored by a professional who supervises emotional, psychosocial and behavioral aspects. However, the identified computerized interventions could facilitate the therapist's work in terms of efficacy in the planning, design, and management of cognitive treatments.

Finally, the literature shows a great variety of computer programs aimed at the field of dementia and cognitive impairment, as well as the effects of interventions in the area of research (Butler et al., 2018). However, a future search could be oriented to assess the actual use of these technological tools in clinical practice as part of a treatment or intervention provided to older people with cognitive impairment. In other words, it would be useful to check whether these computerized programs are available to users if they achieve the objectives for which they were designed or whether they remain in research projects.

CONCLUSION

Eleven computerized programs to improve the cognitive functioning of older adults with dementia or MCI were identified in this systematic review. The scientific evidence on these programs was reported in 19 studies with various study designs. The analysis shows that computer programs differ from each other in terms of objectives, features and functions. This variety of programs allows professionals and end-users to choose the one that suits best with their interests and goals as not all people have the same needs, and not all programs are optimal for all people. However, web-based programs containing numerous exercises of different cognitive functions, without many accessories and applied to computers with large touch screens, might be the most appropriate cognitive programs for people with MCI and dementia. Besides, computer programs seem to be a promising strategy for enhancing the cognitive function of older people as they are more accessible (Maldonado, 2016) and cost-effective in comparison to traditional cognitive interventions (Gooding et al., 2015). Investing in more clinical studies and complying with better user-standards might be useful approaches to create meaningful and practical technology and to make more robust comparisons between different cognitive software. It is also necessary to describe the main features of these computerized programs in more detail as there may be studies that do not sufficiently specify the computer program used in the investigation. Finally, more information on the context of use is essential to improve the knowledge on how to use CCT effectively to delay the progression of cognitive impairment in people with MCI and dementia.

AUTHOR CONTRIBUTIONS

EI and MF-M contributed to the conception and design of the study. EI and LC-S performed the data collection supervised by JT-G. EI wrote the first draft of the manuscript. CJ-R, MF-M, and HR revised the manuscript critically for relevant intellectual content. MF-M and EI revised the last version of the manuscript. All authors contributed to manuscript revision, read and approved the submitted version.

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Review

Benefits in Alzheimer's Disease of Sensory and Multisensory Stimulation

Hong Yang[a,b], Yinpei Luo[b], Qingrong Hu[b], Xuelong Tian[b,*] and Huizhong Wen[a,*]
[a]*Chongqing Key Laboratory of Neurobiology, Department of Neurobiology, School of Basic Medicine, Army Medical University, Chongqing, China*
[b]*Chongqing Medical Electronics Engineering Technology Research Center, Laboratory of Neural Regulation and Rehabilitation Technology, College of Bioengineering, Chongqing University, Chongqing, China*

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Abstract. Alzheimer's disease (AD) is a serious neurodegenerative disease, which seriously affects the behavior, cognition, and memory of patients. Studies have shown that sensory stimulation can effectively improve the cognition and memory of AD patients, and its role in brain plasticity and neural regulation is initially revealed. This paper aims to review the effect of various sensory stimulation and multisensory stimulation for AD, and to explain the possible mechanism, so as to provide some new ideas for further research in this field. We searched the Web of Science and PubMed databases (from 2000 to October 27, 2020) for literature on the treatment of AD with sensory and multisensory stimulation, including music therapy, aromatherapy, rhythmic (e.g., visual or acoustic) stimulation, light therapy, multisensory stimulation, and virtual reality assisted therapy, then conducted a systematic analysis. Results show these sensory and multisensory stimulations can effectively ameliorate the pathology of AD, arouse memory, and improve cognition and behaviors. What's more, it can cause brain nerve oscillation, enhance brain plasticity, and regulate regional cerebral blood flow. Sensory and multisensory stimulation are very promising therapeutic methods, and they play an important role in the improvement and treatment of AD, but their potential mechanism and stimulation parameters need to be explored and improved.

Keywords: Alzheimer's disease, music therapy, aromatherapy, rhythmic stimulation, light therapy, multisensory stimulation, virtual reality

INTRODUCTION

Alzheimer's disease (AD) is a progressive neurodegenerative disease. The characteristics of AD patients are memory decline, cognitive impairment, language disorder, learning ability decline, and so on. In the elderly, AD is the third leading cause of death after heart disease and cancer (2019) [1]. Mild cognitive impairment (MCI) patients are a high incidence of AD, and with the passage of time, about 70% of MCI patients develop AD [2]. At present, the therapeutic effect of AD is not satisfactory. The course of AD generally takes several years, or even decades; this is undoubtedly a painful process for patients and their families, and also causing a huge financial burden to society [3, 4]. Therefore, it is of great significance to carry out research on the treatment and care of AD to improve the quality of life of patients and reduce family burden.

The pathogenesis of AD mainly includes synaptic loss [5], cholinergic neurons damage [6], amyloid-β (Aβ) accumulation and tau protein hypothesis [7–10], and neurovascular hypothesis and vestibular

*Correspondence to: Mr. Xuelong Tian, College of Bioengineering, 174 Shazheng Street, Shapingba District, Chongqing, China. Tel.: +86 23 65103812; E-mail: xltian@cqu.edu.cn; Mr. Huizhong Wen, Chongqing Key Laboratory of Neurobiology, Department of Neurobiology, School of Basic Medicine, Army Medical University, Gaotanyan, Shapingba District, Chongqing, China. Tel.: +86 23 68771379; E-mail: justzhong@sina.com.

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loss hypothesis [11]. Aβ oligomers are deposited outside the cell to form senile plaques [12]. Tau protein is hyperphosphorylated and accumulates in the cells to form neurofibrillary tangles [13, 14]. These misfolded proteins accumulate excessively in the aging brain, leading to tissue oxidation and inflammation, and eventually lead to synaptic dysfunction and memory decline [8, 15]. At present, drug therapy is still the mainstream treatment for AD and has achieved certain results. For example, three acetylcholinesterase inhibitors—rivastigmine, donepezil, and galantamine—are widely used to strengthen synaptic transmission, and memantine by use of N-methyl-D-aspartic acid receptor antagonists to slow down the rate of cognitive and behavioral decline [16], improves the symptoms of patients and delays the disease process. On this basis, a variety of new drugs to alleviate AD pathology have been researched and developed one after another, but most of them ended in failure [17]. Drug therapy usually does not reverse the pathology of AD, and may have great side effects, especially for the elderly. Recently, more attention has been paid to non-drug intervention to alleviate and improve the pathology of AD [18]. These interventions include invasive and non-invasive stimulation [19]. Among them, common invasive stimulation includes deep brain stimulation [20] and optogenetic [21]. Common non-invasive stimulation includes sensory stimulation, transcranial magnetic stimulation [22], transcranial electrical stimulation [23], such as transcranial direct current stimulation, and transcranial alternating current stimulation [24].

AD patients often experience sensory deterioration faster than normal aging, such as visual impairment [25], olfactory impairment [26], and hearing loss [27, 28]. Sensory loss increases the risk factors of AD in daily life and may result in a decreasing cognitive function [29–31]. Studies have shown that sensory intervention for AD patients, such as music therapy (MT), aromatherapy, visual or auditory stimulation, multisensory stimulation, and virtual reality (VR) training seems to be effective [32]. Many researchers have explored the treatment and nursing benefits of MT, aromatherapy, rhythmic acousto-optic stimulation, VR training, and so on in AD patients. These methods can have a significant effect on improving emotion, memory, and motor ability of AD patients. Among them, MT is a safe and effective treatment method, which can effectively regulate the emotion, agitation, and memory of patients with AD [33]. In 1986, Carol Shively [34] used music for the first time in the treatment of AD patients, which showed singing old or familiar songs helps to stimulate reminiscing. In 1993, Gerdner and Swanson [35] considered that personalized music can improve the agitation of AD patients. Subsequently, more and more studies have been conducted on the use of music in the treatment of AD, and it is believed that music has a positive impact on many aspects of AD patients. Olfactory stimulation is transmitted to limbic system and hypothalamus through the olfactory nerve. Aromatics activate the sympathetic nervous system, improve anxiety and depression symptoms, and improve cognitive ability [36]. Rhythmic auditory or visual stimulation can specifically cause the corresponding electroencephalogram (EEG) rhythmic response, 40 Hz auditory stimulation can be used to induce 40 Hz auditory steady-state response (SSR), the gamma oscillation induced by 40 Hz auditory stimulation is related to cognitive function and language learning and memory ability [37, 38]. Animal studies show that 40 Hz cortical light stimulation can cause changes in neuronal activity, accelerate or inhibit neuronal discharge, change microglia into phagocytic state, and reduce Aβ protein. Aβ protein accumulation in the brain is the pathological manifestation of AD [9]. Singer et al. [39] used non-invasive 40 Hz white light flicker to drive 40 Hz neural activity, which can transform microglia into phagocytic state and reduce Aβ protein. Visual stimulation-induced gamma oscillations can reduce amyloid plaques and phosphorylated tau protein, enhance neuroprotective factors, reduce neuronal damage, and reduce inflammatory reaction of microglia [40]. In 2019, Martorell et al. [41] proposed that 40 Hz sound stimulation improved recognition and spatial memory in 6-month-old 5XFAD mice. And they also indicated that the gamma rhythm caused by multisensory stimulation combined with auditory stimulation and light induction can reduce the level of amyloid protein in hippocampus CA1, auditory cortex, and medial prefrontal cortex of AD mice, and improve the spatial memory ability of 5XFAD and APP/PS1 mice. It may be more effective than using a single sensory approach; this indicates that the brain gamma rhythm can be caused by a variety of sensory stimuli. Although rhythmic sensory stimulation is a new method for the treatment of AD, its effectiveness on cognitive function has been studied for a long time. Therefore, it is promising to use rhythmic sensory stimulation in the treatment of AD patients. Light therapy (LT) plays an important role in the regulate circadian rhythm disorders [42]. Increasing

the lighting time of patients during the day may affect circadian rhythm activities and regulate sleep wake and activity-rest rhythm. Patients with AD are often accompanied by sleep disorders and circadian rhythm disorders, and there is also a close relationship between cognitive impairment and sleep [43]. LT has been proved to be effective on anxiety and sleep-wake rhythm of AD patients. Simply increasing the time of exposure to bright light can improve sleep quality, sleep-wake rhythm, and some negative behaviors of AD patients [44, 45]. Sloane et al. [46] also pointed out that the subjects had a good tolerance to bright light, indicating that bright light therapy (BLT) was safe. In addition, the combination of multiple sensory stimuli seems to have an effect on AD patients [47]. Previous studies have provided a good living environment for AD patients, aiming to reduce anxiety, improve happiness, improve their quality of life, and reduce the burden of nursing, such as Snoezelen room and healing garden [48–51], also used a combination of sensory stimulation. VR has a super strong simulation system, because it has the perception function of human beings, such as vision, hearing, touch, taste, smell, and other sensing systems [52], and provides participants with a virtual multisensory training environment. VR systems can provide online human testing and training, allowing precise control of complex dynamic 3D stimulation demonstrations, and these complex behaviors can be recorded. VR technology can be used to evaluate people's attention, executive function, memory, language, and spatial ability. Various studies have proved the successful combination of VR and medicine, including surgical training, education of patients and medical students, treatment of sensory and motor disorders, treatment of psychological disorders such as anxiety and acrophobia, pain relief, and the treatment of AD and MCI [53, 54]. VR technology is safe and effective for cognitive screening and training. Yeh et al. [55] investigated subjects' subjective feelings about the virtual system in the study of VR technology and head-mounted display. The results show that the system is safe, and the participants are willing to accept and continue to use it.

Sensory based interventions are becoming more and more common in the treatment of dementia and AD. Smith et al. [56] reviewed the effects of sensory based interventions on AD patients, and showed that massage, multi-sensory activities based on occupation and environment, including lighting, gardening, meal time, music, Montessori, animal assisted therapy, dance, and yoga interventions are beneficial to dementia and AD, and there is strong evidence to support the use of massage. Arroyo-Anlló et al. [57] reviewed the effect of sensory stimulation on self-consciousness of AD patients, and showed that familiar smell or music, or the use of a rehabilitation garden can play a positive role in arousing the emotional autobiographical memory of AD patients. Emotional sensory stimulation can be used as a tool to activate the self-consciousness of AD patients, so as to improve the quality of life of patients and caregivers.

Sensory stimulation and multisensory stimulation have the advantages of being non-invasive, easy to achieve, almost no side effects, and low cost, making them a promising treatment for AD. Therefore, this paper reviews the benefits of various sensory stimulation and multisensory stimulation for AD patients, discusses the therapeutic effect of various sensory stimulation and multisensory stimulation on AD patients and to explore the possible mechanisms, so as to provide reference for follow-up studies, and hopes that these sensory stimulation methods can be superimposed in a good way to apply to the daily care of AD and reduce the pain of AD patients.

METHODS

Search strategies

Literature retrieval and analysis were conducted in the databases of Web of Science and PubMed. The key words included single search and combination search of "music therapy", "aromatherapy", "olfactory stimulation", "VR technology", "light stimulation", "light therapy", "Visual stimulation", "Auditory stimulation", "sound stimulation", "rhythmic stimulation", "multisensory stimulation", "Snoezelen room", "healing garden", "dementia", "Alzheimer*", "Alzheimer's disease". Considering the novelty of the research and the latest research progress in this field, the retrieval time is set from 2000 to October 27, 2020.

Inclusion and exclusion criteria

The retrieval results were screened by reading the abstract and full text. Studies were eligible for inclusion if they were original studies exploring the therapeutic application of the relevant research on music therapy, visual stimulation, olfactory stimulation, rhythm stimulation, LT, multisensory stimulation, Snoezelen room, or healing garden on

AD patients. Participants included AD patients, and if participants include a range of disease stages, the severity must be clearly defined and a clear distinction between the degree of cognitive impairment, such as mild, moderate, or severe must also be included.

We excluded review articles, patents, and non-experimental research literature on the effectiveness of sensory stimulation. We also excluded studies that did not include AD patients, or where MCI patients accounted for the majority of participants with only a small number of AD patients, because it would affect the accuracy of the results.

Data extraction

Two reviewers (YH, HQR) independently extracted information from the selected papers. Data items comprised of number and age of participants, methods, paradigm features, and results. In order to further illustrate the level of evidence, we classified all the included studies according to evidence-based medicine [58]. The classification level is as follows (reliability decreases in turn): evidence level I: systematic review, or meta-analysis of relevant quality randomized controlled; evidence level II: Randomized controlled trials with sufficient sample size; evidence level III: Study with a control group but not randomized; evidence level I: A series of uncontrolled studies, its reliability is lower than that of level II and III. Because our inclusion criteria did not include review or meta-analysis, the level of evidence was mainly II $\sim$ IV. In the next two sections, data is analyzed qualitatively, and following is a discussion of the possible mechanisms.

RESULT

A total of 1,687 articles were retrieved, and after duplicates were removed, there were 1,531 records. By reading the titles and abstracts, some reviews and mechanisms studies were excluded, leaving 376 articles. After full-text review, 45 articles were included in the analysis. Among them, there are 6 level II studies and 15 level III studies related to MT, 2 level II studies and 5 level III studies related to olfactory therapy, 1 level II study and 1 level III study related to rhythmic stimulation, 5 level II studies and 5 level III studies related to LT, 3 level III studies related to multisensory stimulation, 1 level II study related to VR treatment, and 1 level II study combining MT and VR treatment. A systematic analysis of this literature was concluded. In order to facilitate comparative analysis, the research articles were sorted out and compared to analyze the mode, type, treatment scheme and effects, after effect, and evidence level, as shown in Tables 1–6. Table 1 lists the application of MT in the treatment of AD, Table 2 lists the application of aromatherapy in the treatment of AD, Table 3 lists the application of rhythmic sound and light stimulation in AD patients, Table 4 lists the application of LT in AD patients, Table 5 lists the application of multisensory stimulation for AD patients, and Table 6 lists the application of VR technology or combine VR training in the treatment of dementia.

Music therapy for AD

Parameters of MT

The means of MT include active treatment and passive treatment. Active therapy means active participation in music creation, humming, hitting musical instruments, and rhythm; passive therapy means passively listening to music. In 1994, Brotons et al. [59] explored AD patients' preferences for five kinds of music activities for the first time. Twenty participants were grouped into five groups to participate in five kinds of music activities: singing, playing musical instruments, dancing/moving with music, playing music games, and composing/improvisation. The results showed that AD patients had the highest participation in playing musical instruments, followed by singing and dancing, which indicated that playing musical instruments was a better kind of musical activity for use in the intervention of AD. Sakamoto et al. [60] compared the effects of interactive music interaction, passive music intervention, and non-music on the behavior and psychology of patients with severe AD; the results showed that both interactive and passive MT had an impact on the emotion and stress of patients with AD, with the interactive intervention having the greatest effect on improving the emotional state of patients with AD.

Music has emotion, and it can be cheerful, sad, soothing, or passionate. Different types of music stimulation have different effects on AD patients. Study by Meilan Garcia et al. [61] has shown that emotional music can evoke memories in patients with AD. Some researchers also believe that classical "relaxing" music or personalized music has certain therapeutic effects on AD patients. Arroyo-Anllo et al. [62] showed that when compared with unfamiliar music, using familiar music can improve the self-awareness of AD patients more effectively. The study of Jihui et al. [63] also showed that

Table 1
Application of MT in the treatment of AD

First author year [ref]	Study design	Subjects		Main tasks	Music types	Style of music therapy	Duration	After effect	Evidence level	Outcome measures	Outcome
		Experimental group N (M:F), age (mean y), MMSE, education level (mean y)	Control group N, age (mean y), MMSE, education level (mean y)								
Witter 2020 [81]	Pre–post contrast	11 (8:3), 77	/	Gait training	Rhythmic music	Listen	4 weeks	/	III	Walking speed, cadence, stride length, double limb support duration, and gait variability	Music-cued gait training can help to reduce the rate of decline in gait stride length and speed with AD.
Särkämö 2014 [79]	Randomized, contrast	SG: $n=27$ (11:16), 78.5 ± 10.4, CDR: 1.0 ± 0.6, 3.0 ± 1.7; MLG: $n=29$ (3:26), 79.4 ± 10.1, CDR: 1.6 ± 0.5, 2.8 ± 2.0	SG: $n=28$ (10:18), 78.4 ± 11.6, CDR: 1.1 ± 0.5, 3.0 ± 1.7	Cognition, memory, emotions, executive function, quality of life	traditional folk songs, popular songs	Listen, Sing	10 weeks		II	CBS, QOL-AD	Singing and music listening improved mood, memory, attention, executive function and general cognition, whereas music listening had a positive effect on quality of life.
Arroyo-Anllo 2013 [62]	Contrast	20 (18:2), 74.38 ± 3.56, 19.30 ± 3.68, 3.32 ± 0.41	20 (19:1), 75.15 ± 4.23, 19.90 ± 2.93, 3.25 ± 0.6	Impact of familiar music on SC in patients with AD	Familiar songs, Non-familiar songs	Listen	3 months	/	II	SC scores	Familiar music stimulation could enhancer of SC in patients with AD.
Svansdottir 2006 [66]	Contrast	20	18	BEHAVE-AD	Familiar music	Listen, Sing, Dance	6 weeks	4 weeks	II	BEHAVE-AD scores	There was a significant reduction in activity disturbances in the music therapy group.
Suzuki 2007 [67]	Contrast	8 (1:7), 89.50 ± 4.45, 15.75 ± 5.65	8, 82.75 ± 7.70, 15.50 ± 6.39	Gottfries-Brane-Steen Scale, BEHAVE-AD	Familiar nursery rhymes and songs	Listen	3 months	1 month	III	MMSE, GBS, BEHAVE-AD scores	MT can reduce the anxiety level of AD patients and affect the GBS and BEHAVE-AD Scales.
Guetin 2009 [65]	Single-center, comparative, controlled, randomized study	15 (2:13), 85.28 ± 6, 19.88 ± 4.4	15 (6:9), 86.98 ± 5.2, 20.78 ± 3.4	Anxiety level, depression score	Preference music	Listen	24 weeks	8 weeks	II	Hamilton Scale, Geriatric Depression Scale	Significant improvements in anxiety and depression in the music therapy group.
Rubbi 2016 [76]	Pre–post contrast	21 (8:13), 81.1 ± 9.1	/	Quality of life, MMSE	Folk music	Video-music therapy	12 sessions	/	III	QOL-AD, MMSE	VMT improves the quality of life of patients with less severe AD.
Meilán García 2012 [61]	Pre–post contrast	25, 80.68 ± 5.79, 14.6 ± 8.31	/	Autobiographic memories	HM, SM, NS, CS, NM	Listen	30 min/time	/	III	Autobiographic memory questionnaire	The factors that evoke memory are not music itself, but emotions associated with it.
Sakamoto 2013 [60]	Random, blind	Interactive group: 13 (2:11), 81.2 ± 7.5, 4.6 ± 3.5; Passive group: 13 (10:3), 81.1 ± 11.0, 4.7 ± 4.8	13 (2:11), 81 ± 8.1, 4.7 ± 3.9	Emotional response and stress levels	Individualized music	Listen, clap, sing, dance	10 weeks (30 min/week)	3 weeks	II	BPSD, MMSE	Music intervention can reduce stress with severe dementia, with interactive interventions exhibiting the strongest beneficial effects.
Ray 2017 [68]	Pre–post contrast	132 (20:112), 86.9 ± 7.29	/	Depression, agitation, wandering	Individualized and preferences music	Listen, movement, sing, tonal activities	2 weeks	2 weeks	III	CSD, AWS, CMAI, FAST	After two weeks of MT, symptoms of depression and agitation were significantly reduced; but no change for wandering.
Lancioni 2019 [70]	Pre–post contrast	20 (5:15); Mean age = 82; MMSE: 7∼13	/	Hand responses and positive engagement	Preference	Listen	2-4 times a day	/	III	Hand responses and positive engagement	MT program can develop music-related responses and positive engagement.

(Continued)

Table 1
(Continued)

First author year [ref]	Study design	Subjects		Main tasks	Music types	Style of music therapy	Duration	After effect	Evidence level	Outcome measures	Outcome
		Experimental group N (M:F), age (mean y), MMSE, education level (mean y)	Control group N, age (mean y), MMSE, education level (mean y)								
Lancioni 2012, 2013 [72–74]	Pre–post contrast	Study 1: $n = 7$, Mean age = 81; Study 2: $n = 10$, Mean age = 80; Study 3: $n = 6$, Mean age = 81, Severe AD	/	Positive participation	Preference music	Listen	3-7 sessions/ day	/	III	Singing or music-related (rhythmic) movements of hands, feet, or body	Music stimulation can increase the indices of positive participation of patients in a severe or low moderate stage of AD.
Ziv 2007 [71]	Self-contrast	28 (3:25), 82.6 ± 4.89, MMSE < 11	/	Positive social behaviors and negative behaviors	Familiar background music	Listen	3 weeks	/	III	Positive behaviors, agitation and aggression behaviors	After MT, the positive social behaviors of the participants increased, and the negative behaviors related to anxiety decreased.
Fraile 2019 [80]	Crossover study	6 (1:5),83.16 ± 8.25, MMSE: 21.66 ± 2.86	6 (4:2), 84.50 ± 6.75, MMSE: 21.66 ± 3.67	Autobiographic memories	Individualized music	Sing	5 weeks	/	III	Cued recall, fluency, Total EFCL, Verbal EFCL, Memory EFCL, Executive Processes, EFCL scores	Personalized song had a beneficial impact on the autobiographical memory abilities of AD patients.
Irish 2006 [78]	Contrast, self-contrast	10 (6:4), 76.3 ± 7.484, 21.6 ± 3.718, 9.5 ± 1.509	10 (5:5), 76.5 ± 5.191, 28 ± 1.944, 21.683.718	Overall level of cognitive functioning, anxiety, autobiographical memory	Vivaldi's 'Four Seasons'	Listen	45 min	/	III	MMSE, State Trait Anxiety Inventory, AMI	A significant reduction in state anxiety was found on the State Trait Anxiety Inventory in the music condition
Jihui 2018 [63]	Contrast	MT group: $n = 97$, 68.9 ± 7.1, 13.45 ± 3.66, 6.70 ± 3.01	Lyrics controlled therapy group: $n = 96$, 70.3 ± 8.3, 13.12 ± 3.71, 6.82 ± 3.13; Control group: $n = 95$, 69.9 ± 7.9, 13.22 ± 4.01, 6.71 ± 2.89	Language function, cognitive function and mental well-being	Familiar and favorite songs	Listen, sing	6 months	3 months	II	MMSE, NPI, ADL Assessment	MT can improve the memory and language ability of patients with mild AD and can reduce the mental symptoms of patients with advanced AD and the pain of their caregivers.
Suzuki 2004 [69]	Contrast	10 (4:6), 82.00 ± 8.42, 11.60 ± 6.6	13 (4:9), 85.23 ± 4.19, 9.15 ± 7.09	Endocrine, behavioral, functional	Old Japanese songs	Sing, play musical instrument	8 weeks	/	III	MMSE, N-ADL, NM scale, MOSES, Salivary CgA	According to MOSES scores, after MT, the patient's 'irritability' level decreased significantly.
Dassa 2014 [75]	Pre–post contrast	6 (2:4), Age 65∼83, MMSE 7∼20	/	Conversation	Familiar songs	Sing, played guitar	1 month	/	III	Conversation related to the songs; conversation related to the activity of group singing	Singing familiar songs helped to encourage conversation among people with AD in moderate to late stage.
Amelia Gulliver, 2019 [77]	Pre-post contrast	19	/	Quality of life, well-being and depressive	Familiar music	Listen, Singing	8 weeks (60 min/week)	/	III	Cornell Scale for depression in dementia	MEP can enhance the mental health and well-being of AD

AD, Alzheimer's disease; MMSE, Mini-Mental State Examination; SG, singing group; MLG, music listening group; CG, control group; CDR, Clinical Dementia Rating; CBS, Cornell-Brown Scale; QOL-AD, Quality of Life in Alzheimer's Disease; SC, self-consciousness; BEHAVE-AD, Behavior Pathology in Alzheimer's Disease Rating Scale; GBS, Gottfries–Brane–Steen Scale; QOL-AD, Quality of Life in Alzheimer's Disease Scale; VMT, video-music therapy; HM, SM, NS, CS, and NM, happy music, sad music, no sound, coffee shop sound, and new music; MEP, Music Engagement Program; BPSD, behavioral and psychological symptoms of dementia; CSD, Cornell Scale for Depression; AWS, Algase Wandering Scale; CMAI, Cohen Mansfield Agitation Inventory; FAST, Functional Assessment Screening Test; DBRS, Disruptive Behavior Rating Scales; AMI, Autobiographical Memory Interview; ADAS, Alzheimer's Disease Assessment Scale cognitive test; ADL, Katz Index Independence in Activities of Daily Living; OLST, One leg standing balance test; NPI, Neuropsychiatric Inventory; NM scale, N type Mental States Scale and N type Activities of Daily Living; N-ADL, N type Activities of Daily Living; MOSES, the Multidimensional Observation Scale For Elderly Subjects; CgA, chromogranin A.

Table 2
Application of VR technology in the treatment of AD

First author year [ref]	Study design	Subjects		Main tasks	Virtual simulation	Duration	Evidence level	Outcome measures	Outcome
		Experimental group N (M:F), age (mean y), education level (mean y), MMSE or Cognitive level.	Control group N (M:F), age (mean y), education level (mean y), MMSE or Cognitive level.						
Lee 2016 [109]	Contrast	15 (10:5), 63.8 ± 10.2, MMSE: 22.7 ± 1.5	15 (8:7), 65.5 ± 8.1, 22.6 ± 1.4	Using the Nintendo Wii console in improving balance, emotion, and quality of life among patients with cognitive decline.	Nintendo Wii console	12 weeks	II	BBS, GDS-K, KQOL-AD	VR-training program could improve balance, depression, and quality of life in patients with cognitive decline.

MMSE, Mini-Mental State Examination; BBS, The Berg Balance Scale; GDS-K, The short form geriatric depression scale-Korean; KQOL-AD, the Korean version of quality of life-Alzheimer's disease.

familiar or preferred music of AD patients can effectively improve their memory and language ability. Pleasant music can enhance the energy of EEG, especially the β and α frequencies in right frontal and temporal lobes [64]. It can be seen that different types of music have different effects on AD patients. When designing experiments or conducting treatment, music should be selected according to the needs of each AD patient. If it is necessary to improve the emotion of AD patients, music with emotion should be selected, while to arouse the memory of AD patients, music with familiar or preferred by patients should be selected.

Effect of MT on emotion and psychobehavioral symptoms of AD patients

AD patients will have early temperament changes, such as indifference, depression, anxiety, and irritability; these symptoms are easily ignored, leading to the gradual aggravation of the disease. Research shows that MT can improve the emotion of AD patients. Guétin et al. [65] studied the effect of MT on anxiety and depression in mild to moderate AD patients. After twenty-four weeks of treatment, the anxiety and depression symptoms of AD patients in the treatment group were significantly improved, and the aftereffect lasted for eight weeks. Svansdottir et al. [66] performed MT on thirty-eight patients with moderate and severe AD for six weeks. They found that the aggression and anxiety of AD patients in the MT group were significantly reduced, and there was a four-week aftereffect. Suzuki et al. [67] performed music therapy for AD patients for three months, and the anxiety of the patients was significantly improved after treatment, which may last for one month. Ray et al. [68] studied the effect of MT on depression and agitation symptoms of AD patients. After two weeks of MT, the depression and agitation symptoms of AD patients were significantly reduced, and there was a two-week aftereffect. Suzuki et al. [69] performed MT for ten weeks with ten AD patients. According to the results of Multidimensional Observation Scale for Elderly Subjects (MOSES), the score of irritability decreased significantly, indicating that MT can reduce the level of irritability in AD patients. The above studies show that MT has a positive effect on the emotional improvement of patients with AD and has a certain aftereffect. The duration of the aftereffect may be related to the treatment time.

MT can also improve the psychological symptoms of AD patients, that is, they are more willing to socialize and show some positive behaviors. Lancioni

Table 3
Application of aromatherapy in the treatment of AD

First author year [ref]	Study design	Subjects		Main tasks	Olfactory stimulation	Duration	After effect	Evidence level	Outcome measures	Outcome
		Experimental group N (M:F), age (mean y), education level (mean y), OSIT-J score	Control group N, age (mean y), education level (mean y), OSIT-J score							
Takahashi 2019 [36]	Control	19 (7:12), 76.2 ± 9.8, 9.7 ± 1.6, 10 ± 1.1	17 (7:10), 75.8 ± 7.8, 9.6 ± 2.4, 11 ± 1.2	Cognitive function, behavioral and psychological symptoms	Cedar fragrance	8 weeks	/	II	NPI, J-ZBI, ADAS-cog	Cedar fragrance improved BPSD in AD and may reduce the burden of nursing care.
Glachet 2020 [89]	Control	24 (6:18), 85.12 ± 5.68, 9.88 ± 2.09, MMSE: 20.29 ± 2.58	25 (4:21), 84 ± 8.5, 9.12 ± 1.99, MMSE: 27.44 ± 1.89,	General cognitive efficiency, episodic memory, working memory, depression	Lemon, orange, grass, cinnamon, chocolate, coffee, coconut, peach.	2 sessions	/	III	MMSE, TEMPau scale, SAM	Odor exposure has positive effect on the ability of AD patients to produce past and future events.
Glachet 2019 [91]	Control	25 (22:3), 82.04 ± 7.34, 10.36 ± 2.55, MMSE: 19.32 ± 3.68	23 (18:5), 80.91 ± 9.87, 10.78 ± 2.63, MMSE: 27.78 ± 1.41	general cognitive efficiency, episodic memory, depression	cinnamon	2 sessions	/	III	MMSE, Grober and Buschke	Compared with the odorless condition, the arousal, subjective revisit and more positive memories after odor exposure were higher, and these differences were only observed in AD participants.
Glachet 2018 [90]	Control	25 (7:18), 73.32 ± 6.86, 8.64 ± 2.84, moderate AD	27 (8:19), 71.56 ± 8.13, 9.26 ± 2.34,	Autobiographical memories	Chocolate fragrance	2 sessions	/	III	MMSE, Grober and Buschke	Compared to memories evoked without odors, olfactory-evoked autobiographical memories were more specific and accompanied by more subjective experience of reviviscence in AD patients.
Jimbo 2009 [86]	Crossover Control	17 (2:15), 86.3 ± 6.4, AD	11 (0:11), 84.5 ± 8.3, VaD and others	Cognitive function	Rosemary and lemon essential oils, lavender and orange	28 days	/	III	GBSS-J scale, HDS-R, TDAS	Aromatherapy improved cognition and is an efficacious non-pharmacological therapy for dementia.
Takeda 2017 [92]	Pre-post control	19 (10:9), 80.7 ± 9.1, MMS:6.0 ± 6.5	/	Sleep disturbance	True lavender; true lavender and sweet orange oil blend; Japanese cypress, Virginian cedarwood, cypress, and pine oil blend	20 days	/	III	Sleep latency, total sleep time, sleep efficacy, duration of the longest sustained sleep period, wake time after sleep onset, early morning awakening, total daytime sleep, NPI	Inhalation aromatherapy has a positive effect on sleep disorders in patients with AD.
Fujii 2008 [93]	Control	14 (5:9), 77 ± 10, MMSE:9 ± 8	14 (4:10), 80 ± 11, MMSE:8 ± 7	Behavioral and psychological symptoms	Lavender aroma	3 months	/	II	NPI, MMSE, Barthel Index	Lavender aroma therapy is useful to subside BPSD in dementia patients via the olfactory sensory system.

NPI, Neuropsychiatric Inventory; J-ZBI, the Japanese version of Zarit Caregiver Burden interview; ADAS-cog, Alzheimer's Disease Assessment Scale-cognitive subscale; MMSE, Mini-Mental State Examination; BPSD, behavioral and psychological symptoms of dementia; TDAS, Touch Panel-type Dementia Assessment Scale; TEMPau scale, Test Episodic de Mémoire du Passe; SAM, Self-Assessment manikin; OSIT-J, Odour Stick Identification Test for Japanese; PSQI-J, Pittsburgh Sleep Quality Index; PAS, Pittsburgh Agitation Scale; CMAI, Cohen-Mansfield Agitation Inventory; VaD, vascular dementia; GBSS-J scale, the Japanese version of the Gottfries, Brane, Steen (GBS) Scale; HDS-R, the revised version of Hasegawa's dementia scale; ADAS, Alzheimer disease Assessment Scale.

Table 4
Application of rhythmic stimulation in AD (clinical research)

First author year [ref]	Study design	Subjects		Stimulus mode	Stimulus parameters	Main tasks	Duration	After effect	Evidence level	Outcome measures	Outcome
		Experimental group	Control group								
		Patients: N (M:F), age (mean y), MMSE, education level (mean y)									
Clements-Cortes 2016 [98]	Cross-over pilot study	Mild AD: N = 6 (4:2); Moderate AD: N = 6 (3:3); Severe AD: *N* = 6(3:3), Age range:59-93, MMSE range:9-23		Visual + auditory stimulation	Experimental group: 40 Hz sound + DVD; Control group: DVD + 40 Hz sound	Alertness, cognition, short-term memory	13 sessions	/	II	SLUMS, Observed Emotion Rating Scale, Researcher Observation	40 Hz treatment may have on improving mental function as measured by SLUMS in persons with AD, while DVD were not.
van Deursen 2011 [99]	Contrast	AD: N = 15,75.2 ± 6.9, 20.8 ± 2.7; MC: N = 20, 70.6 ± 7.2, 26.3 ± 1.6	HE: N = 20, 69.1 ± 6.1, 29.3 ± 0.8	Auditory click trains	Auditory 40 Hz stimulation	To evaluate test–retest reliability (TRR)	2 sessions	/	III	TRR, 40 Hz steady state response	A high TRR and a significant increase of 40 Hz SSR power in the AD group compared to MCI and controls.40 Hz SSR can reliably be used to measure disease progression.

AD, Alzheimer's disease; MCI, mild cognitive impairment; HE, healthy elderly; SLUMS, Saint Louis University Mental Status; TRR, test–retest reliability; SSR, steady state response.

et al. [70] studied the hand movement of patients with severe AD during MT and their active participation in the process of treatment, such as singing or shaking with the music. The results show significant differences between the average hand reaction and active participation data of patients before and after music intervention. The social behaviors of AD patients have also changed. Positive social behaviors include trying to contact, talking, smiling, trying to calm another patient, humming, drumming with hands/feet to the rhythm of music, shaking the body with the rhythm of music, shaking hands, touching, etc. Negative behaviors include showing excitement and aggression. Ziv et al. [71] studied the influence of music on social behavior of AD patients. The results showed that when music was playing, AD patients showed more positive behaviors (such as talking, smiling, or moving with rhythm) and less negative behaviors (such as walking, sitting uneasy, and showing aggression to others). Lancioni et al. [72–74] designed experiments to explore the effects of active and passive music on positive participation of patients with moderate and severe AD; results showed that active music stimulation increased the positive participation index (such as singing, music related actions, or smiling). Dassa et al. [75] used familiar music to treat AD patients for one month and encouraged them to participate in singing songs. After singing, the patients expressed positive emotions, sense of achievement, and belonging.

Rubbi et al. [76] showed that Video-MT was a valuable tool for improving the quality of life in patients affected by less severe neurocognitive impairment. Gulliver et al. [77] evaluated the effectiveness of music in terms of quality of life, well-being, and depressive symptoms in AD patients, indicating that MT can enhancing the mental health and well-being of AD patients.

Effect of MT on memory of patients with AD

A major feature of AD is progressive loss of memory; patients gradually forget previous memories of their lives and their relatives. Irish et al. [78] studied the effect music has on autobiographical memory in ten patients with mild AD; patients were interviewed under two conditions of music playing and no music. The results showed that the recall ability of patients in the autobiographical memory interview was greatly improved under the condition of music playing, which indicated that MT could improve the autobiographical memory of patients. Meilán García et al. [61] analyzed the recall of autobiographical

Table 5
Light therapy for Alzheimer's disease

First author year [ref]	Study design	Subjects		Stimulus parameters	Main tasks	Duration	After effect	Evidence level	Outcome measures	Outcome
		Experimental group	Control group							
		Patients: N (M:F), age (mean y), MMSE, education level (mean y)								
van Hoof 2009 [106]	Contrast	16 (12:4), (AD: 10, VaD: 5, MX: 1), 86.3 ± 7.6	10 (7:3), (AD: 6, VD: 1, MX: 3), 84.4 ± 5.7	High-intensity light stimulation. Bluish (6500 K) and yellowish (2700 K) light	Apathic behavior, disturbances of consciousness, restless behavior, depressive/sad behavior, and anxious behavior of patients with AD.	4 months	/	III	GIP, tympanic temperature	Bluish light scenario significantly improved restlessness and increased tympanic temperature range in patients with dementia, but the yellowish light scenario did not.
Ancoli-Israel 2002 [100]	Randomized controlled trial	77 (19:58), 85.7 ± 7.3, MMSE: 12.8 ± 8.8		Evening bright light, morning bright light, evening dim red light, and DSR	Nighttime sleep quality, daytime alertness, and circadian activity rhythm parameters.	18 days	/	II	Actillume recorder (to measure sleep/wake activity), EEG.	Morning bright light might delay circadian rhythms and improve circadian rhythm quality in nursing home residents.
Ancoli-Israel 2003 [101]	Randomized controlled trial	92 (29:63), 82.3 ± 7.6, MMSE: 5.7 ± 4.0, 13.8 ± 3.3		Morning bright light (n = 30), morning dim red light (n = 31), evening bright light (n = 31)	Effect of light on sleep and circadian activity rhythms	10 days	5 days	II	Actillume recorder (to measure level of illumination, maximum activity level per min, and mean activity level per min), EEG.	Both morning and evening bright light resulted in more consolidated sleep at night, evening light also increased the quality of the circadian activity rhythm.
Burns 2009 [108]	A single center randomized controlled trial	22 (6:16) (AD: 11, VaD: 7, dementia with Lewy bodies: 3, MX: 1), 84.5 ± 1.7, MMSE: 6.9 ± 5.3	26 (10S:16) (AD: 10, VaD: 9, dementia with Lewy bodies: 3, MX: 4), 82.5 ± 1.5, MMSE: 5.1 ± 5.6	Full spectrum BLT (10000 lux), standard fluorescent tube light (100 lux)	Assess the effects of bright light therapy on agitation and sleep	2 weeks	/	II	MMSE, CSDD, CRBRS, MOUSEPAD and CMAI	There was limited evidence of reduction in agitation in people on active treatment, sleep was improved and a suggestion of greater efficacy in the winter months.
Figueiro 2016 [107]	Pre–post contrast	6 (2:4), 84 ± 8.6, BIMS: 5.3 ± 1.9		60* 120 cm fluorescent light fixtures. Illumination: less than 50 lx at eye level	Personal light exposure and activity levels, Sleep analyses, depression and agitation	4 weeks	4 weeks	III	Daysimeter, PSQI, SCDD CMAI	Light therapy significantly alleviated the symptoms of agitation and depression in AD patients.
Yamadera 2000 [102]	Pre–post contrast	MSD: 17, mean age = 79.9, MMSE: 4.4 ± 2.1	QMD: 17, mean age = 79.9, MMSE: 13.6 ± 3.6	Bright light therapy (3000 Lux; 9–11 am)	Sleep–wake (circadian) rhythm disturbances	4 weeks	/	III	MMSE, circadian rhythm	Bright light therapy improved the circadian rhythm disturbances and then bettered the cognitive state in early-stage ATD.
Dowling 2005 [104]	Randomized, placebo-controlled, clinical trial	46 (10:36), 84 ± 10, MMSE: 6.7 ± 6.8		Morning bright light therapy (≥2500 lux), control group: (150–200 lux)	Rest–activity (circadian) disruption (nighttime sleep efficiency, sleep time, wake time and number of awakenings and daytime wake time).	12 weeks	/	III	Actigraphy	Only subjects with the most impaired rest–activity rhythm respond significantly and positively to a brief (1 h) bright light intervention.
Dowling 2007 [105]	A randomized clinical trial	70 (13:57), 84 ± 10, MMSE: 7 ± 7 MBL: n = 29, afternoon bright light: n = 24	n = 17	Morning or afternoon bright light (10000lux), and usual indoor light (150-200 lux)	agitation/ aggression, depression/ dysphoria and aberrant motor behavior.	10 weeks	/	II	NPI-NH	Morning or afternoon bright light can improve agitation/ aggression and depression/ dysphoria in AD patients.
Skjerve 2004 [103]	Pre–post contrast	10 (6:3) (severe dementia: AD: 7, VaD: 3), average age: 79.40		Bright light treatment, illumination: 5000–8000 lux.	Behavioral symptoms and sleep–wake disturbances.	4 weeks	2 weeks	II	CMAI, BEHAVE-AD, SWD, and wrist-worn actigraphy (Actiwatch).	Short-time bright light therapy can improve the behavioral symptoms and aspects of activity rhythm disturbances in patients with severe AD.
Sloane 2007 [46]	A cluster-unit crossover interven-tion trial	66 (35:31), mild to moderate: 21, severe: 31, very severe: 14		Morning bright light (2,495 ± 179 lux), evening bright light, all-day bright light, and minimum standard light (599 ± 53 lux)	Sleeping patterns and circadian rhythms.	3 weeks	/	III	Wrist actigraphy, daytime observations, and MMSE.	Night-time sleep increased significantly in participants exposed to morning and all-day light, with the increase most prominent in participants with severe or very severe dementia.

GIP, The Dutch Behaviour Observation Scale for Intramural Psychogeriatrics (Gedragsobservatieschaal voor de Intramurale Psychogeriatrie); MMSE, Mini-Mental State Examination; BLT, Bright light therapy; DSR, daytime sleep restriction; CSDD, Cornell Scale for Depression in Dementia; CMAI, Cohen-Mansfield Agitation Inventory; CRBRS, Crichton Royal Behavior Rating Scale; MOUSEPAD, Manchester and Oxford Universities Scale for the Psychological Assessment of Dementia; BIMS, Brief Interview for Mental Status; PSQI, Pittsburgh Sleep Quality Index; BEHAVE-AD, Behavior Pathology In Alzheimer's Disease Rating Scale; NPI-NH, The Neuropsychiatric Inventory–Nursing Home; SWD, sleep–wake disturbances in dementia.

Table 6
Application of multisensory stimulation in AD patients

First author year [ref]	Study design	Subjects: Experimental group	Subjects: Control group	Multisensory stimuli	Main tasks	Duration	After effect	Evidence level	Outcome measures	Outcome
		Patients: N (M:F), age (mean y), MMSE, education level (mean y)								
Optale 2010 [110]	contrast	15 (10:5), 78.5 ± 10.9, 5.3 ± 2.4	16 (11:5), 81.6 ± 5, 6 ± 3.5	Auditory stimulation and VR experiences	Can VRMT lessen cognitive decline and improve memory functions.	6 months	/	II	The clinical and neuropsychological evaluation	VRMT significantly improved memory function, especially long-term memory.
Goto 2014 [48]	contrast	Snoezelen group:18 (12:6); garden-viewing group: 18 (13:5); age: 88 ± 4; MMSE < 12.		Multisensory Snoezelen room; Japanese garden.	Responses of individuals with advanced dementia to two novel sensory environments	4 weeks	/	III	Heart rate; Behavioral Assessment Check List	The garden-viewing group showed positive behavioral changes while the responses of the subjects in the Snoezelen group were more negative.
Gueib 2020 [49]	contrast	16 (11:5), 82.1 ± 7.8, 10.2 ± 5.5,	18 (10:8), 82.4 ± 6.2, 12.4 ± 4.8	The Art, Memory and Life garden	Evaluate the impacts of hospitalization and of a specific healing garden on SC	2 weeks	/	III	SCQ, MMSE	In the Art, Memory and Life garden, SC was found significantly improved in the group of patients with ADRD.
Rivasseau Jonveaux 2013 [50]	pre-post contrast	Pre: 20 (11:9), age: 74–96 (85), Post: 14 (8:6), age: 39–92 (81)		Healing garden	Evaluate the effect of healing garden on AD and patients' satisfaction with the garden	15 days	/	III	Patients' satisfaction	Healing garden is effective in promoting communication and improving cognition.

VRMT, VR memory training; SC, self-consciousness; SCQ, the Self-Consciousness Questionnaire.

memory in twenty-five AD patients under different emotional music (happy, sad, lack of emotion) stimulation, noisy sound stimulation, and silent conditions. They found that emotional music, especially sad music, was more effective in arousing long-term memory of AD patients. Särkämö et al. [79] conducted music intervention on patients with dementia for 10 weeks and found that listening to music and singing improved the mood of patients and improved the memory and cognitive ability to a lesser extent, whereas music listening had a positive effect on quality of life. Fraile et al. [80] explored the effects of personalized music on autobiographical memory and cognitive function of AD patients. The results showed that MT has a significant improvement in cued recall, and the executive ability of AD patients', such as linking objects and uses, producing sentences, oral understanding of implicit senses, and solving mathematical problem was significantly improved. Personalized music may be a useful and motivating tool to solve the decline of autobiographical memory and cognitive function in patients with AD.

Effect of MT on motor behavior of AD patients

AD patients are often accompanied with gait disorders, such as decreased balance ability, walking speed, step length, etc. When walking, it is easy to fall down and it can create risk to the lives of AD patients when they go out alone, which is also one of the reasons why AD patients need long-term care from caregivers. Research shows MT can improve the gait of AD patients and increase the active participation of AD patients. Wittwer et al. [81] studied the effect of rhythmic music on the gait of patients with AD, walking speed, step length, duration of bipedal support, and gait variability (coefficient of variation) of AD patients before and after the intervention was quantified. The results showed that after listening to music, the gait variability had no significant change, but walking speed and step length were significantly improved, which indicated that MT was effective in improving the gait of AD patients. Patients with AD are also accompanied by a decrease in their participation and practical ability.

Olfactory stimulation for AD

Application progress of aromatherapy in the treatment of AD

Studies have shown that the olfactory function of AD patients is impaired to varying degrees. In the early stage of AD, degeneration occurred in the

entorhinal hippocampal inferior colliculus complex [82] and especially in the olfactory anterior nucleus, showing many neurofibrillary tangles, the damage of the inner olfactory area, and trans olfactory area effectively cut off the connection between the hippocampus and cerebral cortex. This disturbs the flow factor information necessary for advanced olfactory tasks such as breathing, odor recognition, and odor memory [83]. Odor recognition defects often occur in AD and MCI can be used to predict the transition from MCI to AD [84, 85]. Jimbo et al. [86] treated twenty-eight elderly patients (including seventeen AD patients) with aromatic drugs and observed the curative effect. In the morning, lemon and rose were mixed to activate the sympathetic nervous system to strengthen attention and memory. At night, the fragrance of lavender and orange was used to activate the parasympathetic nervous system to pacify the nerves of patients. After twenty-eight days of control treatment, it was found that aromatherapy had potential to improve cognitive function. It is an effective non drug therapy for dementia, especially for patients with moderate AD. Before and after olfactory stimulation, fMRI data showed significant activation of entorhinal cortex and temporal lobe [87], and medial temporal lobe was related to olfactory function [88].

Aromatherapy improves memory of AD

Olfactory dysfunction is also associated with decreased language learning and memory, and previous studies have shown that olfactory stimulation can improve the memory of AD patients. Glachet et al. [89] studied whether olfactory stimulation can influence memory of past events and imagination of future in AD patients. They treated AD patients with various flavors of sesame oil (lemon, orange, cinnamon, chocolate, coffee, coconut, peach, etc.), and selected the most suitable sesame oil to stimulate each AD patient according to the score of patients' odors, and considered the relationship between the past and the future, the results showed that olfactory stimulation made the memory of past events and imagination of future events more specific and emotional. Two other studies by Glachet et al. [90, 91] also showed that olfactory stimulation has a positive effect on the memory of AD patients. Compared to memories evoked without odors, olfactory-evoked autobiographical memories were more specific and accompanied by more subjective experience of reviviscence in AD patients.

Aromatherapy improves psychobehavioral symptoms of AD

Olfactory stimulation has positive effects on many aspects of AD patients, such as improving agitation symptoms, sleep disorders, behavior, psychology, and so on. The study of Takeda et al. [92] found that inhaled aromatherapy has a positive effect on sleep disorders in AD patients. Takahashi et al. [36] divided thirty-six AD patients without olfactory disturbance into two groups (intervention and the control groups). After eight weeks of treatment, the cognitive function, behavior, and psychological symptoms of AD patients in the treatment group were significantly improved. This indicates that olfactory stimulation can effectively improve the symptoms of AD and may reduce the burden of care. Fujii et al. [93] found that the use of lavender fragrance in the treatment of AD patients can effectively improve the behavioral and psychological symptoms of dementia, and this method is safe.

Rhythmic sensory stimulation for AD

EEG and cognition

EEG signals are very weak, generally 0–75 mV and not more than 100 mV, and is a non-stationary random signal. According to the rhythmic activity of EEG signals, it can be subdivided into five basic rhythms: δ (1–4 Hz), θ (4–8 Hz), α (8–12 Hz), β (15–30 Hz), and γ (30–100 Hz) according to the frequency. Different frequency bands of brain waves reflect the different state of brain activity. Among them, gamma waves are a high frequency band of brain waves, with its frequency range at about 30–100 Hz, especially the 40 Hz gamma wave, which has attracted the attention of researchers [94]. Research shows that gamma waves are related to thought formation, language processing, learning ability, memory, and cognition, and the faster the wave speed, the faster the recall speed [95]. Specific EEG rhythmic oscillations can be caused by specific external rhythmic stimuli and may regulate the sensory integration or cognitive function of the brain [96, 97]. Rhythmic sensory stimulation may be beneficial to patients with neurological disorders and cognitive dysfunction.

Study of rhythmic sensory stimulation in the treatment of AD

Clements Cortes et al. [98] studied the rhythmic sensory stimulation of 40 Hz auditory stimulation and the use of non-rhythmic DVD in patients with

mild to moderate AD. The results showed that 40 Hz auditory stimulation had a great impact on mild to moderate AD patients and improved anxiety level, and also increased cognition. Van Deursen et al. [99] used 40 Hz click sound to stimulate AD patients, MCI patients, and normal controls to study the 40 Hz SSR between AD patients, MCI patients, and normal controls. The study showed that the 40 Hz SSR power of AD group was significantly increased.

Light therapy for patients with AD

LT can regulate sleep rhythm and improve sleep quality of dementia patients. Ancoli-Israel et al. [100] evaluated whether bright light under four different light modes (evening bright light, morning bright light, evening dim red light, and daytime sleep restriction) could improve the nighttime sleep quality, daytime alertness, and circadian activity rhythm of patients with dementia. The results showed that there was no improvement in nighttime sleep quality and daytime alertness in any treatment group, while bright light in the morning might delay the circadian rhythms and improve circadian rhythm quality in nursing home residents. Another study by Ancoli-Israel et al. [101] also showed that morning and evening bright light resulted in more consolidated sleep at night. More consolidated sleep of patients may reduce sleep interruption of caregivers and their worries about patients at night, and patients and caregivers may sleep better. Evening light also increased the quality of the circadian activity rhythm, and it lasted more than five days. Sloane et al. [46] compared the effects of light on the circadian rhythm and sleep patterns of AD patients under four modes, including morning bright light, night bright light, all day bright light, and minimum standard light. The results showed that under morning and all-day light, the nighttime sleep time of patients increased significantly, especially in patients with severe or very severe dementia. It was also pointed out that the subjects had a good tolerance to bright light, indicating that BLT was safe. Yamadera et al. [102] conducted morning BLT for AD patients for four weeks, which showed that BLT can improve the circadian rhythm disorder of early AD patients, and then improve the cognitive status of patients. Skjerve et al. [103] treated ten patients with severe dementia with 45 minutes of bright light (5000–8000 lux) every day for four weeks. The results showed that short-term bright light irradiation improved the behavioral symptoms and activity rhythm disturbances in patients with severe dementia. Dowling et al. [104] compared the effects of morning BLT and ordinary room light on patients, as well as morning and afternoon BLT, which showed that morning BLT had a positive effect on the most impaired rest–activity rhythm of patients with AD.

LT can not only regulate the circadian rhythm of dementia patients but also improve the symptoms of dementia patients' restlessness and depression. The study by Dowling et al. [105] in 2007 also showed that the morning BLT or afternoon bright light improved the association/aggregation, depression/dysphoria, and aberrant motor behavior of AD patients. Van Hoof et al. [106] evaluated the effects of long-term high-intensity bluish light and yellowish light on apathic behavior, disturbances of consciousness, restless behavior, depressive/sad behavior, and anxious behavior of patients with AD. Nighttime sleep quality, daytime alertness, and circadian activity rhythm parameters were evaluated, indicating that high-intensity bluish light irradiation can significantly improve sleep rhythm and restlessness, while yellow light has no such effect. Figueiro et al. [107] also showed that four-week light intervention significantly reduced the depression and agitation scores of patients, and the sleep quality of patients also improved. Four weeks after of intervention, the depression and agitation scores of patients still decreased significantly, indicating that LT has a certain residual effect. Burns et al. [108] used BLT and standard light to treat dementia patients, which showed that BLT had beneficial effects on restlessness, and circadian rhythm of severe cognitive impairment patients.

Multisensory stimulation on AD

Using a specific sensory stimulation alone can improve and treat AD. At the same time, the use of a variety of sensory stimulations can also have a therapeutic effect on AD. The design of Snoezelen room and heating garden, which combines vision, smell, touch, and hearing, may play an important role in the daily care of AD patients. Goto et al. [48] studied the effects of multisensory Snoezelen room and Japanese garden on the behavior of AD patients. The results showed that garden-viewing group had more positive behavior changes, while Snoezelen group showed negative behavior. The garden-viewing group showed positive behavioral changes while the responses of the subjects in the Snoezelen group were more negative. Exposure to a small interior Japanese garden could be an effective intervention for individu-

als suffering from late-stage AD. Rivasseau Jonveaux et al. [50] studied the effects of different smell, color, texture, and sound in healing garden on improving cognitive impairment and psychological behavior of AD patients. The results show that the healing garden can promote interpersonal relationship and communication and improve cognitive ability of AD patients. Gueib et al. [49] also showed that the self-awareness of AD patients was improved in the multisensory healing garden.

VR technology helps to create a multi-sensory, dynamic, and interactive virtual environment, which has greater similarity with real life. Lee et al. [109] used VR technology to conduct game training on patients with dementia to strengthen the physical exercise. By comparing the scores of the Berg Balance Scale, Geriatric Depression Scale-Korean, and the Korean version of the Quality of Life-Alzheimer's Disease scale before and after treatment. Results showed that after VR technology was used to treat cognitive decline patients, the scores of the Berg Balance Scale, emotion, and quality of life were significantly improved. Improving balance to prevent falls is important because it can overcome the limitation of daily activities and improve the quality of life in these patients. MT can restore the emotion of AD patients, combining MT with VR technology can make patients get more attention and achieve good training and treatment effect. Playing quiet music during VR training will help patients better immerse themselves in virtual environment. Optale et al. [110] performed VR visual and auditory training on thirty-six patients. After six months of intervention under the condition of soothing and calm background music, the participants' language ability, cognitive ability, and depression were evaluated. The results showed that VR training significantly improved the cognitive function, speech function and memory ability of the treatment group.

THE MECHANISM OF SENSORY STIMULATION

Mechanism of MT in the treatment of AD

There are fundamental differences between AD patients and healthy elderly people in the coding and retrieval process of musical and non-musical stimuli. AD patients retain good music processing ability and the ability to sing familiar song lyrics [111]. Compared with the brain regions usually related to memory, the brain circuits related to music memory are better preserved in AD. With the aggravation of AD pathology, the hippocampus, frontal lobe, temporal cortex, and anterior cingulate gyrus of AD patients will be damaged in varying degrees, affecting the ability to recognize the emotion of music. By comparing the volume of hippocampus and amygdala in 18 mild AD patients and 18 healthy patients, Philippi et al. [112] indicated that emotional memory impairment is related to the atrophy of right amygdala and hippocampus. However, Gagnon et al. [113] and Drapeau et al. [114] studied the judgment of music emotion between healthy elderly and mild AD patients, and the results showed that there was no difference between the performance of healthy elderly and AD patients; early AD patients still retained the ability to identify the emotion of music.

Music stimulation can activate multiple brain regions and enhance brain plasticity. King et al. [115] shows that after listening to their favorite music, AD patients can activate the supplementary motor area and increase the functional connectivity in the cortex and cerebellar network, which has a short-term impact on brain function. Gordon et al. [116] also shows that after listening to music, most of the brain regions located in the motor system were widely activated, including the primary motor cortex, supplementary motor area, dorsal and ventral premotor area, and parietal lobe area. In addition, music has been shown to induce synchronization of neural network oscillations related to learning and memory [117], such as high-frequency synchronous enhancement of right temporal cortex and low-frequency synchronous enhancement of bilateral temporal lobes and frontal cortex. Some studies have shown that memory is related to such synchronous oscillation of frontal and temporal lobes [118]. Therefore, this synchronous rhythmic oscillation may be the neurophysiological basis of music induced lasting memory.

Music stimulation can cause the release of a variety of chemicals, such as excitatory neurotransmitters, cortisol, testosterone, and estrogen [119], and affect the expression of receptor genes and related proteins related to these substances [120], and potentially change status of AD patients. Estrogen can inhibit the increase and deposition of Aβ protein and prevent nerve cell injury [121]. Dopamine is an excitatory neurotransmitter; the mood changes of AD patients during music stimulation may be accompanied by dopamine. Salimpoor et al. [122] has shown that emotional states induced by pleasant music can lead to dopamine release, combined with PET scanning and fMRI technology, dynamic information about

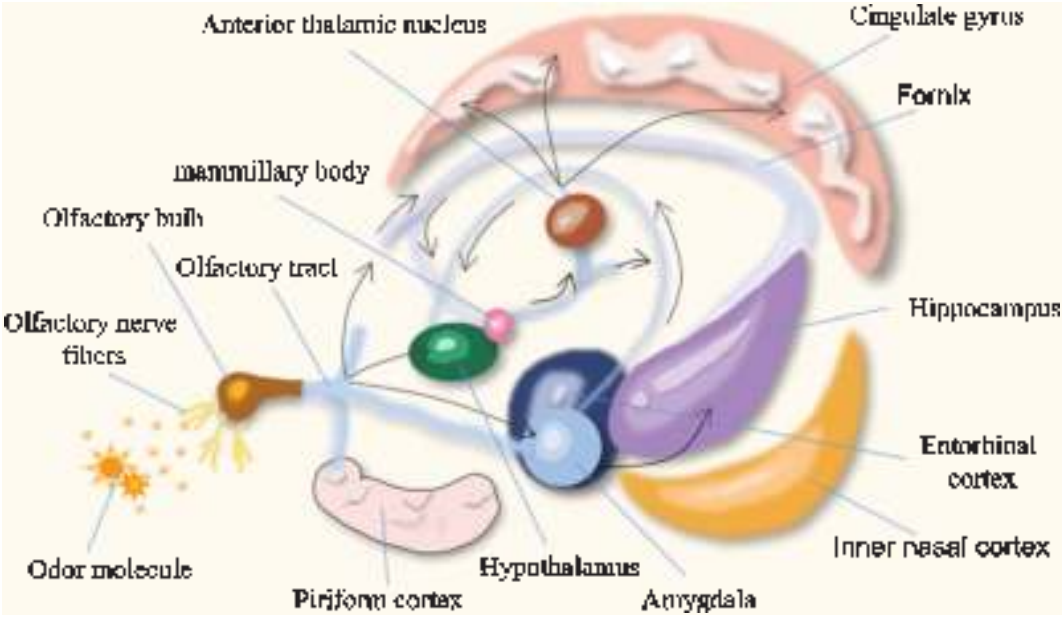

Fig. 1. Olfactory projection pathway.

dopamine release over time was obtained. It was found that dopamine release was most active in the midbrain limbic system including dorsal and ventral striatum under pleasant music stimulation. Through fMRI, Koelsch et al. [123] found that under music stimulation, some brain regions related to emotion, such as amygdala, hippocampus, parahippocampal gyrus, and ventral striatum, were significantly activated. On the contrary, when using sad and unpleasant music stimulation, the risk-taking behavior of participants increased significantly, which indicated that these structures had emotional responses to both pleasant and unpleasant auditory information, and music had the ability to upregulate and downregulate the neuronal activities in these structures. At the same time, it also shows that music memory may be related to emotion [124]. The decrease of anxiety level caused by music is the potential mechanism of music stimulation enhancing autobiographical memory [78].

Mechanism of aromatherapy in the treatment of AD

Aromatic essential oils have neuroprotective effects, which can reduce the toxic effect of Aβ on the brain and is an effective tool to alleviate neurological dysfunction [125]. There are many interconnected brain regions in the entorhinal cortex, hippocampus, amygdala, peripheral cortex, olfactory bulb, and piriform cortex, which are directly involved in olfactory memory process [126] and are activated during olfactory stimulation. FMRI showed that odor stimulation significantly activated amygdala and hippocampus; the hippocampus is related to memory function. The amygdala in the limbic system is also an important brain area involved in emotion regulation and memory. Another study showed that olfactory cue memory activated limbic system and temporal lobe, such as the middle temporal gyrus, bilateral activities of superior temporal gyrus and temporal parietal cortex, and marginal lobes such as anterior entorhinal cortex, parahippocampal gyrus and right insular lobe were activated [127] (Fig. 1 shows the olfactory activation pathway). Therefore, odor can be used as a powerful tool to evoke memories and can be used to evoke memory in AD patients [90]. Familiar or specific odors may evoke people's memories intentionally or unintentionally. However, these memories are likely to be involuntary. El Haj [128] and Glachet et al. [91] found that when compared with the blank control group, odor and music can induce more specific, emotional experiences and faster induction of memory, indicating that odor can be used as a clue to evoke memory. The beneficial effects of odor exposure and MT on autobiographical characteristics were similar, but for retrieval time, odor exposure was more improved. Research by Herz et al. [129] also showed

that odor stimulation on AD patients can stimulate more emotional memory. These results indicate that smell is a powerful clue to retrieve autobiographical memory. This involuntary autobiographical memory of AD patients has little connection with cognitive control and is easy to be aroused.

Neural oscillations of sensory stimulation

When a person receives a specific external stimulus, the EEG signals will also keep pace with the frequency of external stimulus. When a person is stimulated by a continuous external stimulus such as frequency flash, the EEG signals collected from the cerebral cortex keeps pace with the frequency of the flash stimulation. Recent studies have shown that gamma entrainments are related to cognition, that is, the 40 Hz EEG segment is a specific event-related potential, and the research on sensory stimulation is also devoted to inducing 40 Hz gamma entrainment. Jones et al. [130] analyzed the 40 Hz gamma response induced by 40 Hz, 60 Hz, and 80 Hz light stimulation by quantitative electroencephalogram. The results showed that the average response of 40 Hz light stimulation was the largest; 40 Hz light stimulation might induce extensive entrainment. Martorell et al. [41] has proposed that under the tone of 8 Hz, 20 Hz, 40 Hz, 80 Hz, or random tone stimulation, the 40 Hz tone stimulation can significantly improve the cognitive level of AD mice, and significantly reduce the number and size of plaques in the brain. Similarly, Singer et al. [39] treated the visual cortex of AD mice with 20 Hz, 40 Hz, 80 Hz, and random sequence light scintillation. Under the same conditions, only 40 Hz light stimulation could reduce the level of amyloid protein. The use of sensory stimulation can also enhance brain plasticity. Studies have shown that non-invasive flash visual stimulation shows significant frontal parietal gamma coherence [131]. In all gamma entrainment, the response of AD patients to visual sensory and cognitive stimuli will increase gamma consistency. Therefore, gamma oscillations seem to be the basic function of the brain at the sensory and cognitive levels.

DISCUSSION

Senile dementia is one of the main issues affecting the quality of life of the elderly, especially AD, which is the main type of dementia. Since the process of AD is irreversible, various studies have been carried out all over the world to seek effective methods for the treatment of AD. In this paper, from the perspective of sensory and multisensory stimulation for AD, the effects and mechanisms of MT, VR, aromatherapy, rhythmic stimulation, and multisensory stimulation in the treatment of AD were discussed. Among them, strong evidence supports the effectiveness of MT in improving the autobiographical memory, behavior, and emotion of AD patients. Two level II studies and five level III studies support the value of aromatherapy in AD. By activating the central and peripheral nervous system, aromatherapy can improve the agitation symptoms, sleep disorders, behavior, and psychology of AD patients, and also has a positive impact on learning ability and memory ability. There is only limited evidence supporting that rhythmic stimulation can specifically induce gamma oscillations, enhance brain plasticity, and improve the memory ability of AD patients. Animal studies have also shown that rhythmic stimulation can cause changes in glial cells, accelerate or inhibit neuronal discharge, and reduce Aβ and plaque deposition to alleviate AD process. There is strong evidence to support the effectiveness of LT-based interventions in the treatment of AD. LT can regulate the circadian rhythm of dementia patients, improve their sleep quality, and improve their cognition and quality of life. The Snoezelen Room and Healing Garden for the treatment of AD by multisensory stimulation is currently developed for AD patients through environmental enrichment. Three level III studies supported the effectiveness of multi-sensory therapy for AD. There is only limited evidence indicate that cognitive training with VR technology can improve the spatial memory and behavioral ability of AD patients.

MT is non-invasive, ubiquitous, and accessible. Therefore, if music can be used in medical treatment or nursing, the application prospect of this safe and cheap treatment method is unlimited. However, MT may need to be guided by professional music therapists to get good therapeutic effect.

The olfactory function of AD patients is impaired due to different degrees of peripheral and central nervous system damage, which often occurs in the early stage of the disease [132]. Therefore, olfactory tests can be used as one of the clinical diagnostic methods. It was found that the coherence of spontaneous activities of the two olfactory bulbs in AD mice were significantly reduced in each wave band of the brain. However, the coherence of β-band was significantly reduced only when the olfactory bulb was stimulated by odor. The local field potential inconsistency of olfactory bulb caused by odor is also a problem

worthy of attention [133]. In addition, olfactory disorders have a great impact on cognition, memory, and emotion, and it has been proved that aromatherapy plays an important role in improving the symptoms and cognitive function of AD. Aromatherapy is simple to implement and easily accepted by patients.

Neural oscillations are closely related to memory: temporal cortex θ-γ phase amplitude coupling and frontotemporal cortex θ phase synchronization are related to working memory. Desynchrony of frontotemporal θ phase in AD or elderly patients will lead to working memory defects [118]. The decrease of cortical functional connectivity may be one of the causes of cognitive dysfunction in AD. At present, there are many non-drug intervention methods that can cause the synchronous response of EEG rhythm and change the neural plasticity of functional connection, thus producing direct and lasting effects, such as transcranial magnetic stimulation, transcranial direct current stimulation, transcranial alternating current stimulation, deep brain stimulation, optogenetic, etc. However, sensory stimulation is the safest means of intervention. In addition, most sensory stimulation methods are low-cost and easy to implement, which are easily accepted by patients and affordable for families. Sensory stimulation can even relax the psychological status of patients, while other intervention methods may cause trauma, side effects, or psychological pressure in patients. To date, the application of rhythmic sensory stimulation in AD is still in its infancy. At present, the application of sensory stimulation in AD animal model has achieved exciting results. Anyway, rhythmic sensory stimulation is still a very novel research direction, and more research is needed to support its therapeutic effect in human AD.

Multisensory therapy environment is beneficial to dementia, but it is easy to be limited by the environment, such as site, climate, etc. Patients also need nursing staff to prevent accidents when they play in the treatment garden.

VR technology has a high degree of flexibility and programmability. It can make a specific diagnosis or treatment plan for patients, but professionals are needed to complete it. The successful application of VR technology in cognitive training shows that the cognitive training method based on virtual reality is very promising. It may be difficult and costly to create a special multisensory treatment environment for patients, but through VR technology, it is easy to customize the appropriate training plan for each patient. Although VR has unique advantages in short-term memory, spatial memory, language ability, and other aspects, VR technology needs to be combined with a computer to form an interactive interface, and professionals are still required to design targeted training modes. AD patients also need a certain period of adaptation before therapeutic use, and there may be operational difficulties and poor effect for moderate and severe AD patients with cognitive decline. Clay et al. [134] systematically reviewed the application of immersive virtual reality (iVR) in AD assessment and treatment. It is confirmed that iVR is becoming a feasible method to evaluate the elderly and AD patients. It is also beneficial to cognitive training. In order to further fully evaluate the clinical benefits, acceptability, and participation of iVR technology for AD patients, further randomized controlled trials integrated with clinical populations are required. In general, VR technology is a relatively advanced method in cognitive training, which caters to the trend of social development. How to effectively use intelligent equipment to better serve AD patients will be a hot topic in future research. The future research should also focus on how VR technology can be better integrated into the daily life of AD patients, such as 3D smart TV, smart helmet, etc. Research is also needed to develop a set of simple and flexible cognitive assessment, diagnosis and treatment procedures for AD, to provide auxiliary support for clinicians and nursing staff. Third, we should also consider the cost of changing procedures and whether more people can afford it.

We have ample evidence that phototherapy is useful in dementia. However, there are many factors influence the effect of LT; most of the studies use LT to improve the wake-sleep rhythm of dementia was in the morning but after the lowest core body temperature, to increase the exposure time of AD patients to bright light, which seems to have a significant impact on improving the sleep quality, restless behavior, and depressive symptoms of AD patients. [108]. On the contrary, LT may aggravate circadian rhythm disorder [135]. LT is also affected by seasons, the light intensity during the day will affect the effect of LT. Alistair Burns et al. [108] show that BLT may be more effective in winter. Future research should also focus on exploring effective lighting device parameters and lighting time. Previously, we have shown that 40 Hz flash stimulation may be effective on AD, and the LT may have a more beneficial effect when 40 Hz entrainment is considered. However, this method has not been confirmed by experiments.

Although sensory stimulation is noninvasive and easy to implement, we need to consider the patient's

hearing ability, olfactory function, vision, sensitivity, physical disability, and so on. Due to individual differences, the implementation of sensory stimulation still needs to be combined with the actual situation of patients to formulate specific experimental scheme, which is difficult to complete. At the same time, we also need to consider the influence of implementation site, the surrounding environment and other external factors.

CONCLUSION

In general, research shows it is safe and effective to treat AD with sensory and multisensory stimulation. In the early stage of AD, the use of sensory stimulation for intervention may produce exciting effects that hinder the development of AD, and these operations are easy to achieve. Due to the lack of drugs to cure AD, it is of great significance to study and develop sensory stimulation therapy for AD. In the diagnosis and treatment of AD, future research may focus on providing a comfortable multi-sensory stimulation treatment environment for patients using advanced VR technology to assist the diagnosis of AD. In addition, more efforts should be made to explore the neuroprotective mechanism caused by sensory stimulation and the interaction between brain circuits. Experiments should be carefully designed when exploring how rhythmic sound or flash can lead to a coherent neural response and promote brain plasticity in some brain neurological injury diseases.

Because AD patients need long-term care, many researchers have focused on studying the improvement and enrichment of living environments for AD patients. Therefore, we can also provide a comfortable living environment for AD patients from the perspective of multi-senses. If possible, it can provide improvement and treatment for these patients. At the same time, it can also greatly reduce the burden of nurses. Sensory consideration may play an important role in the nursing of AD patients in the future. Of course, the environmental enrichment of multi-sensory stimulation may not be a simple superposition. How to maximize the stimulation effect, whether there is any influence among the stimulus parameters, whether the stimulus is superimposed at the same time, in turn, or intermittently, still needs to be confirmed.

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REVISIÓN

Beneficios de la musicoterapia como tratamiento no farmacológico y de rehabilitación en la demencia moderada

María Jiménez-Palomares, Juan Rodríguez-Mansilla*, María Victoria González-López-Arza, María Trinidad Rodríguez-Domínguez y Marta Prieto-Tato

Departamento Terapéutico Médico-Quirúrgico, Facultad de Medicina, Universidad de Extremadura, Badajoz, España

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RESUMEN

En este artículo se profundiza sobre los beneficios que la musicoterapia puede aportar al nivel cognitivo y/o conductual de los ancianos con demencia. Para ello se realizó una búsqueda bibliográfica de artículos de ensayos controlados aleatorios, ensayos casos-control y estudios pilotos, publicados desde enero de 2000 a enero de 2012 en las bases de datos Cochrane, MEDLINE, Dialnet y CSIC, centrados en la comparación de la musicoterapia como tratamiento no farmacológico en las personas mayores de 65 años con demencia moderada, frente a su tratamiento terapéutico-ocupacional habitual. Se seleccionaron 10 artículos en función de los criterios de inclusión. El análisis de los resultados sugiere que la musicoterapia mejora en las personas con demencia su nivel conductual, cognitivo y de comportamiento social.

Benefits of music therapy as therapy no pharmacology and rehabilitation moderate dementia

Keywords:
Music therapy
Moderate dementia
Rehabilitation

ABSTRACT

An in-depth review is presented the possible benefits of music therapy in relation to the cognitive and/or behavioural level of elderly patients with dementia. We have carried out a systematic review of randomized controlled trials, case-control and pilot studies published from January 2000 to January 2012 using the Cochrane Database of Systematic Reviews, MEDLINE, Dialnet and CSIC. We focused on comparison of music therapy as non-pharmacological therapy, in patients over 65 years of age with moderate dementia, with regular therapeutic and occupational treatment. Ten articles were selected based on the inclusion criteria. The analysis of the results suggest that music Therapy influences the elderly people with dementia in a positive way by improving levels of behavioural and cognitive functioning and social participation.

Introducción

La demencia, por sus dimensiones socioeconómicas, y por las repercusiones sanitarias que conlleva, supone ya un problema prioritario de salud pública[1].

«Es un síndrome adquirido, de etiología orgánica, originado por numerosas enfermedades, caracterizado por la presencia de un deterioro de las funciones cognitivas, que afecta a la memoria y algunas otras áreas del funcionamiento intelectual, en ausencia de alteración del nivel de conciencia y que afecta al funcionamiento social del sujeto»[2].

Existen diferentes tipos de síndromes demenciales, y diferentes formas de clasificarlos, según la edad de aparición (senil, presenil), según las áreas afectadas (cortical o subcortical) y, por último, la más utilizada, según su etiología[2].

El tratamiento farmacológico ralentiza el curso de la enfermedad, pero también puede ayudar a controlar conductas sintomática como el insomnio, la agitación, el deambular, la ansiedad y la depresión[1,2].

Debido a que en la actualidad no se ha encontrado ningún tratamiento curativo es necesario un abordaje terapéutico multidimensional que incluya, además de las intervenciones farma-

* Autor para correspondencia.
Correo electrónico: jrodman@unex.es (J. Rodríguez-Mansilla).

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cológicas, intervenciones no farmacológicas dirigidas a optimizar la cognición, la conducta y la función de los sujetos con demencia, y que además atienda las necesidades de los cuidadores.

Muchos de estos tratamientos dependen de la comunicación verbal. Cuando está dañada o es imposible hablar, la música ofrece la posibilidad de comunicarse a las personas con demencia.

Mientras que las funciones cognitivas se deterioran durante la evolución de la enfermedad, la receptividad a la música puede perdurar hasta las fases tardías de la demencia[3].

La Federación Mundial de Musicoterapia (1996) define la musicoterapia como la «utilización científica de la música y/o de sus elementos por un musicoterapeuta cualificado, con un paciente o grupo, en un proceso destinado a facilitar y promover la comunicación, el aprendizaje, la movilización, la expresión, la organización u otros objetivos terapéuticos relevantes, a fin de asistir a las necesidades físicas, psíquicas y sociales».

La aplicación de la música en el entorno terapéutico deriva de estudios científicos realizados a partir de mediados del siglo xx.

Son muchos los autores que afirman los diferentes beneficios de la música y muchas las aplicaciones que podemos hacer de ella[4], recogen las conclusiones de otros autores, y afirman que «la música estimulante tiende a incrementar el ritmo cardiaco», Poch[5] afirma que «una música sedante que guste a los niños autistas, les mueve a la acción física y a abandonar su aislamiento», y Wolfe[6] «la música puede ayudar muy efectivamente en la rehabilitación del dolor».

Cuando la aplicamos en el campo de las demencias, nuestros objetivos serán reducir los problemas del comportamiento, estimular las funciones cognitivas y favorecer la interacción social.

Esta revisión pretende evaluar si la musicoterapia aporta beneficios positivos en las funciones cognitivas, el nivel conductual y en el comportamiento social de los ancianos con demencia.

Material y métodos

Revisión bibliográfica sobre el objeto de estudio. Para ello se desarrolló una estrategia de búsqueda en bases de datos con el fin de captar todos aquellos artículos datados a partir de enero de 2000 hasta enero de 2012 y, relacionados, al menos potencialmente, con la comparación de la musicoterapia como tratamiento no farmacológico frente al tratamiento terapéutico-ocupacional habitual en las personas mayores de 65 años que presentasen demencia.

Las bases de datos empleadas fueron Cochrane, MEDLINE, Dialnet y CSIC.

La búsqueda en MEDLINE fue llevada a cabo mediante la página web Pubmed (http://www.ncbi.nlm.nih.gov), empleando los términos *Medical subject headings* (MeSH), por ser palabras claves consideradas como acceso al vocabulario médico de la *National Library of Medicine*, *Music therapy* en combinación con el término *Dementia*.

Para la búsqueda en la base de datos Cochrane Library Plus se emplearon los descriptores *Music therapy AND Dementia*.

En las bases de datos de Dialnet y CSIC se utilizaron como palabras clave «Musicoterapia y Demencia».

Los criterios de inclusión y exclusión empleados fueron los siguientes:

Tipos de estudios: revisión sistemática de ensayos controlados aleatorios, ensayos casos-control, y estudios pilotos que comparen la musicoterapia con el tratamiento terapéutico-ocupacional.
Tipos de pacientes: personas mayores de 65 años con diagnóstico de demencia en fase moderada.
Tipos de medidas de resultados: cambios de comportamientos problemáticos (agitación, deambulación, excitabilidad) cognitivos, bienestar emocional y comportamientos sociales.

Se excluyen aquellos estudios científicos en los que las medidas de los resultados no están relacionadas con los cambios producidos a nivel conductual, cognitivo y de comportamiento social mediante el tratamiento no farmacológico de la musicoterapia.

También se excluyen los estudios que hacen referencia a cualquier otro tipo de demencia que no sea la moderada.

Resultados

Como norma general, se realizó una preselección de las publicaciones, considerando si se adecuaban a la temática propuesta para esta revisión bibliográfica.

Se localizó los textos completos de los artículos, y se procedió a la lectura de su resumen o abstract, excluyendo aquellos que no cumplían los criterios de selección mencionados anteriormente, y aquellos sin accesibilidad con los medios disponibles.

Se identificaron inicialmente 248 estudios como resultado de la búsqueda bibliográfica. El proceso de búsqueda y selección de los estudios relevantes se resume en la figura 1.

Como resultado de la búsqueda en MEDLINE-Pubmed se identificaron un total de 227 artículos, de los cuales 21 fueron preseleccionados, y 10 finalmente incluidos en esta revisión.

Como resultado de la búsqueda en Cochrane Library Plus se identificaron 0 artículos.

Como resultado de la búsqueda en Dialnet se identificaron un total de un artículo, pero no se seleccionó para la revisión ya que no cumplía los criterios de inclusión.

Como resultado de la búsqueda en CSIC se obtuvieron un total de 20 resultados, de los cuales 0 artículos se incluyeron en el estudio por no cumplir los criterios de inclusión.

Finalmente, se incluyeron en la presente revisión los 10 artículos científicos de selección preestablecidos de las distintas bases de datos.

La mayoría de estos estudios evalúan las áreas multidimensionales englobando áreas cognitivas, funcionales y/o neuropsicología, con resultados favorables principalmente en las alteraciones conductuales, resumiéndose sus características más importantes en la tabla 1.

Discusión

Si bien son numerosos los trabajos realizados con el objetivo de valorar la eficacia del tratamiento terapéutico en los ancianos con demencia, hasta el momento son pocos los publicados con el objetivo de evaluar los beneficios de la musicoterapia como un tratamiento no farmacológico para los ancianos con demencia leve-moderada. Gran parte de los estudios realizados con esta finalidad se han centrado en las posibilidades del tratamiento con musicoterapia para reducir los problemas conductuales, cognitivos y del comportamiento social de estas personas.

Observamos la evolución de los estudios sobre esta temática. Los primeros estudios encontrados[15,17] ponen de manifiesto la efectividad de la musicoterapia según sea la fluidez verbal o la presión arterial sistólica de los pacientes. En los últimos años encontramos estudios que analizan esta efectividad con mayor profundidad, evalúan la eficacia de esta musicoterapia a nivel conductual, destacando la depresión, la apatía y la ansiedad[7,8,10].

Encontramos programas o tratamientos con musicoterapia donde no se obtienen resultados favorables en la mejora de la ansiedad y depresión[10,11], pero sí en la apatía. En estos trabajos, la duración del estudio se redujo a un tiempo máximo de 2 meses.

Sin embargo, cuando se incrementa el tiempo de aplicación de la musicoterapia, observamos que la mayor parte de los investigadores obtienen resultados positivos en la depresión y en el comportamiento de los pacientes[8,9,13,16].

Tabla 1
Características de los estudios incluidos

Autor/a	Tipo de intervención	Sesiones	Áreas evaluadas	Medidas	Resultados
Ferrero-Arias et al.[7]	*Ensayo clínico multicéntrico:* con un total de 146 pacientes. *Grupo experimental*: se realiza tratamiento de la música y del arte con actividad psicomotora. *Grupo control:* actividad gratuita en sala de día	Durante 4 semanas	Áreas neuropsicológica, depresión y apatía	Al final de la 4.ª semana y de la 8.ª semana del estudio	Diferencia significativa (p 0,21) en la escala DAIR. Se mejoró la apatía en los pacientes del grupo experimental
Raglio et al.[9]	*Ensayo clínico aleatorizado:* con un total de 59 personas. *Grupo experimental*: 30 sesiones de musicoterapia (16 semanas de tratamiento) (n = 30). *Grupo control:* apoyo educativo o actividades de entretenimiento (n = 29)	Veinte semanas	Evaluación multidimensional incluyendo el área cognitiva, funcional y neuropsiquiatría	Al inicio, 8, 16 y 20 semanas	La puntuación total del NPI disminuyó significativamente en el grupo experimental en las semanas 8, 16 y 20. Los delirios, agitación, ansiedad, apatía, irritabilidad, la actividad motora aberrante, y los disturbios nocturnos mejoraron significativamente. La relación de empatía y la participación de los pacientes también mejoraron
Cooke et al.[10]	*Ensayo clínico aleatorizado controlado:* con 47 participantes. El resultado es de un análisis de 24 participantes. *Grupo experimental*: música *Grupo control:* lectura	Programa de 40 min. Tres veces a la semana durante 8 semanas	Agitación y ansiedad	Tres veces durante el proceso	El programa de música no afectó significativamente a la agitación y a la ansiedad. Se aumentó su comportamiento verbal
Massimi et al.[11]	*Estudio caso-control:* el estudio tiene 3 fases: una fase inicial, otra fase en donde se recolectan los materiales autobiográficos y discutido y, por último, una fase llamada «Biografía Teatro» con ciclos mediante la música, fotografías, películas y relatos tomados de la vida pasada y actual del paciente en el hogar (n = 1)	Dos veces por semana durante un mes. Con una duración de 1 h cada sesión	Memoria autobiográfica, cognición, depresión, apatía y comunicación	Al inicio, a la mitad del proceso, y al final	Mejoría en las pruebas estandarizadas de la apatía y positivo de identidad propia, pero no mejoró en las pruebas de la memoria autobiográfica, la ansiedad, la depresión y la cognición en general
Holmes et al.[12]	*Ensayo clínico aleatorizado controlado:* con un total de 32 participantes. *Grupo experimental*: 30 min música en vivo. *Grupo control:* 30 min silencio o música pregrabada		Cartografía de la demencia de atención para evaluar la calidad del compromiso con la intervención de música	Grabación de vídeo cada 3 min	La mayoría de los sujetos (69%), independientemente de la gravedad de la demencia, mostraron una participación significativa y positiva con música en vivo. La música pre-grabada no fue significativa
Svansdottir y Snaedal [13]	*Estudio caso-control*: con un total de 38 participantes asignados al azar, en grupo de tratamiento de la música y grupo control,	Seis semanas	Alteraciones en el comportamiento mediante la escala BEHAVE-AD		Reducción significativa en las áreas de disturbios, agresividad y ansiedad en la escala BEHAVE-AD. Los beneficios desaparecen a las 4 semanas del estudio
Brotons y Marti[14]	*Estudio piloto:* 14 pacientes con un diagnóstico probable de enfermedad de Alzheimer, y 14 cuidadores familiares		Depresión, satisfacción de los familiares, agitación, carga del cuidador, memoria	Dos días antes de la finalización del proyecto, y 2 meses más tarde	Los cuidadores perciben una mejora en las áreas social y emocional y las pruebas estadísticas mostraron diferencias significativas entre las puntuaciones pre y post-test en: a) *Dementia Scale* (χ^2 = 12,29; p = 0,002); b) p NPI (χ^2 = 17,72; p = 0,001); c) La escala de agitación de Cohen-Mansfield (χ^2 = 11,45; p = 0,003); d) Carga de la entrevista (χ^2 = 9,19; p = 0,01); e) De memoria y problemas de conducta lista de verificación (subescala de frecuencia) (χ^2 = 11,09; p = 0,004); f) STAI-S (χ^2 = 14,72; p = 0,001), y g) Inventario de depresión de Beck (χ^2 = 9,38; p = 0,009)
Takahashi y Matsushita[15]	*Grupo experimental:* música. *Grupo control:* no música	Período de 2 años. El grupo de música llevado a cabo una vez por semana	Observación de los cambios en el nivel de cortisol en la saliva, en la presión arterial, y de una evaluación de la inteligencia	Uno y 2 años después del inicio del tratamiento	La presión arterial sistólica determinada uno y 2 años después del inicio del tratamiento incrementado significativamente en el grupo de tratamiento no música en comparación con el tratamiento de grupo en la música (p < 0,05). No hubo diferencias significativas en el nivel de cortisol en la saliva ni en la puntuación de la evaluación de inteligencia. Pero se ha observado que el grupo de tratamiento de la música mantiene su estado físico y mental durante el período de 2 años mejor que el grupo de tratamiento no música

Tabla 1 (*continuación*)

Autor/a	Tipo de intervención	Sesiones	Áreas evaluadas	Medidas	Resultados
Guétin et al.[16]	*Estudio controlado aleatorizado:* con un total de 30 participantes. *Grupo experimental:* sesiones semanales de tratamiento individual, la música receptivo (n = 15). *Grupo control:* sesiones semanales de lectura (n = 15)	Veinticuatro semanas con sesiones semanales de tratamiento individual	Nivel de ansiedad (escala de Hamilton). Los cambios en la puntuación de depresión (escala de depresión geriátrica)	Semanas 1, 4, 8, 16 y 24	Mejoras significativas en la ansiedad ($p < 0,01$) y depresión ($p < 0,01$) en el grupo de tratamiento de la música a partir de 4 semanas y hasta la semana 16. El efecto de la tratamiento musical se mantuvo durante hasta 8 semanas después de la interrupción entre las semanas 16 y 24 ($p < 0,01$)
Van de Winckel et al.[17]	*Ensayo controlado aleatorizado:* con un total de 25 participantes. *Grupo experimental:* ejercicios físicos con música (n = 15). *Grupo control:* conversación diaria (n = 10)	Sesiones diarias de 30 min durante 3 meses	Cognición y comportamiento	MMSE y BOP escala antes y después del periodo experimental, 3 y 6 meses después del ensayo	Mayor puntuación en el MMSE 15,53 y mayor puntuación en la fluidez verbal, pasando de 10 a 14 puntos en el grupo experimental. Grupo control no tuvo cambios significativos

χ^2: prueba de Chi cuadrado.

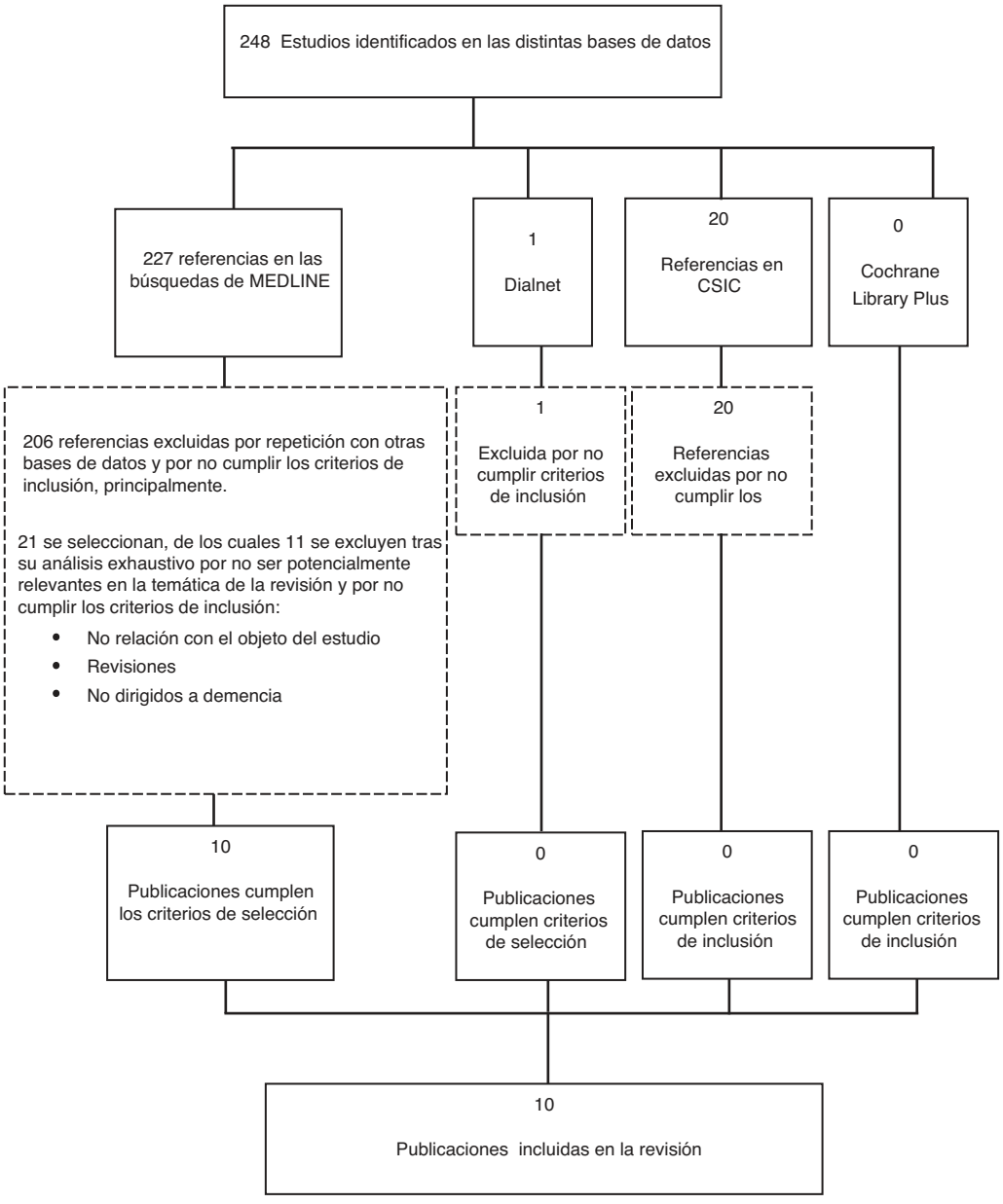

Figura 1. Procedimiento de selección de los artículos en las búsquedas bibliográficas.

Respecto a los contenidos abordados en los estudios, la mayoría de los trabajos encontrados reflejan el estado conductual de los pacientes antes, durante y al final del tratamiento experimental[7–11]. Son pocos[7,14] los que evalúan si esas mejoras se mantienen y cuánto, a lo largo del tiempo, una vez aplicado el tratamiento con musicoterapia.

Aunque la mayor parte de los trabajos descritos manifiestan una eficacia a nivel conductual, cabe destacar la ausencia de instrumentos de valoración o medidas temporales de la evaluación que determinen de forma específica la mejora de esos trastornos conductuales asociados a las actividades de la vida diaria.

Los estudios deberían ser más rigurosos para establecer si la musicoterapia puede participar en el tratamiento de los ancianos con demencia, disponer de una muestra más amplia de los pacientes, y ser más duraderos en el tiempo para valorar la efectividad de la musicoterapia a medio y largo plazo.

Así mismo, dado que el objetivo final de este tipo de intervenciones es reducir la prevalencia de los trastornos conductuales en esta tipología de pacientes, algunos de estos estudios ya han confirmado su repercusión en la mejora de estas alteraciones.

La mayoría de los estudios utilizan una muestra de sujetos reducida, lo cual no hace posible extraer resultados estadísticamente significativos. El tamaño muestral de los artículos consultados oscila entre 1-59 pacientes, a excepción de los trabajos de Ferrero-Arias et al.[7], que muestran resultados finales sobre 146 pacientes. Con tamaños muestrales tan reducidos no se pueden extrapolar los resultados de los estudios al total de la población de ancianos con demencia moderada.

Además, existe una gran diversidad en datos relevantes para el estudio como es la duración total de los mismos (4 semanas[7,11], 8 semanas[10], 20 semanas[9], 24 semanas[15,16]...).

Las limitaciones que se han encontrado, y que han dificultado la realización de esta revisión han sido la escasez de artículos científicos relacionados con los beneficios de la musicoterapia como tratamiento no farmacológico, y que todos se evalúan antes y después de la intervención, pero no consideran una revaluación pasado un tiempo de la actuación experimental a excepción de los estudios de Van de Winckel et al.[17] y de Brotons y Marti[14] que reevalúan a los 6 y 2 meses respectivamente.

Tal y como concluyen varios estudios citados[14,16,17], la musicoterapia parece ser beneficiosa en la mejora conductual y del comportamiento en los ancianos con demencia, aunque es necesario seguir investigando.

Conflicto de intereses

Los autores declaran no tener ningún conflicto de intereses.

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BMJ Open

Systematic review of systematic reviews of non-pharmacological interventions to treat behavioural disturbances in older patients with dementia. The SENATOR-OnTop series

Iosief Abraha,[1] Joseph M Rimland,[1] Fabiana Mirella Trotta,[1] Giuseppina Dell'Aquila,[1] Alfonso Cruz-Jentoft,[2] Mirko Petrovic,[3] Adalsteinn Gudmundsson,[4] Roy Soiza,[5] Denis O'Mahony,[6] Antonio Guaita,[7] Antonio Cherubini[1]

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For numbered affiliations see end of article.

Correspondence to
Dr Iosief Abraha;
iosief_a@yahoo.it

ABSTRACT

Objective: To provide an overview of non-pharmacological interventions for behavioural and psychological symptoms in dementia (BPSD).

Design: Systematic overview of reviews.

Data sources: PubMed, EMBASE, Cochrane Database of Systematic Reviews, CINAHL and PsycINFO (2009–March 2015).

Eligibility criteria: Systematic reviews (SRs) that included at least one comparative study evaluating any non-pharmacological intervention, to treat BPSD.

Data extraction: Eligible studies were selected and data extracted independently by 2 reviewers.

The AMSTAR checklist was used to assess the quality of the SRs.

Data analysis: Extracted data were synthesised using a narrative approach.

Results: 38 SRs and 142 primary studies were identified, comprising the following categories of non-pharmacological interventions: (1) sensory stimulation interventions (12 SRs, 27 primary studies) that encompassed: acupressure, aromatherapy, massage/touch therapy, light therapy and sensory garden; (2) cognitive/emotion-oriented interventions (33 SRs; 70 primary studies) that included cognitive stimulation, music/dance therapy, dance therapy, snoezelen, transcutaneous electrical nerve stimulation, reminiscence therapy, validation therapy, simulated presence therapy; (3) behaviour management techniques (6 SRs; 32 primary studies) and (4) other therapies (5 SRs, 12 primary studies) comprising exercise therapy, animal-assisted therapy, special care unit and dining room environment-based interventions. Music therapy was effective in reducing agitation (SMD, −0.49; 95% CI −0.82 to −0.17; p=0.003), and anxiety (SMD, −0.64; 95% CI −1.05 to −0.24; p=0.002). Home-based behavioural management techniques, caregiver-based interventions or staff training in communication skills, person-centred care or dementia care mapping with supervision during implementation were found to be effective for symptomatic and severe agitation.

Conclusions: A large number of non-pharmacological interventions for BPSD were identified. The majority of the studies had great variation in how the same type of intervention was defined and applied, the follow-up duration, the type of outcome measured, usually with modest sample size. Overall, music therapy and behavioural management techniques were effective for reducing BPSD.

Strengths and limitations of this study

- Non-pharmacological interventions have gained increasing attention in recent years as an alternative first-line approach to treat behavioural and psychological symptoms in dementia (BPSD).
- The strength of this review is its extensive, comprehensive systematic search of studies that investigated non-pharmacological interventions for BPSD. It provides a compendium of the types of non-pharmacological interventions, including the component of each single intervention, the dosage (when available) and the duration of the treatment.
- Primary studies were generally of limited sample size; there was substantial variation in the characteristics of the intervention and the authors of primary studies reported different conceptual frameworks, and sometimes broad, and quite generic descriptions, of the interventions.

INTRODUCTION

Dementia is a neuropsychiatric syndrome characterised by cognitive decline and progressive deterioration of daily function, often associated with behavioural disturbances.

The prevalence of dementia in older participants is reported to be ~6% worldwide[1] and, with global population ageing, it is expected to rise, although some recent studies have suggested declining trends in dementia frequency.[2] Dementia presents a considerable burden to families and caregivers and is becoming a major challenge for all healthcare systems, as well as for society at large.[3 4] Alzheimer's disease (AD) is the most common form of dementia in older people, accounting for 60% of cases.

Approximately five out of every six patients with dementia, including those living at home, will develop behavioural and psychological symptoms during the course of the disease.[5–8] Behavioural and psychological symptoms in dementia (BPSD) are defined as signs and symptoms of disturbed behaviour, mood, thought or perception.[9] These disturbances, namely agitation, depression, elation, delusions and hallucinations, are strongly correlated with each other.[10 11] Twenty per cent of those initially without symptoms will manifest them within 2 years of dementia diagnosis,[12] whereas 50–80% of those with clinically important symptoms remain agitated for several months.[13] In addition, at least 50% of patients with dementia present with significant BPSD on a monthly basis.[14] Agitation, together with depression, hinder activities and relationships, cause feelings of helplessness and distress in families and formal caregivers[15] and are strong predictors for poor quality of life,[16] as well as nursing home admission.[17]

Currently, options for treating BPSD include pharmacological and non-pharmacological therapies.[18 19] Psychotropic medications are often used to reduce the frequency and severity of BPSD, but in the majority of patients, they provide only modest symptom control.[20–22] A recent trial reported that the addition of citalopram to psychosocial support significantly reduced agitation and caregiver distress.[23] However, their adverse effects are common and problematic, in particular the increased risk of falls and fractures,[24] stroke and even mortality.[25] In addition, there is some evidence that the use of benzodiazepines to treat agitation in patients with dementia may increase cognitive decline[24] and may expose patients to an immediate risk of injurious falls.[26] Finally, memantine and cholinesterase inhibitors are considered to be of very limited value to improve agitation in participants with AD.[27 28]

In general, non-pharmacological interventions are considered a preferable alternative to psychotropic pharmacotherapy for treating BPSD.[29] However, there is conflicting evidence concerning the efficacy and practicality of non-pharmacological interventions to improve BPSD, particularly agitation.[9 30]

The purpose of the present overview is to assess the evidence supporting these non-pharmacological interventions with a view to providing a working compendium for the non-drug management of BPSD.

The present overview updates the evidence on the same theme gathered by a previous systematic overview published in 2011.[31]

METHODS

This work is part of the Optimal Evidence-Based Non-drug Therapies in Older People (ONTOP) project, a work package of a European Union funded FP7 research named SENATOR (Software ENgine for the Assessment & Optimization of drug and non-drug Therapy in Older peRsons). The ONTOP aim is to undertake a literature search of systematic reviews (SRs) and provide clinical recommendations concerning evidence-based non-pharmacological treatments of several prevalent medical conditions affecting older people, including delirium,[32 33] pressure ulcers,[33–35] falls,[36 37] stroke and heart failure. A protocol that describes the search strategy, screening and inclusion criteria, has been previously published.[38] Briefly, to obtain the evidence regarding the non-pharmacological interventions, we first identified published SRs using a systematic search across several databases. After processing eligible SRs, we identified and obtained primary studies from these SRs to generate the compendium of non-pharmacological interventions. In a subsequent work will present the assessment of the body of evidence and provide recommendations according to the GRADE approach.[38]

Search strategy and inclusion criteria for systematic reviews

The search sources included the Cochrane Database of Systematic Reviews, PubMed, PsycINFO and CINAHL (see online supplementary appendix 1). Two criteria were considered for further evaluation of an abstract: (1) a paper defined as a review or a meta-analysis; (2) the use of any non-pharmacological intervention to treat behavioural disturbances in patients with dementia. The publication years ranged from 2009 to March 2015.

Subsequently, full-texts of relevant abstracts were obtained and screened to identify SRs of interest based on (1) the use of at least one medical literature database; (2) the inclusion of at least one primary study and (3) the use of at least one non-pharmacological intervention to treat behavioural disturbances in people aged 60+years.

We assessed the methodological quality of each SR using the AMSTAR (A Measurement Tool to Assess Reviews) instrument that contains 11 items.[39] Final grading of the methodological quality of each SR was based on the overall score and reported as either 'high' (score≥8), 'medium' (score 4–7) or 'low' (score≤3). Two reviewers independently assessed the quality of the SRs, and disagreements were resolved by consensus.

Data extraction and management

From each SR, the following data were collected: the publication year, the databases searched, the study population, the non-pharmacological interventions, the number of primary studies included, the outcome measures and the AMSTAR score. Pairs of reviewers independently screened titles, abstracts and full texts of

articles. Disagreements were resolved by discussion or, where necessary, by consulting another author.

Outcome measures

We focused on reviews that considered BPSD, as a primary outcome, measured by (1) multidomain scales (eg, Neuropsychiatric Inventory (NPI), Brief Psychiatric Rating Scale, BPRS), (2) scales specific to agitation (eg, Cohen-Mansfield Agitation Inventory, CMAI) and (3) scales specific to depression or anxiety (eg, Cornell Scale for Depression in Dementia, CSDD).

Inclusion criteria for primary studies and assessment

From the included SRs, we obtained any experimental comparative study, either randomised or non-randomised, that investigated any non-pharmacological intervention to treat BPSD in older patients. Observational studies or before–after studies, with historical controls, were excluded. As outlined in our protocol, we extracted data from primary studies to perform meta-analyses and heterogeneity was addressed using the Cochrane Collaboration approach.[38]

Risk of bias assessment and grading the quality of evidence

We used the Cochrane Collaboration method to evaluate the risk of bias. The domains considered were random sequence generation, allocation concealment,[40] blinding of participants, personnel, or outcome assessor,[40] incomplete outcome data,[41] selective reporting[42] and other potential biases (eg, balance in baseline characteristics). The overall quality of evidence was assessed using the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) methodology that takes into account the risk of bias, consistency of results across the studies, precision of the results, directness and likelihood of publication bias.[43] Results regarding the risk of bias assessment, and grading the quality of evidence, will be provided in a companion paper.

RESULTS

Our search strategy identified 4392 abstracts of which 2549 were duplicates and were subsequently removed. After abstract screening, 67 records were identified for full-text assessment. Of these, 38 reviews were included in this overview. From these SRs, we obtained 142 primary studies from which we abstracted details of the non-pharmacological interventions. Figure 1 shows the study screening process. Table 1 depicts the basic characteristics of the included SRs. The characteristics of relevant primary studies are reported in online supplementary appendix 2 as electronic tables (etable). The AMSTAR evaluation are summarised in online supplementary appendix 3.

The interventions in this overview were classified according to the following categories: (1) sensory stimulation interventions that encompass acupuncture, aromatherapy, massage therapy, light therapy, sensory garden intervention, cognitive stimulation, music/singing and dance therapy, snoezelen and transcutaneous electrical

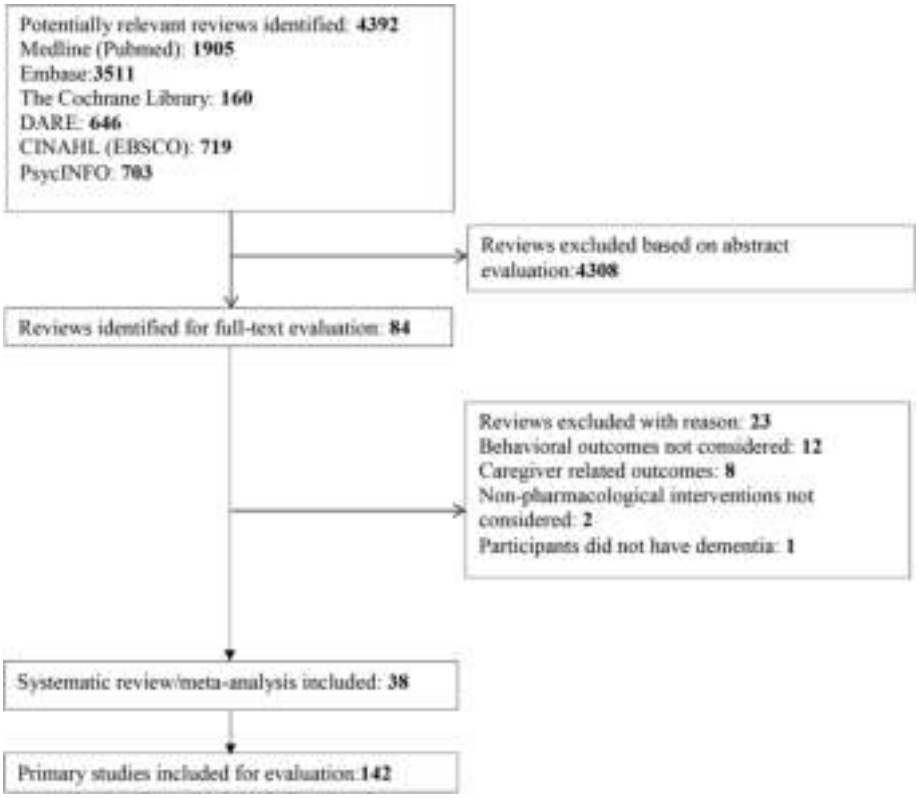

Figure 1 Study screening process.

Table 1 Characteristics of included systematic reviews/meta-analyses

Author (year)	Databases searched	Population	Non-pharmacological intervention	Primary studies	Outcome
Aguirre 2013	MEDLINE, Embase, Cinahl, PsycINFO, the Cochrane Library, Lilacs, trial registers, grey literature	Participants who had a diagnosis of dementia (Alzheimer's disease, vascular dementia mixed Alzheimer's and vascular dementia, other types of dementia), including all levels of cognitive impairment	Cognitive stimulation	15 RCTs	Mood, quality of life, well-being, ADL, communication, behaviour, neuropsychiatric symptoms and social interaction
Alves 2013	MEDLINE, PsycINFO, Cochrane Library, EMBASE, metaRegister of Clinical Trials, OVID all, EBM Reviews	Patients diagnosed with Alzheimer's disease (without mild cognitive impairment, mixed Alzheimer's disease, vascular dementia, and other types of dementia such as frontotemporal dementia or dementia with Lewy bodies)	Memory-training program; attention-stimulating activities; computerized 'cognitive training'	4 studies	Cognitive functioning; ADL; memory Symptoms; finger tapping test; depressive symptoms; QoL; reaction time; screening of mental status; neuropsychiatric symptoms
Bernabei 2013	MEDLINE, Embase, PsycINFO	Elderly patients affected by dementia or psychiatric disorders	Animal-assisted interventions	10 studies on BPSD (3 case–control and 7 repeated measures design)	Any psychiatric disorder
Blake 2013	PubMed, Science Direct, the Cochrane Library and Web of Knowledge	Adults diagnosed with dementia who have depressive symptoms	Reminiscence group therapy	4 studies	Change in level of depressive symptoms
Carrion 2013	MEDLINE, EMBASE, PASCAL, the Cochrane Library, National Guidelines Clearinghouse, Trip database, HEALTHSTAR, CINHAL and PsycINFO	Older people diagnosed as having Alzheimer's disease or probable Alzheimer's disease	Cognition-oriented care approaches: 1.Reality orientation; 2. Skills training	Reality orientation: 9 RCTs;Skills training: 8 RCTs	Cognitive function; behavioural symptoms and mood
Chaudhury 2013	MEDLINE, CINAHL, Ageline, Web of Science, and Simon Fraser University library catalogue	Long-term facility residents with dementia	Supportive dining environment	21 studies included: light therapy (1 study); music therapy (3 studies)	Physiological and sociopsychological aspects of dining, including caloric intake, enjoyment in eating and social interaction
Collet 2010	MEDLINE, PsycINFO and PubMed	Nursing home patients suffering from either somatic illness or dementia combined with psychiatric disorders or severe behavioural problems	Psychiatric care and nursing home care combination	8 RCTs	Psychosis and depression, increase in global functioning, behaviour disorders, cognition and ADL

Continued

Table 1 Continued

Author (year)	Databases searched	Population	Non-pharmacological intervention	Primary studies	Outcome
Eggenberger 2013	MEDLINE, AMED, EMBASE, PsycINFO, CINAHL, The Cochrane Library, Gerolit, Web of Science	People with dementia; professional and family caregivers	Communication skills training by means of face-to-face interaction	12 RCTs	QoL, social interactions
Forbes 2014	MEDLINE, EMBASE, the Cochrane Library, CINAHL, PsycINFO, LILACS+several Registries, proceedings+other sites	People with dementia	Light therapy	5 studies met the inclusion criteria—only 3 were included in the analyses because of inappropriate reported	Sleep, behaviour, mood, and cognitive disturbances associated with dementia
Forrester 2014	MEDLINE, EMBASE, the Cochrane Library, CINAHL, PsycINFO, LILACS+several Registries, proceedings+other sites	People with dementia	Aromatherapy	2 RCTs	Agitation, behavioural symptoms, quality of life and adverse effects
Fung 2012	MEDLINE, CINAHL, Cochrane Library, PsycINFO, Social Sciences Citation Index, SCOPUS	Participants with dementia	Aromatherapy	11 studies (5 RCTs; 6 controlled trials)	Behavioural problems
Gonzalez 2014	MEDLINE, AMED, CINAHL, ISI Web of Knowledge, Embase and Scopus	People with dementia	Sensory gardens and horticultural activities	2 RCTs	Agitation levels; cognitive status
Guzman-Garcia 2013	MEDLINE, AgeInfo, EBM Reviews EBSCO-CINAHL, EMBASE, ISI Web, LILACS, SCOPUS ZETOC; reference lists; EthOS-Beta; ACER; Google;+	People with dementia living in long-term care homes	Dance movement therapy; dance therapy; Psychomotor dance-based; Social dancing	10 studies (1 RCT)	Not specified
Kiepe 2012	MEDLINE and PsycINFO	Patients with mental illness	Dance therapy	1 study (RCT) for dementia	Any physical and mental outcomes
Kim 2012	MEDLINE, CINAHL, ProQuest Medical Library, and Cochrane and OT	Persons with dementia	Occupational therapy	9 studies	Behavioural problems and depression
Kverno 2009	MEDLINE, CINAHL, PsycINFO, EMBASE	Individuals diagnosed with advanced dementia	Any non-pharmacological intervention	460 primary studies	Neuropsychiatric symptoms
Lai 2009	MEDLINE, The Cochrane Library, EMBASE, PsycINFO and CINAHL	Patients with a confirmed diagnosis of dementia or Alzheimer's disease or related disorders	Special care units	8 non-randomised studies (0 RCT)	Behavioural problems, mood, use of restraints and psychotropic medication

Continued

Table 1 Continued

Author (year)	Databases searched	Population	Non-pharmacological intervention	Primary studies	Outcome
Livingston 2014	MEDLINE; Web of Knowledge; EMBASE; British Nursing Index; the Health Technology Assessment programme database; PsycINFO; NHS Evidence; System for Information on Grey Literature	Participants with dementia	Sensory, psychological and behavioural interventions	160 primary studies	Agitation
McDermott 2013	MEDLINE, EMBASE, PsycINFO, CINAHL, Cochrane Library, Web of Science, J Music Therapy, and Nordic Journal of Music Therapy	Participants with dementia	Music therapy	15 studies (6 RCTs; 4 non-randomised trials; 5 before–after studies	Behavioural, psychological aspects, hormonal and physiological changes, social and relational aspects of music therapy
Moniz-Cook 2012	MEDLINE, EMBASE, CINAHL, PsycInfo and LILACS;+	People with dementia, irrespective of its cause or diagnostic subtype, with reported BPSD or 'behaviours that challenge', receiving support or treatment from mental health workers, care staff or family or other informal caregivers	Formulation-led individualised interventions targeting reduction in the person's distress and/or resolution of the caregivers' management difficulties	18 trials	Challenging behaviours (eg, verbal and physical aggression, restlessness) and mood (depression).Changes in caregiver self-report of reaction to challenging behaviours.
Moyle 2013	MEDLINE, CINHAL, PsycINFO, Cochrane Library, Scopus, Web of Science, Health Reference Center Academic	Older people with dementia:	Massage therapy	Of 13 studies identified only 1 satisfied the quality of the inclusion criteria	Agitated behaviour
O'Neill 2011	MEDLINE, the Cochrane Library, PsycINFO	Adults with mild, moderate, or severe dementia	Non-pharmacological treatments	28 systematic reviews	Behavioural symptoms of dementia
Olazaran 2010	MEDLINE, PsycINFO, CINAHL, Embase, Lilacs and the Cochrane Dementia and Cognitive Improvement Group Specialized Register	People with Alzheimer's disease and related disorders	Any non-pharmacological intervention	213	Cognition; institutionalization; ADL; behaviour; mood; QoL; psychological well-being
Padilla 2011	MEDLINE, the Cochrane Library, AgeLine, CINAHL, PsycINFO, EMBASE, and HealthSTAR, OT Seeker, and Allied and Complementary Medicine+reference list	People with Alzheimer's disease and related dementias	Environment-based interventions; multisensory approaches; other interventions	1 cross-overall trial (environmental-based intervention)	Performance, affect and behaviour

Continued

Table 1 Continued

Author (year)	Databases searched	Population	Non-pharmacological intervention	Primary studies	Outcome
Potter 2011	MEDLINE, EMBASE, CINAHL, PsycINFO, AMED, the Cochrane Library, the UK National Research Register, Current Controlled Trials	Older people with dementia	Strength and flexibility; strength and balance Tai Chi classes sitting and standing; walking; stretching; seated exercises; balance training; endurance; aerobic training	13 RCTs	Physical functioning, quality of life anddepression
Robinson 2011	MEDLINE; EBM reviews; AMED; BNI; CINAHL; EMBASE	Not specified	Acupressure	1 RCT (of 71 acupressure studies)	Any outcome
Salami 2011	MEDLINE, EMBASE and the Cochrane Central Register	People with Alzheimer's disease	Any treatment option for sleep disturbance not attributable to other clinical conditions	9 RCTs	Sleep disturbance
Seitz 2012	MEDLINE, EMBASE, PsycINFO, the Cochrane Library and Google Scholar	People with dementia	Any non-pharmacological intervention	40 studies	Neuropsychiatric symptoms
Subramaniam 2012	MEDLINE, PsycINFO, CINAHL, the Cochrane Library, EMBASE and Web of Knowledge	People with dementia	Reminiscence therapy	5 RCTs	Psychosocial benefits
Thune-Boyle 2012	MEDLINE, EMBASE, PsycINFO	People with dementia	Exercise therapy	2 RCTs	Behavioural and psychological symptoms
Ueda 2013	MEDLINE, CINAHL, PsycINFO	People with dementia	Music therapy	18 of 20 studies considered agitation or anxiety (9 CCT; 9 RCTs)	Behavioral and psychological symptoms; ADL; cognitive function
Vasionytė 2013	JSTOR, EBSCO, ERIC, SCIRUS, MEDLINE, PsycINFO, Cochrane Library and ProQuest, the journal databases SAGE PUB and Cambridge journals	Patients with dementia	Music therapy	3 RCTs	Affective, behavioural, cognitive and physiological outcomes
Vasse 2010	PubMed, PsycINFO, Web of Science and the Cochrane library	People with dementia	A walking program combined with conversation, group validation therapy, life review programs, cognitive stimulation therapy, activity therapy and staff education	9 RCTs	Communication between residents with dementia and care staff; neuropsychiatric symptoms of residents with dementia.

Continued

Table 1 Continued

Author (year)	Databases searched	Population	Non-pharmacological intervention	Primary studies	Outcome
Wall 2010	MEDLINE, CINAHL, PsycINFO	Older people with dementia	Music therapy	4 RCTs	Behaviour and well-being
Whear 2014	MEDLINE, PsycINFO, Embase, HMIC, AMED; Cochrane Library; CINAHL; British Nursing Index; ASSIA; Social Science Citation Index; EThOS; Social Care Online and OpenGrey November 2012.	Elderly residents with dementia	Mealtime interventions categorized into four types: music, changes to food service, dining environment alteration, and group conversation	11 studies (7 time series repeated measures; 3 pre-post study design; 1 controlled clinical trial)	Behavioural symptoms (anxiety, agitation, aggression)
Woods 2012	MEDLINE, the Cochrane Library, EMBASE, PsycINFO, CINAHL and LILACS, ongoing trial databases and grey literature sources	People with dementia and their caregivers	Cognitive stimulation	15 RCTs	Cognitive functioning; mood; QoL; ADL; behavioural symptoms; neuropsychiatric symptoms
Yu 2009	MEDLINE (PubMed), CINAHL, PsycINFO, and the Cochrane Library	People with early-stage Alzheimer's disease and dementia	Cognitive training	7 RCTs	Any dementia symptoms in early-stage Alzheimer's disease and related dementia.
Zimmerman 2013	MEDLINE, EMBASE, the Cochrane Library, the Cumulative Index to Nursing and Allied Health Literature, AgeLine, and PsycINFO	People with dementia in nursing homes and other residential long-term care settings	Effective characteristics of residential long-term care	14 studies: 4 prospective cohort studies, 9 RCTs, 1 non-randomized controlled trial	Health and psychosocial outcomes

ADL, activities of daily living; QoL, quality of life; RCT, randomised controlled trial.

nerve stimulation (TENS) therapy; (2) cognitive/emotion-oriented interventions that include reminiscence therapy, validation therapy, simulated presence therapy (SPT); (3) behavioural management technique and (4) other interventions, such as exercise therapy, pet-therapy and special care unit.

Sensory stimulation interventions

Shiatsu and acupressure

Only one SR was identified. Robinson 2011[44] (AMSTAR=7) investigated the evidence available for shiatsu and acupressure in BPSD. Shiatsu is a form of complementary medicine primarily developed in Japan, which employs gentle manipulations, stretches and pressure with the fingers, elbows, knees and feet. Acupressure is similar, but exerts pressure for longer on specific meridian points according to traditional Chinese medicine or acupoints of the human body in order to 'balance energy fields'.

The authors identified 40 RCTs, 8 controlled clinical trials, 5 crossover trials, 6 within-participants studies, 1 observational study, 10 uncontrolled studies and 1 prospective study. Only one randomised trial (n=133 participants) using acupressure in dementia participants was relevant for our assessment.[45] The authors reported that agitation, aggression and physically non-aggressive behaviour all declined significantly in demented participants.

Aromatherapy

Aromatherapy is proposed as a complementary intervention, to treat a wide-range of health problems, including lack of sleep and behavioural symptoms for people with dementia.[46] Aromatherapy is based on the use of plant products or aromatic plant oils to produce essential oils and blends of aromatic compounds. Aromatherapy can be delivered through massage or topical application, inhalation and water immersion.

Our systematic search identified three SRs that considered aromatherapy as an intervention to treat agitated behaviours and other outcomes in patients with dementia. The AMSTAR scores ranged from 6 to 8 across the reviews. The range of included primary studies varied from 4 to 13.[29 47 48]

The most recent SR was a Cochrane review,[48] which had the highest AMSTAR quality score (8). The review included only randomised trials and launched its last search strategy in January 2013. Seven studies with 428 participants were identified. The types of interventions included lavender-based (four studies[49–52]), Melissa-based (two studies[53 54]) and lemon balm oil (1 study) aromatherapy. However, only two of these had usable data for pooling. The first study (n=71) reported a favourable treatment effect on measures of agitation (MD −11.1, 95% CI −19.9 to −2.2) and behavioural symptoms (MD −15.8, 95% CI −24.4 to −7.2), whereas the second trial (n=63) did not detect any difference in agitation (MD 0.00, 95% CI −1.36 to 1.36) or behavioural symptoms (n=63, MD 2.80, 95% CI −5.84 to 11.44). The review authors remarked that the published studies used different scales to assess the behavioural symptoms and were limited in sample size and methodological quality, particularly because of selective reporting bias.

The second review by Seitz *et al*[29] consisted of any non-pharmacological interventions, including aromatherapy, to treat outcomes relevant to patients with dementia. The review reported data in a narrative way and cited only one study of aromatherapy,[53] which was also included in the Cochrane review above.[48] The review received an AMSTAR score of 6.

The third study was a review by Fung *et al*,[47] which considered only aromatherapy as a non-pharmacological intervention. The review was judged to have moderate methodological quality (AMSTAR score=6). After performing a comprehensive search in several electronic databases, 11 studies were identified, with a total of 405 patients in different settings, including long-term care (LTC) homes, clinical centres and general and old age psychiatry. In addition to the trials included in the above cited Cochrane review, the review by Fung *et al*[47] included one randomised trial[55] which was excluded in the Cochrane review because the route of administration was not reported and there was no mention of the type of the aromatherapy, in addition to five controlled clinical trials.[56–60] Moreover, the Fung *et al* review[47] did not include the two trials[49 51 61] that were evaluated in the Cochrane review. The controlled clinical trials could not be included in a meta-analysis because of heterogeneity. The review highlighted the methodological limitations of the studies and reported promising results of aromatherapy. Online supplementary etable 1 describes the type of interventions, the outcomes and the results of the primary studies included in the aromatherapy reviews.

Massage therapy

Massage and touch therapy have been proposed as non-pharmacological interventions to be used in dementia to offset manifestations of cognitive decline and behavioural disturbances, including related psychological problems, such as depression and anxiety, and to improve quality of life.[62]

Two reviews were identified. The first was a Cochrane review[63] that was included in the review by O'Neil *et al*.[31] This review assessed the efficacy of massage and touch therapy for the treatment of BPSD. Its last search strategy was launched in 2006. The aim of the overview was to evaluate the effects of a range of massage and touch therapies on conditions associated with dementia, such as anxiety, agitated behaviour and depression, to identify any adverse effects and to provide recommendations for future trials. The review considered only randomised trials. The primary outcome measures were changes in the frequency and severity of various types of agitated behaviour, as observed by staff or investigators (short-term and long-term using any rating method), and the

emotional well-being and the quality of life of the patients (rated by staff, investigators and/or patients themselves using any method).

Remington (2002)[64] assessed the effect of music and massage in 68 nursing home residents with dementia (AD, multi-infarct dementia or senile dementia). The participants were randomly allocated into four groups: calming music, hand massage, simultaneous calming music and hand massage and no intervention. The intervention lasted 10 min and was given to each patient once.

The efficacy of treatment on 'agitation level' was evaluated with a modified version of the CMAI administered by trained research assistants who were blinded to treatment allocation when possible. The method of randomisation was unclear and to conceal allocation, sealed envelopes, without further explanation, were used. However, patients could have been excluded after allocation (if they had a CMAI score of 0 at baseline) and consequently the study was considered to have high risk of selection bias.

The trial found that agitated behaviour decreased, more so in the group receiving hand massage than in the group receiving no treatment. This treatment effect was consistently found, compared to baseline, for measurements taken during treatment, immediately after treatment and 1-hour after treatment, and it was practically identical among the three groups receiving treatment (hand massage, calming music or both). The mean agitation score was in favour of massage therapy immediately after treatment (MD 7.83 (4.30 to 11.36)) and 1-hour after treatment (MD 12.12 (6.58 to 17.66)).

The second review by Moyle *et al*[65] conducted a search in 10 databases in October 2011. The authors identified 13 studies that evaluated massage therapy for the treatment of behavioural disturbances in patients with dementia, but only one study with a high methodological score, using the Validity Rating Tool, was identified. The included study, performed by Holliday-Welsh,[66] was a prospective before–after study in which 52 participants (39 women and 13 men; mean age 90 years) from two skilled nursing facilities in Northeastern Minnesota, USA, were enrolled. Patients were cognitively impaired and had a history of agitated behaviour confirmed by the facility staff. The intervention consisted of a 10-min to 15-min massage of the upper extremities (including the head, shoulders and hands), undertaken by a physical therapy assistant, during a 1-hour period identified by caregivers as the time the participant was usually most agitated (individualised for each participant). The outcomes of interest were assessed with a scale that used the five behavioural symptoms from the minimum data set; (1) wandering; (2) verbally abusive behavioural symptoms; (3) physically abusive behavioural symptoms; (4) socially inappropriate/disruptive behaviour and (5) resistance to care.

Methodologically, the study was considered at high risk of selection and performance bias given the study design and the nature of the intervention. In addition, it was unclear whether the outcome assessor was blinded. Massage therapy was significantly associated with improvement for four of the five outcomes examined, including wandering (0.38 vs 0.16, p<0.001), verbally agitated behavioural symptoms (0.59 vs 0.49, p=0.002), physically agitated behavioural symptoms (0.82 vs 0.40, p<0.001) and resistance to care (0.10 vs 0.09, p=0.022). Online supplementary etable 2 describes the type of interventions, the outcomes and the results of the primary studies included in the massage therapy reviews.

Light therapy

Rest-activity and sleep-wake cycles are controlled by the endogenous circadian rhythm generated by the suprachiasmatic nucleus (SCN) of the hypothalamus. Degenerative changes in the SCN appear to be a biological cause of circadian rhythm disturbances in people with dementia. In addition to the internal regulatory loss, older people (especially those with dementia) experience a reduction in sensory input, due to less visual sensitivity to light and less exposure to bright environmental light. Evidence suggests that circadian rhythm disturbances may be reversed by stimulation of the SCN with light.[67]

Four reviews considered the use of bright light therapy to treat behavioural problems in patients with dementia.

The first was a Cochrane review[67] (AMSTAR=10) with the aim of evaluating the effectiveness of light therapy to improve cognition, activities of daily living (ADLs), sleep, challenging behaviour and psychiatric disturbances associated with dementia. The search strategy was launched in January 2014. The included studies were randomised trials that compared any bright light therapy, including dim red light or dim, low-frequency blinking light <300 lux, to usual care. The primary outcome measures included cognition (global or single domain, eg, memory), ADLs, sleep-wake disturbances, challenging behaviour (eg, agitation), psychiatric disturbances (eg, depression) and adverse effects. Secondary outcomes were rates of institutionalisation and overall cost of care. The authors identified 11 studies, but stated that three of the studies could not be included in the analyses either because the data were insufficient or could not be retrieved from the trial authors. Only four of the included studies considered challenging behaviour as an outcome, but the sample sizes were limited and the outcome measures were not the same across the studies.[68–71] A meta-analysis of challenging behaviour, however, was performed and no substantial heterogeneity was found, although the results were not statistically in favour of bright light therapy.

The second review aimed to identify which non-pharmacological interventions were most effective for BPSD in LTC.[29] Only two studies[68 69] were included in the review (which were already included in the Forbes review[67]), but were not assessed in detail. The review received four points in the AMSTAR rating system.

The third review[72] aimed to assess the role of physical environment in supporting person-centred dining in LTC. Only one study that evaluated the effect of ambient bright light in activity and dining areas among institutionalised people with dementia was identified.[73] This study was not included in the previous two reviews.

The fourth review[74] that addressed the effectiveness of environment-based interventions for people with AD or dementia identified a cluster-unit crossover trial.[75] The trial was conducted in two geriatric units in a state-operated psychiatric hospital and in a dementia-specific residential care facility in Oregon, USA, and enrolled 66 older adults with dementia to evaluate the effectiveness of ambient bright light therapy, delivered through a high-intensity, low-glare lighting system installed in the public areas of study units at both sites, at reducing depressive symptoms. Each lighting condition was provided for multiple 3-week periods in a predetermined sequence. The CSDD was used to assess depressive symptoms. Results did not support the use of ambient bright light therapy as a treatment for depressive symptoms in people with dementia.[75] Online supplementary etable 3 describes the type of interventions, the outcomes and the results of the primary studies included in the light therapy reviews.

Sensory garden and horticultural activities

Whear 2014 [76] (AMSTAR=7) investigated the impact of gardens and horticultural therapy on the mental and physical well-being of residents with dementia, in nursing homes and specialised dementia care facilities. This approach uses either 'sensory' gardens to stimulate the five senses (sight, vision, hearing, smell and touch), or plants and plant-related activities to improve well-being (horticultural therapy or therapeutic horticulture). Eighteen studies were identified: ten were quantitative studies (two RCTs (n=34), six pre-post studies, one crossover study, one prospective cohort study), seven qualitative and one used mixed methods. In one of the RCTs,[77] there was a non-statistically significant decline in verbal and physical aggression and non-verbal aggression, and total CMAI score (Online supplementary etable 4).

Gonzalez *et al*[78] (AMSTAR=3) examined the effects of sensory garden and horticultural activities in dementia care. Sixteen studies were identified, including 2 RCTs (n=149), one of which was cluster randomised, 11 pre-post studies, 2 case studies and 1 survey. In the smaller of the two RCTs,[79] verbal agitation significantly decreased in the outdoor horticultural group compared to the indoor horticultural group, while in the larger trial, the effect of participants in the horticultural group did not differ from the traditional activity group. (Connell *et al*[79] was included in both SRs.[76 78])

Online supplementary etable 4 describes the type of interventions, the outcomes and the results of the primary studies included in the sensory garden and horticultural activities reviews.

Music and dance therapy

Music therapy is the application of music and/or its elements (melody, rhythm, harmony, sound) by a qualified musical therapist, in order to support and stimulate various aspects of cognitive, emotional, social and physical needs, such as expression, communication, learning and forming relationships. Participants can passively listen to music or actively participate by singing, playing an instrument or moving. Dance therapy is a psychotherapeutic intervention that uses movement to 'further the emotional, cognitive, physical and social integration of the individual'.[80]

Six SRs that evaluated music therapy,[29 81–85] and one review that assessed live singing to people affected with dementia,[80] were identified.

The number of included primary studies in the reviews varied from 3 to 18, and the AMSTAR scores of the reviews ranged from 2 to 7.

The review by Ueda 2013[82] received the highest score (AMSTAR=7) and included nine randomised trials and nine controlled clinical trials that evaluated one music-related experience or a combination of music-related experiences, such as singing, listening, performing, rhythmic exercising and improvising. Uncontrolled before-and-after studies and case studies were excluded.

Participants were allocated to music therapy (mean of 36 min/day, 2–3 days/week for 10 weeks (range 1 day to 11 months)) or usual care for BPSD assessment. The music therapy comprised listening,[86–93] moving/dancing,[86 88 89 94–97] singing/playing a musical instrument[86 88 89 92 93 95 96 98–102] and in some occasion was administered in combination with exercise[103] and reminiscence therapy.[89 99 101]

Music therapy was effective in reducing behavioural symptoms (6 RCTs+5 CTs; 397 participants) (SMD=−0.49 (95% CI −0.82 to −0.17)), despite a moderate and statistically significant heterogeneity (I^2=58%, p=0.009). The same intervention achieved a statistically significant reduction on depression (4 RCTs+5 CTs; 250 participants) (SMD=−0.32 (95% CI −0.68 to −0.04); I^2=44%, p=0.08) and anxiety (SMD −0.64, 95% CI −1.05 to −0.24; I^2=55%; eight studies; 258 participants).

Whear *et al*[85] investigated the effectiveness of mealtime interventions, including music, on BPSD in people with dementia in residential nursing homes or care homes. Eleven studies were identified: one controlled trial, three before/after studies and seven repeated measure time series studies. The results of the studies were described narratively. One before/after study with 22 participants found that music played at mealtime improved physical and verbal, aggressive and non-aggressive, behaviour using the CMAI.

Seitz *et al*[29] (AMSTAR=6) identified 40 RCTs of non-pharmacological interventions, of which 3 studies with 133 participants[96 97 104] evaluated music therapy for BPSD of dementia in LTC facilities. Owing to the heterogeneity of the studies (study design, patient populations,

interventions, treatment duration and outcomes measured), the authors did not perform a meta-analysis. The behavioural outcome was measured either with a modified CMAI, Behavioural Pathology in Alzheimer's Disease Rating Scale (BEHAVE-AD) or the NPI. In one study, the music therapy was performed with movement, in a group, for 30 min, twice/week for 4 weeks.[97] In a second study, the music intervention lasted 30 min, 3 times/week for 6 weeks.[104] And in a third trial, the duration and frequency of individual sessions were not specified, but the therapy lasted 14 weeks.[96] Two of the three studies employing music found a statistically significant difference between treatment and control groups, but all three were at risk of randomisation bias and two had unclear bias of incomplete outcome data. All the studies were included in Ueda's review.[82]

The review by McDermott *et al*[81] (AMSTAR=4) searched MEDLINE, EMBASE, PsycINFO, CINAHL, the Cochrane Library, Web of Science, *Journal of Music Therapy* and *Nordic Journal of Music Therapy* and identified 18 studies of which 6 were RCTs (the remaining were non-randomised controlled studies (n=4), before-and-after studies (n=5) and qualitative and mixed-method studies (n=3)). Two trials[96 100] and the case–control study[104] were already included in the reviews described above.[29 82] Three RCTs (n=165), two of which were carried out by the same group, measured BPSD using either the NPI or BEHAVE-AD. In one trial, the music therapy (patients and music therapist play musical instruments to express emotions and interact) was performed for 30 min, 3 times/week for 1-month, followed by a 1-month interruption, over 6 months (Raglio 2010). In another study by the same group, the music therapy (singing and body movement with music to stimulate communication) was administered for 30 min, 30 times over 16 weeks.[96] In the third trial, the therapy was executed for 30 min, 3 times/week for 6 weeks (Svansdottir 2006). McDermott *et al* concluded that evidence for reduction of behavioural disturbance was consistent, but there were no high-quality longitudinal studies that demonstrated long-term benefits of music therapy. Of note, five of the RCTs included in the review were not included in the review by Ueda *et al*.[82]

Unlike the previous review, Vasionytė and Madison[83] (AMSTAR=4) provided a meta-analysis of the effects of music interventions (median=8 weeks; range 2–53 weeks) in patients with dementia, differentiating between different types of interventions (listening, active music therapy, recorded music, live music, selected music, individualised music, classical/relaxation music, popular/native music and group and individual interventions). This SR included 18 studies comprised of 6 RCTs,[87 90 105–108] 6 CCTs [88 91 98 102 109] and 6 pre–post-test studies. The outcomes evaluated were behaviour (measured with the CMAI, NPI-Q, Multidimensional Observation Scale for Elderly Participants (MOSES), an agitation checklist or a behavioural chart), affect, cognition and physiology. There was no statistically significant effect on behaviour (effect size (ES) 1.16, 95% CI −0.65 to 2.98; 8 studies, n=217) or affect (ES 0.38, 95% CI −0.56 to 1.32; 6 studies, n=109), while cognition (ES 1.56, 95% CI 1.11 to 2.01; 4 studies, n=63) and physiology (ES 0.72, 95% CI 0.36 to 1.08; 4 studies, n=88) were affected. Three of the RCTs, and four of the controlled trials, in this review, were also included in Ueda *et al*.[82]

The review by Wall and Duffy[84] included 13 studies that were presented narratively. The review was of low quality (AMSTAR score 2).

The review by Chatterton *et al*[80] evaluated the efficacy of 'live' singing to people with dementia for cognitive, behavioural, physiological and social outcomes. The study received an AMSTAR score of 1.

An additional SR[72] that aimed to assess the role of the physical environment in supporting person-centred dining in LTC identified four non-randomised studies, with different designs, that evaluated the effect of music on the incidence of agitated behaviours during mealtimes, among older adults with dementia, residing in special care units (SCUs).[110–113] The results of these studies showed that playing music during mealtime reduced the incidence of agitated behaviour.

Online supplementary etable 5a describes the type of interventions, the outcomes and the results of the primary studies included in the music therapy reviews.

Dance therapy

Two reviews evaluated dance therapy in patients with dementia.[114 115] The first review's objective was to evaluate the evidence concerning dancing interventions in physical and mental illnesses compared to other types of interventions or non-specific interventions.[115] The review received 3 points in the AMSTAR scoring system and identified 13 small studies reporting results from 11 randomised trials of which only one considered patients with dementia. The trial that considered participants with dementia included 29 participants (mean age 79 years, SD 7.7; 75% women) in a nursing home and evaluated the efficacy of dance and movement therapy delivered in nine sessions, lasting 30 to 45 min each, once-a-week.[116] The outcome measures included the word list savings score, the Clock drawing test (for visual spatial ability), the Cookie Theft picture description task from the Boston Diagnostic Aphasia test and the Nurses' Observation Scale for Geriatric Patients (NOSGER). The results did not show any important differences in favour of dance therapy.

The second SR aimed to evaluate the effects of dance (movement) therapy and ballroom dancing, compared to usual care, for adults with physical and mental illnesses.[114] The review received only one point on the AMSTAR Scale and identified only one study that investigated the intervention in a population affected by dementia[116] and which was also included in the review above.

Snoezelen multisensory stimulation therapy

Snoezelen multisensory stimulation therapy (SMST) comprises multiple stimuli and is aimed at stimulating the primary senses of sight, hearing, touch, taste and smell. The intervention is provided in specially designed rooms, which provide diverse sensory-stimulating effects/material including music, aroma, bubble tubes, fibre optic sprays and moving shapes projected across walls. SMST was investigated by two reviews.[29 31]

The first was an overview of reviews,[31] and its evidence for SMST was based on a Cochrane review that included three studies.[117] The inclusion criterion was any randomised trial that assessed the efficacy of SMST and/or multisensory stimulation to treat people over 60 years of age suffering from dementia. The outcomes of interest included behaviour, mood, cognition, physiological indices and client–carer communication, as well as short-term effects measured during the sessions or postsession, and longer term benefits measured postintervention and at follow-up.

The three included primary studies evaluated a total of 311 patients with dementia, aged 60 or older. The first was a randomised trial[118] that compared eight standardised multisensory programmes with eight standardised activity sessions. Both programmes were implemented on a one-to-one basis, twice-a-week, with each session lasting 30 min. Fifty participants (25 women, mean age 78) with a diagnosis of AD (N=33), vascular dementia (N=7) or a mixed diagnosis (N=10) were enrolled. The objectives of the trial were the immediate effects of SMST on the behaviours of older people with dementia, the carryover effects of SMST on mood and behaviour to day-hospitals and home environments and the maintenance effects of SMST on mood, behaviour and cognition over time. The effects of SMST on behaviour were measured by INTERACT.[119] The generalisation effects were measured by three outcome measures: the carryover effect of day-hospitals was measured with the General Behaviour and Community Skills subscales of REHAB (Baker 1988); the carryover effect to home, at midintervention and postintervention, was measured with the Behaviour and Mood Disturbance Scale (BMD) and the Behaviour Rating Scale (BRS) of the Clifton Assessment Procedures for the Elderly (CAPE). The maintenance effect (at the 1-month postintervention follow-up) on behaviours and cognition were measured by REHAB, BMD, the Cognitive Assessment Scale (CAS) of CAPE and Mini-Mental State Examination (MMSE). No significant effects on any scale of behavioural symptoms were found either immediately after intervention or at 1-month follow-up.

The second study[120] was a quasi-experimental pre-test and post-test design with cluster randomisation performed at a ward level, which compared a 15-month, 24-hour individualised care plan that was integrated with SMST, with 15-month usual care. The study included 136 participants diagnosed with AD, vascular or mixed dementia from three different countries (UK=94 day patients, the Dutch sample=26 inpatients. Swedish sample=16 inpatients). There was a significant group difference in the mean baseline MMSE scores (data from the UK and the Dutch only) between the SMST group (9.4) and the control group (6.7) (p=0.01). All participants attended eight, 30-min sessions on a one-to-one basis according to their group assignment. The sessions were conducted by the same key workers throughout the study period. The following outcomes measured the short-term effects of SMST on behaviours: (1) INTERACT (22-item) measured behaviours during the sessions; (2) INTERACT (12-item) measured behaviours 10 min before and 10 min after the sessions and (3) Behaviour Observation Scale for Intra-mural Psycho-Geriatrics (GIP) measured behaviours that were videotaped during the sessions in the Netherlands sample.

The study showed significant effects on two behavioural items of INTERACT during sessions: enjoying oneself (MD=−0.74; 95% CI (−1.29 to −0.19); z=2.62, p=0.01) and bored/inactive (MD=−0.56; 95% CI (−1.11 to −0.01); z=1.99, p=0.05). There were no longer term treatment effects of the integrated SMST-care programme on behaviour.

The third study[121 122] assessed the effects of SMST when integrated into 24-hour daily care on nursing home residents with dementia. A total of 125 patients with moderate or severe dementia and care dependency were recruited from six old age psychiatry wards for pre-test. A cluster randomised design was used to assign the wards to either experimental (integrated SMST-care programme) or control (usual activity) conditions. Twelve old age psychiatry wards in six nursing homes (out of 19 homes) were recruited to the study. At baseline, 125 participants (woman 79%, mean age 84) were recruited and were assigned to experimental or control conditions according to the ward in which they stayed. For the experimental group, participants were given a stimulus-preference screening in 10 weekly one-hour sessions to identify their preferred sensory stimuli. Subsequently, individual SMST-care plans were developed for each participant based on their life history, stimulus preference and discussions from multidisciplinary conferences. Certified nursing assistants (CNAs) used multisensory stimuli in the 24-hour care of the experimental participants. Participants in the control group were provided with individual usual care. A minimum period of 3 months was used for experimental and control conditions.

The short-term effects of the integrated SMST-care programme on behaviours were measured using a modified version of INTERACT, in which six items were deleted and eight new items were added during morning care sessions. The long-term effects of integrated SMST-care programmes on behaviours, mood and interaction were evaluated at the 18-month follow-up using the eight items of GIP for apathy, anxiety and disoriented behaviours, the Dutch version of CMAI for agitated behaviours, physically non-aggressive

behaviour and verbally agitated behaviours and the Cornell Scale for Depression for depressive symptoms. In terms of behavioural disturbances, when compared to the control, the 24-hour integrated SMST-care programme[122] showed a significant effect on two behavioural items of INTERACT during sessions: enjoying self (MD=−0.74; 95% CI (−1.29 to −0.19); z=2.62, p=0.01) and bored/inactive (MD=−0.56; 95% CI (−1.11 to −0.01); z=1.99, p=0.05). There were no longer term treatment effects of the integrated SMST-care programme on behaviour. In terms of mood, there were significant improvements in one mood item of INTREACT during sessions: the SMST group was happier and more content than the control group (MD=−0.84; 95% CI (−1.39 to −0.29); z=2.98, p=0.003). There were no significant effects of the 24-hour integrated SMST at postintervention. The fourth review scored 6 in the AMSTAR evaluation and investigated different non-pharmacological interventions including SMST for the treatment of BPSD.[29] The review identified only one study that was included in the above cited review.[122] Online supplementary etable 6 describes SMST-based interventions, outcomes and results of the primary studies included in the reviews.

Transcutaneous electrical nerve stimulation

TENS is a simple, non-invasive, non-pharmacological intervention commonly used for pain control[123] and occasionally for neurological and psychiatric conditions such as drug/alcohol dependency, headaches and depression.[31] TENS consists of attaching electrodes to the skin and applying an electrical current, whose frequency can vary from low (<10 Hz) to high (>50 Hz).

Two reviews were identified. One review that evaluated current treatment options for sleep disturbance in AD scored 3 in the AMSTAR evaluation.[124] Different non-pharmacological interventions were considered, including bright light therapy, behavioural and multifaceted interventions (combined increased daytime physical activity and exercise, decreased daytime in-bed time, daily sunlight exposure, structured bedtime routine and decreased night-time noise and light) and TENS. For the latter intervention, only one randomised trial of 19 nursing home residents was identified. The study did not evaluate behavioural outcomes.

A Cochrane review that was included in O'Neil's review[31] was also considered.[125] The review was focused only on RCTs that enrolled inpatients and outpatients of any age (with or without caregivers), with a diagnosis of dementia. The outcomes of interest included visual and verbal short-term and long-term memory, semantic verbal fluency, circadian rest-activity rhythm, affect/depression, level of independent functioning, adverse effects and dropouts due to inefficacy. The review identified and included nine trials that were performed in Japan and the Netherlands. The Dutch studies were performed by the same group of authors.[126–131] These studies were randomised placebo-controlled trials, and the participants were chosen from a group of 350–500 residents of a residential home for older people. The age range of the participants was ∼70 to mid-90 years and were mostly women (>80%). All participants met NINCDS-ADRDA criteria for the clinical diagnosis of probable AD; most participants had early AD, but some had moderate AD. Participants generally had scores of 17 or less on the Hamilton Depression Rating Scale. All included studies used a similar TENS protocol, except the most recent one published in 2002, which addressed cranial electrostimulation.

The remaining three publications were performed by a group of authors from Japan and describe the results of the same study.[132] The study design was a double-blind crossover and, in contrast to the Dutch studies, participants were thought to have multiinfarct dementia or AD and were selected on the basis of irregular sleep-wake patterns in conjunction with nocturnal behaviour disorders and/or dementia. Twenty-seven participants completed the study. The intervention used a HESS-10 stimulator with rectangular pulse waveforms at a frequency of 6–80 Hz, a pulse duration of 0.2 ms maximum, 256 µAmps and an amplitude of 6–8 V. The outcomes evaluated were sleep disorder, motivation, behaviour disorder, intelligence, emotion, language, neurological signs, subjective symptoms and activities of daily life. All of these were rated on a five-point scale: absence of the related symptom, 0; mildly disturbed, 1; moderately disturbed, 2; markedly disturbed, 3 and severely disturbed, 4. Of the nine studies, only three could be included in a meta-analysis for a combined total of 63 participants. Two of these studies were conducted in the Netherlands, and one was conducted in Japan. Results, however, were inconclusive. It should be noted that none of the other studies mentioned adverse effects, although it is unclear if adverse events were monitored.

Online supplementary etable 7 describes TENS-based interventions, outcomes and results of the primary studies included in the reviews.

Cognitive/emotion-oriented interventions

Cognitive stimulation

Cognitive stimulation involves a variety of pleasurable activities, such as word games, puzzles, music, cooking, gardening and discussing past and present events, and is usually carried out by trained personnel with small groups of four to five people. It lasts for 45 min, minimally 2 times/week. It is based on Reality Orientation, which was developed in the 1950s to counteract the confusion and disorientation of older people during hospitalisations. Seven reviews were identified.[133–139]

Woods 2012[133] (AMSTAR score=10) was a Cochrane review that identified 15 RCTs that used cognitive stimulation for people with dementia. The authors stated that most of the studies were of low quality, but that generally, investigators had taken measures to protect against

the risk of allocation concealment bias. In a meta-analysis of three trials[140–142] (n=190 participants), the intervention had no effect on problem behaviours (SMD −0.14, 95% CI −0.44 to 0.17; I^2=0%, p=0.57).

The review by Aguirre *et al* in 2013[134] (AMSTAR score=5) evaluated the effectiveness of cognitive stimulation in patients with dementia and identified nine RCTs. Three trials that considered behaviour-related outcomes were identified. These trials were already included in Woods's review[133] and reached the same conclusion.

Alves *et al* in 2013[135] (AMSTAR score=4) identified four RCTs of cognitive interventions for AD patients. Only one trial that measured BPSD as an outcome was identified. The study population was composed of 32 patients with a score between 10 and 24 on the Mini Mental State Examination, no history of antidepressant medication and a total NPI score >5 points arising from at least 2 domains of behaviour. The cognitive stimulation intervention was administered individually and focused on a set of tasks requiring executive functions and working memory. The study found a statistically significant reduction of BPSD (MD −2.06; 95% CI −2.91 to −1.21).

The study of Carrion *et al* in 2013[136] (AMSTAR score=4) found 17 RCTs of cognition-oriented interventions (reality orientation and skills training) for dementia sufferers. Challenging behaviour was evaluated in only two trials (n=156 and n=44, respectively) that employed the two categories of cognitive interventions, using the NPI and the Revised Memory and Behaviour Problems Checklist. In both RCTs, the intervention group had a smaller increase in change from baseline compared to the control group. Owing to the heterogeneity among the studies, the authors decided a meta-analysis was inappropriate.

Yu 2009[137] (AMSTAR=3) included 15 studies (9 RCTs, 5 CCTs and 1 before–after study), in addition to 5 case studies and 3 undefined studies, all of which investigated different types of cognitive interventions for AD and dementia. The only study, a CCT (n=32 with early-stage AD), that evaluated the effect of cognitive stimulation on behavioural disturbances, showed larger improvement than the cognitive training group.

Olazarán *et al* in 2010[138] (AMSTAR=4) identified 179 RCTs of diverse types of non-pharmacological interventions for AD patients and examined problem behaviour, mood, QoL, cognition, ADLs, mechanical restraint and institutionalisation of patients and mood, psychological well-being and QoL of CGs. The authors performed a meta-analysis of three low-quality RCTs to determine the effect of cognitive stimulation on problem behaviour and mood. There was a non-statistically significant reduction in problem behaviour (group session cognitive stimulation (ES=0.61; 95% CI 0.09 to 1.12)). The primary study by Baines *et al*[140] was included in the Woods[133] review above, while the study by Robichaud *et al*[143] was included in the review by Kim[144] which examined behaviour management techniques described below.

Thirty-three RCTs, employing cognitive interventions for cognitively impaired individuals (dementia and mild cognitive impairment), were identified in Kurz *et al*[145] (AMSTAR score=2). Twelve of these trials examined behavioural disturbances, but only three studies found a significant effect of the intervention.

Zientz *et al*[139] (AMSTAR score=2) identified three studies (two RCTs and one RCT or CCT; n=124 participants) of caregiver-administered cognitive stimulation for individuals with AD. One of the randomised trials (n=16) found that individuals who received the intervention displayed fewer behavioural problems compared to those who had not been given the intervention.

Online supplementary etable 8 describes cognitive stimulation-based interventions, outcomes and results of the primary studies included in the reviews.

Reminiscence therapy

Reminiscence therapy is a non-pharmacological intervention that involves the discussion of past experiences, events and activities with family members or other groups of people. The intervention uses materials such as photographs, books, old newspapers and familiar items from the past to inspire reminiscences and facilitate people to share and value their experiences. Three reviews assessed reminiscence therapy as a non-pharmacological intervention to treat agitated behaviour in patients with dementia.[29 146 147]

The first review[29] received the highest score (AMSTAR score of 6) and considered all non-pharmacological interventions to treat relevant outcomes in patients with dementia. The review identified two small studies involving a total of 107 patients[148 149] performed in care facilities. The NPI and the Clifton Assessment Procedures for the Elderly-Behavioural Rating Scale (CAPE-BRS) were used to measure BPSD. Seitz *et al*[29] reported that this outcome was unaffected in one study,[149] while the effect of the intervention was unclear in the other study.[148]

The second review[147] was focused only on reminiscence therapy as a sole treatment of behavioural outcomes for patients with dementia. The review was of low methodological quality (AMSTAR score=3). The results were presented in a narrative synthesis. The review included five trials with a before–after design, containing 258 patients affected by dementia. The studies considered different interventions. Two studies (one with 31 participants (Haight 2006)[150] and the other with 17 participants (Morgan 2010[151])) assessed a life review or story approach and found significant improvements in depression, communication, positive mood and cognition. The third study (101 participants (Lai 2004[152])) evaluated specific reminiscence, which produced a life-story book using personalised triggers for each person's life history. No significant differences were observed between groups except for outcomes such as well-being and social engagement. The remaining two trials (involving 73 participants[153]) and 36 participants[154]) evaluated individual reminiscence approaches.

One study used six weekly sessions, which focused on a particular life phase, such as childhood or family life, while the other study used a basket of visual and auditory activities, based on five themes, such as musical instruments, designed to stimulate reminiscence. No significant differences were observed between the groups in terms of behavioural outcomes.

The third review[146] focused on whether reminiscence therapy could alleviate depressive symptoms in adults with dementia, but its methodological quality was extremely low (AMSTAR score=1). Four primary studies with a pre–post-test design were included and were described individually, three of which were randomised trials and one of which comprised a single group.

Online supplementary etable 9 describes reminiscence therapy interventions, outcomes and results of the primary studies included in the reviews.

Validation therapy

Validation therapy is based on the general principle of the acceptance of the reality and personal truth of another person's experience and incorporates a range of specific techniques. Validation therapy is intended to give the individual an opportunity to resolve unfinished conflicts by encouraging and validating the expression of feelings. The specific interventions and techniques are based on a synthesis of behavioural and psychotherapeutic methods. The approach can be used as a structured therapeutic activity in a group setting, usually lasting several weeks, or it can be conducted individually as part of an ongoing approach to facilitate communication as a supplement to group work. The validation therapy techniques comprised non-threatening, simple concrete words; speaking in a clear, low and empathic tone of voice; rephrasing and paraphrasing unclear verbal communication; responding to meanings through explicit and implicit verbal and non-verbal communication and mirroring verbal and non-verbal communication.

One Cochrane review that evaluated the effectiveness of validation therapy to reduce BPSD was identified (AMSTAR score=7).[155] The review included only randomised trials of participants over 65 years of age, diagnosed with Alzheimer's disease, dementia or other forms of cognitive impairment, according to ICD 10, DSM IV or comparable criteria. The outcomes of interest were cognition, behaviour, emotional state and activities of daily living. The review, updated in 2005, included three randomised trials (n=155 participants).[156–158] Another SR[159] that evaluated the effective characteristics of residential LTC settings for people with dementia identified one trial[158] that was included in the Cochrane review.[155]

Primary studies

Among the primary studies, the first study[156] (n=31) was performed in a nursing home and used an intervention (30 min once-per-week for 6 weeks) that included activities such as discussion of a previously agreed subject, singing and movement, followed by a closing ritual and refreshments. Behaviour was measured with the Behaviour Assessment Tool. The control groups consisted of reminiscence therapy, which followed the guidance of a reality orientation manual (cues such as flannel boards and calendars were used to promote orientation) and usual care. At 6 weeks, validation therapy was associated with a decrease of problem behaviours (MD=−5.97, 95% CI −9.43 to −2.51; p<0.001; based on an analysis of participants who completed the study).

The second study[157] enrolled 36 patients with moderate-to-severe disorientation of which 25 had a diagnosis of dementia. The study was performed in a LTC institution in the USA. The validation therapy was performed twice-a-week for 9 months; details of the validation therapy were not given. Agitation was measured using the Minimal Social Behaviour Scale (MSBS; Farina 1957) where a reduction in score indicated improvement. No effects on behaviour were detected.

The last study[158] was carried out in 'skilled-care nursing homes' in the USA. In this study, patients were included if they had at least a moderate level of dementia (assessed by the Short Portable Mental Status Questionnaire—SPMSQ—and the Validation Screening Instrument) and displayed problem behaviours, such as physical aggression. Validation therapy (four meetings lasting 30 min per week for 52 weeks) was composed of groups divided into four sessions of 5–10 min each. The first session included introductions, salutations and singing. The second session involved conversation regarding a subject of interest; recalling past events was promoted. The third session comprised an activity programme and singing or poetry. The fourth session involved refreshments and individual goodbyes. Agitation was measured with the CMAI,[160] carried out as CMAI(N) nurse observed and CMAI(O) non-participant observed. The authors reported that depression (MOSES) decreased at 12 months (MD −4.01, 95% CI −7.74 to − 0.28; p=0.04, based on an analysis of participants (66 out of 88) who completed the study. Online supplementary etable 10 describes validation therapy interventions, outcomes and results of the primary studies included in the reviews.

Simulated presence therapy

SPT involves the use of video/audiotapes made by family members containing scripted 'telephone conversations' about cherished memories from earlier parts of a person's life, in an effort to stir remote memory, improve behavioural symptoms and enhance the quality of life among people with dementia.[161] Two SRs were identified.[30 162]

The first review was written by only one reviewer and scored 3 on the AMSTAR Scale. The review was aimed at investigating the effectiveness of SPT for challenging

behaviours in dementia. The review searched PubMed, PsycINFO and the Web of Science, conducted hand searches of relevant articles and considered for inclusion, studies that reported pre-test and post-test, or pre-test and during-test data for SPT for challenging behaviours. The SPT consisted of audio or videotapes prepared by a spouse, family members, the caregiver, a psychologist, a surrogate or researchers. Of the seven included primary studies, only the data from four could be pooled, showing an overall mean effect of 0.70, with a 95% CI of 0.38 to 1.02, but with statistically significant heterogeneity (I^2=71%, p=0.02).

The second review examined the efficacy of any non-pharmacological intervention (including SPT) to reduce BPSD in patients with dementia.[162] After searching the databases MEDLINE, CINAHL, PsycINFO, EMBASE, Dissertations International and the Cochrane Database of Systematic Review, from 1974 to May 2008, the review identified only two studies that were included in the Zetteler review above.[30] Online supplementary etable 11 describes SPT, outcomes and results of the primary studies included in the reviews.

Behavioural management techniques

There is a multitude of behavioural interventions that constitute behavioural management techniques, which include behavioural or cognitive–behavioural therapy, functional analysis of specific behaviour, individualised behavioural reinforcement strategies, communication training and other therapies such as habit training, progressive muscle relaxation and token economies. These behavioural interventions can be realised either with the patient or by training caregivers to perform the intervention with the patient.

One overview of reviews and four SRs that considered behavioural interventions were identified. The overview of reviews by O'Neil 2011[31] identified three SRs, and after performing additional searches of primary studies, included nine randomised trials.[163–171] The overview authors' conclusions were in support of behavioural management techniques as effective interventions for behavioural symptoms of dementia although they admitted there were mixed results. In addition, the authors highlighted some concerns regarding the variety of specific interventions and methodological limitations in many studies and advocated additional research with carefully assessed outcomes.

A Health Technology Assessment (HTA)[172] report that aimed to evaluate the clinical and cost-effectiveness of sensory, psychological and behavioural interventions to manage agitation in older adults with dementia, systematically searched and identified four randomised trials.[166 173–175] The intervention in all four trials was caregiver-based. The HTA authors concluded that the evidence in favour of the behavioural management techniques was limited.

A Cochrane review[176] aimed to assess the effects of functional analysis-based interventions for people with dementia (and their caregivers) living in their own home or other settings and identified 18 randomised trials. The development of the intervention was driven by various approaches and theories, including knowledge and/or training approaches, the stress-coping model, the progressively lowered stress threshold model and problem-solving approaches. In addition, the time frame in which the intervention was delivered varied from 9 days to 18 months and the number of sessions used to deliver the intervention varied widely, from 1 to 2 sessions to more than 10 sessions. Of the 18 studies included,[164–168 173 174 177–187] the authors were able to meta-analyse data from 4 trials,[178 180 182 188] of which one contained unpublished data. There were no significant reductions in the incidence of challenging behaviours reported postintervention in four family care studies (SMD 0.02, 95% CI −0.13 to 0.17, p=0.80, N=722).

Among 179 RCTs of diverse types of non-pharmacological interventions for AD patients, identified by Olazarán 2010[138] (AMSTAR score=4), the authors performed a meta-analysis of three low quality RCTs of behavioural interventions (analysis and modification of antecedents and consequences of behaviour) and found a statistically significant reduction in problem behaviour (ES=0.57, 95% CI 0.21 to 0.92; 3 trials; n=167). The same authors carried out another meta-analysis of four low-quality RCTs of care staff training in behavioural management and found a reduction in problem behaviour (ES=0.22, 95% CI 0.02 to 0.43; 4 trials; n=370).

Two primary studies examined emotion-oriented care. The first study[189] was a RCT of NH residents (n=146 older residents with AD, mixed AD and vascular dementia and dementia syndrome; mean age 84). The intervention of emotion-oriented care was associated with less anxious behaviour in the group of residents who needed less assistance/care compared to similar residents in the usual care group. The second study[190] was a cluster randomised study of residential care homes (n=16 homes; n=151 residents). The authors reported that there was no statistically significant effect of the intervention on any behavioural outcome, including behavioural problems. Teri 2000[174] was included in the HTA;[172] Gormley 2001[173] and Teri 2005[166] were included in the Brodaty 2012 review;[191] Gonyea 2006[183] was included in reviews in behaviour management techniques and McCallion 1999 and Teri 2005 were included in Eggenberger 2013.[192]

Eggenberger 2013[192] (AMSTAR score=3) aimed to evaluate interventions that were designed to enhance communication or interaction in dementia care, in any setting. Review authors identified 12 studies (7 randomised trials, 2 controlled clinical trials and 3 before–after studies) that focused on communication training for staff in institutions and family caregivers at home. In institutional settings, the results on challenging behaviour, of residents with dementia, were not consistent.

Four studies reported a significant reduction of challenging behaviour.[171 193 194] McCallion *et al*,[171] for instance, demonstrated a decrease of physically aggressive behaviour (15.16 (SD 9.81) to 12.21 (SD 8.31), p<0.001)) and a reduced mean occurrence of verbally aggressive behaviour in patients with dementia (16.22 (SD 10.31) to 12.88 (SD 8.39), p<0.001)). In addition, one trial demonstrated a significant decrease of residents' agitation during care routines (F(1.7=5.12, p<0.05)).[194] Conversely, three studies reported no effect on challenging behaviour of people with dementia.[195–197] Only one trial[167] was included in the Brodaty 2012 review.[191]

Kim *et al*[144] conducted a review to assess the effectiveness of occupational therapy on behavioural problems and depression in patients with dementia. MEDLINE, CINAHL, ProQuest and The Cochrane Library were searched up to the end of March 2011. The AMSTAR score was 7. The authors defined occupational therapy as an application of 'activity analysis, caregiver training, sensory stimulation, behaviour control skill teaching, physical and social environmental modification, cognitive training, and purposeful activity'. The review identified nine randomised trials with a total of 751 participants. On the basis of the type of intervention, the authors categorised four studies[118 120 143 198] as sensory stimulation, three studies[198–200] as functional task activities and two studies[200 201] as environmental modification. The authors performed a meta-analysis of the trials with occupational therapy-based sensory stimulation and found an ES of 0.32 (95% CI 0.04 to 0.59; 250 participants; no significant heterogeneity). No significant effect was detected for OT-based functional task activities (0.15, 95% CI −0.17 to 0.47; 203 participants) or environmental modification (0.13, 95% CI −0.09 to 0.36; 298 participants).

Primary studies

Overall 22 trials were evaluated in the 6 reviews that were included. Except for one study performed in Taiwan, all the studies were carried out in Europe, the USA and Australia. Thirteen studies were performed in family care settings.[164 167 168 173 174 178 180 182–187] Three studies with a total of 740 residents were conducted in care homes.[165 179 181] Finally, one study was located in an assisted living setting[166] and the other in a hospital setting.[177]

Characteristics of the interventions varied greatly across the trials. Fifteen trials were focused on enhancing communication skills in family and formal caregivers. Eighteen trials focused on functional activity of which four were described as a behavioural management intervention. The intervention in one trial involved caregiver training on verbal or non-verbal communication focused on activities of daily living. Another trial was dedicated to teaching participants the basic technique for progressive muscle relaxation.[170] Time delivery of the intervention also varied widely. However, as noted by Moniz-Cook, the intervention delivery was determined by setting: the interventions in care homes were provided weekly and lasted for 6 months.[176] In one family care study, the intervention was provided in just 4 sessions over 8 weeks.[173] Follow-up data varied from a few weeks to 24 months.

Setting-based description

Family care: In this setting, family caregivers assisted people with dementia at home, with or without support from formal caregivers, healthcare workers and adult day care centres. Thirteen trials were conducted in a family care setting.[164 166 168 173 174 176 178 180 182–185 187 200 201]

Six of these trials investigated an intervention that was focused on enhancing communication skills of the caregiver. The duration of the intervention ranged from 3 weeks[184] to 12 months.[178] The number of weekly sessions administered were, according to a classification proposed by Moniz-Cook 2012,[176] high (>10 session) in three trials,[164 178 180 185] moderate-high (6–10 sessions) in one trial,[185] moderate (3 to 5 sessions) in one trial[182] and minimal (1 to 2 sessions) in one trial.[184] The participants who delivered the interventions varied from trial to trial: occupational therapists;[182] trained nurses or social workers;[180] professionals specialised in the REACH programme;[178] healthcare professionals supervised by an old age psychologist;[164] psychologists[185] or trial investigator together with an experienced nurse.[184]

Of the 13 trials in the family care setting, 4 investigated a behavioural intervention that was focused on providing support to the caregiver. The interventions lasted from 5 weeks[183] to 18 months,[186] with the number of sessions that varied from 4[186] to 8 sessions,[187] with home visits[176 187] and associated with or followed by telephone contacts.[166 168] Overall, the intervention dosage was high for three trials,[166 168 176] medium-high in one trial[187] and moderate in one trial.[183] The interventions were delivered by different healthcare experts: community mental health nurses;[176] therapists;[187] occupational therapists;[168] community consultants trained by an old age psychologist.[166]

The remaining two trials evaluated behavioural management techniques. Teri 2000[174] compared the intervention consisting of eight weekly and three biweekly sessions (high-intensity intervention) with pharmacological interventions or placebo. The intervention was provided by a therapist with a master's degree and 1-year clinical experience, but was not reported in detail. The postintervention evaluation started at 4 months, and the follow-up lasted beyond 12 months. The second study[173] did not completely describe the intervention for behavioural management. The intervention was delivered in four sessions (moderate intensity) over 8 weeks by the trial investigator.

In terms of results, no statistically significant change in the incidence of challenging behaviours was observed in any of the studies. Moniz-Cook 2012 meta-analysed data of four studies (N=722), but did not find any difference

among the groups (SMD 0.02, 95% CI −0.13 to 0.17, p=0.80; I^2=0%).[168 178 180 182] At follow-up of 6 months, two studies did not show any significant effect of behavioural management techniques.[168 180]

When the frequency of challenging behaviours was examined, none of the studies detected a significant difference even when a meta-analysis, using the data from 10 studies, was performed (SMD −0.05, 95% CI −0.17 to 0.07).

Assisted living: In this setting, people with dementia lived in a residence, did not require full-time nursing care, but needed assistance with some ADLs, such as bathing, dressing and eating. Family members could still act as intermittent caregivers during visits by providing different types of support for ADLs, instrumental ADLs (eg, laundry washing, room cleaning, transportation to a doctor's office), socioemotional support (eg, talking, reminiscing, socialising), monitoring care provision or advocating.[202] One study evaluated a behavioural management intervention to improve caregiver training to manage residents with dementia.[166] The intervention intensity was medium-high, delivered by a clinical psychologist and graduate nursing students who performed two half-day group workshops and four individualised sessions with a follow-up 2 months after the termination of the intervention. Results for residents showed a statistically significant effect, in intent-to-treat analyses, in favour of the STAR-caregivers (STAR-C) intervention, general behavioural disturbance (measured by the Revised Memory and Behaviour Problems Checklist (RMBPC), NPI and ABID) and depression.

Residential care: This setting referred to assisted living residences and nursing homes. The latter included facilities for people with dementia who needed significant nursing care. Three cluster randomised trials were conducted in residential care with a total of 743 residents.[165 179 181]

In 15 residential care sites across metropolitan areas in Sydney (Australia), Chenoweth *et al*[179] examined the efficacy of person-centred care versus usual care. The intervention was a high-intensity, person-centred care, based on the needs-driven model in which staff, selected by managers, administered training sessions to caregivers. The topics covered during the sessions were derived from Bradford University's training manual. The duration of the intervention was 4 months, and the overall follow-up was 8 months. The total number of residents enrolled was 289. During follow-up, the mean agitation score (measured with the CMAI) in the person-centred care group decreased significantly, from 47.5 (9.1) at baseline, to 37.2 (9.1) at 6 months (p=0.01), compared to usual care in which agitation increased from 50.3 (6.8) at baseline to 57.7 (6.8) at 6 months (p value not reported).

In 12 residential homes, Fossey 2006[181] allocated 346 residents to an intervention that consisted of training and support delivered to nursing home staff over 10 months, focusing on person-centred care and skill development for the management of agitated behaviour in dementia. The comparison intervention was usual care. The high-intensity intervention was delivered during the whole period of follow-up (12 months) by a psychologist, an occupational therapist or a nurse supervised weekly by the trial investigators. The study's main outcome measure was mean levels of agitated and disruptive behaviour measured with the CMAI, but no significant difference between the groups was detected.

In 10 residential homes, Proctor 1999[165] allocated 120 patients to a staff-based intervention or usual care. The intervention, of high-medium intensity, consisting of training on "psychosocial management of residents'" behavioural problems, was delivered through seven, 1-hour seminars by members of the hospital outreach team and psychiatric nurse during the whole period of follow-up (6 months). The seminars covered topics that the staff had identified to improve their knowledge and skills (eg, management of dementia, aggression, etc). The Crichton Royal Behavioural Rating Scale was used to assess behavioural characteristics of residents (0=no problems, 38=severe problems). In addition, the geriatric mental state schedule and the diagnostic algorithm AGECAT (Automatic Geriatric Examination for Computer-Assisted Taxonomy) were used to assess the effect of the intervention on residents' organic and depressive symptoms. Despite the control group having mean scores on the Crichton Scale higher than the intervention group at follow-up, this difference was not statistically significant (mean score −0.7 (−3.0 to 1.6)).

Although the clustered trials reported different types of interventions, intensities, durations and follow-up times, Moniz-Cook *et al*[176] attempted an analysis using two studies and found a significant reduction in behavioural disturbances (SMD, −0.21, 95% CI −0.39 to −0.03; p=0.02; I^2=9%).

Online supplementary etable 12 describes behavioural management technique-based interventions, outcomes and results of the primary studies included in the reviews.

Multicomponent interventions

Integrated interventions combining psychiatric and nursing home care

Collet 2010[203] (AMSTAR score=5) carried out a SR in MEDLINE, PsycINFO and PubMed to determine the efficacy of interventions that combined psychiatric and nursing home care in nursing home residents. The authors identified 4 RCTs (n=371 participants), 1 retrospective cohort study and 3 prospective case studies. All the studies used tailored treatment plans that combined psychosocial, nursing, medical and pharmacological interventions. The results of the RCTs were described narratively. Three out of the four randomised trials reported an improvement in behaviour and mood, while

one trial found no difference among the groups (online supplementary etable 13).

Combination of environmental sensory stimulation

A SR[204] that evaluated the effective characteristics of residential LTC settings for people with dementia identified one controlled clinical trial.[205] The intervention in this trial was provided in five nursing homes and consisted of 15 agitated participants with dementia taking showers, 15 agitated participants with dementia taking walks in an environment where natural elements such as large bright pictures coordinated with audio, including bird songs, bird pictures, the sound of water flowing gently, as well as food (such as banana, pudding and soda). The control group consisted of 15 other agitated participants with dementia that received only usual care. Agitation was measured with a modified version of CMAI. The analysis showed a significant decline in agitation in the treatment group with respect to the comparison group.

Combination of music and hand massage

Another review[72] that aimed to assess the role of physical environment in supporting person-centred dining in LTC identified another trial[206] that was not included in the previous reviews. This trial applied an experimental 3×3 repeated measures design and included 41 residents with dementia living in three SCUs. Participants were mostly women (78.0%), with a mean age of 84.5 years (SD=6.0). Residents in the treatment group received each of three treatments (hand massage, favourite music and the combination of both) with each treatment lasting 10 min; the control group did not receive any treatment. The CMAI was used to measure agitation. The results showed that each single and combined treatment were effective in significantly decreasing agitation immediately following the intervention and one-hour postintervention.

Online supplementary etable 13 describes multicomponent interventions, outcomes and results of the primary studies included in the reviews.

Other interventions

Exercise therapy

The systematic search identified two reviews[207 208] that evaluated the efficacy of only exercise as a therapeutic intervention.

The review by Potter *et al*[207] received 6 points in the AMSTAR assessment and identified 13 randomised trials that evaluated the effects of physical activity on physical functioning, quality of life and depression in older people with dementia. Only four of these trials investigated depression as an outcome using four different rating scales (Geriatric Depression Scale (GDS15); Montgomery-Asberg Depression Rating Scale (MADRS); a Dutch Evaluation scale for older patients (subscale used) and the CSDD) and two trials measured behavioural disturbances (NPI and Stockton Geriatric Rating Scale).

The review authors stated that the methods of randomisation were clear and adequate in six of the trials with only three of these also providing methods of allocation concealment; eight of the trials reported information regarding losses to follow-up and six trials declared intention-to-treat analysis.

The first study, Burgener 2008,[209] was a small trial (n=43) carried out in community-dwelling older people with dementia. The intervention was multimodal comprising Tai Chi (sitting and standing; 60 min, 3 times-a-week for 40 weeks) and cognitive–behavioural therapies. Depressive symptoms were measured with the GDS15. The authors reported that at 20 weeks of observation, there were no statistical differences between the groups.

The second study, Rolland 2007,[210] was a larger trial (n=134) carried out in nursing homes. Participants performed exercises including stretching, walking, strength, flexibility and balance training for 60 min, 2 times/week for 40 weeks. Depression was evaluated using the MADRS. After 12 months of observation, the MADRS score (13.4±8.0) was higher in the intervention group than in the control group (14.8±7.2), but without any statistical difference.

The third study[103] was also a small study (n=25) conducted in a psychiatric hospital. The invention was composed of strength, balance and flexibility exercises with music, 30 min daily for 12 weeks. Depression was measured in older patients with the subscale *Beoordelingsschaal voor Oudere Patienten*. At 3 months follow-up, no significant difference in depressive behaviour was observed.

The last study[164] was a larger trial (n=153) that enrolled community-dwelling patients and their caregivers. The exercise intervention, for patients, comprised aerobic, endurance, strength, balance and flexibility training, 30 min twice weekly, reducing to twice monthly, for 23 weeks. Caregivers were given training in behavioural management techniques. The CSDD was used to assess depression. At a 2-year follow-up, the mean difference was 2.14 (95% CI 0.14 to 4.17) and statistically significant in favour of the intervention. The four trials used different types of interventions, outcome measures and follow-up times that hindered the possibility of performing meta-analyses.

The two randomised trials[103 210] that considered behavioural disturbances used the NPI and Stockton Geriatric Rating Scale, respectively.

The second review by Thuné-Boyle *et al*[208] received an AMSTAR score of 2 and included six studies comprising two small randomised trials (n=31), two prospective design and two repeated measures studies that examined the effect of exercise on BPSD. In the first trial (Hokkanen 2003), the exercise intervention consisted of 16 sessions of dance and rhythmic movement lasting 30–45 min, once-a-week. This trial was already discussed in the dance section. The second trial[211] aimed to assess the efficacy of a home-based exercise intervention programme to improve the functional performance of

patients with AD. The intervention consisted of a daily programme of aerobic, balance and flexibility and strength training, given to patients and caregivers. Depression and apathy were measured using NPI and the CSDD at 6 and 12 weeks. Online supplementary etable 14 describes exercise therapy, outcomes and results of the primary studies included in the reviews.

Animal-assisted therapy

One review[212] performed a comprehensive literature search in PubMed, EMBASE and PsycINFO to identify pertinent studies that evaluated the efficacy of animal-assisted therapy (AAT) in older patients with dementia or other psychiatric disorders. The authors identified 23 eligible studies of which 18 recruited patients with dementia, but only 10 studies investigated the effect of AAT on BPSD. The design of the studies was as follows: 3 case–control and 7 repeated measures (eg, interrupted time series analysis) studies. Overall, the authors concluded that AAT may have positive influences on patients with dementia by reducing the degree of agitation and improving the amount and quality of social interaction. However, they advocated more research examining the issue of optimal AAI duration, frequency of sessions and suitable target group.

Primary studies

Churchill *et al*[213] included 28 residents of three SCUs with dementia (25% women; mean age 83.8 years; dementia evaluated with Bourke Dementia Rating Scale). The authors administered pet-therapy visits during the difficult 'sundown' time to examine the effect on residents with a history of agitated 'sundowning' behaviour. The active group was exposed to 30-min interaction with an investigator and a dog, which ameliorated agitated/aggressive behaviour measured with the Agitated Behaviours Mapping Instrument Scale. However, the study did not report the p values. In addition, the variability in resident response over time after the departure of the dog was not explored.

The effect of dog-based AAT was also evaluated in another special care unit. McCabe *et al*[214] enrolled 22 participants with dementia (women 68%; mean age 83.7, range 68–96 years). The study introduced a resident dog and agitated behaviour was measured using the Nursing Home Behaviour Problem Scale. Data were collected 1 week before and for the first 4 weeks after introduction of the dog. The authors reported a significant reduction in daytime behavioural disturbances among residents, but not during evening shift.

In a small pilot study, Richeson[215] evaluated visiting therapy dogs in 15 residents with dementia (14 women; age range 63–99 years; dementia MMSE mean score: 3.9; 26% with depression). The session with visiting therapy dogs lasted 1 hour daily for 3 weeks. Agitated behaviour, measured with the CMAI, decreased significantly after 3 weeks and increased significantly after 2 weeks washout subsequent to the end of AAT.

Libin and Cohen-Mansfield[216] assessed the efficacy of a robotic cat (NeCoRo) and a soft toy cat in reducing agitated behaviour in nine women with moderate dementia in nursing homes. The intervention consisted of two, 10-min interactive sessions on different days. The robotic cat produced a significant increase in pleasure and interest, but did not reduce agitation. Conversely, the soft toy cat significantly reduced agitation.

Motomura *et al*[217] included 8 women (mean age 84.8 years) residing in a nursing home and evaluated the efficacy of AAT, consisting of two dogs visiting for 1 hour, over four consecutive days, to reduce apathy or irritability. The outcomes were measured using the Geriatric Depression Scale, Physical Self-Maintenance Scale and MMSE. The intervention did not show any significant change on any of the outcomes evaluated.

Sellers *et al*[218] included four residents with dementia to evaluate the efficacy of a visiting dog. Agitation was measured with the Agitated Behaviours Mapping Instrument and Social Behaviour Observation Checklist. The authors reported that the intervention reduced agitated behaviour during treatment and increased observed social behaviour, but data and p values were not reported.

Dining room environment

Two small (n=38) pre-post studies included in Whear's review[85] examined the effect of improved lighting and table-setting contrast in a dining room environment. One study[219] (Brush 2002; n=25) found a positive effect on problem behaviours using the Meal Assistance Screening Tool, while the other study[220] found a statistically significant reduction in daily agitation.

Special care units

In a Cochrane review, Lai 2009 (AMSTAR=8) examined SCUs for dementia individuals with behavioural problems. SCUs are characterised by trained staff, special care programmes, an altered physical environment and involvement of families. This SR included one quasi-experimental study and seven observational studies (six prospective cohort studies and one prospective case–controlled study). The absence of randomised trials is likely a consequence of important practical and ethical issues in applying this methodology in older participants with dementia and behavioural problems. Only one case-controlled study evaluated agitation and used NPI and CMAI to measure the outcome in 65 participants with dementia.[221] The results showed no significant changes in outcomes at 3 months; however, there were small, but significant improvements in the NPI score in favour of the SCU group at 6 months (WMD −4.30 (95% CI −7.22 to −1.38), 12 months (WMD −4.30 (95% CI −7.22 to −1.38)) and 18 months (WMD −5.40 (95% CI −9.16 to −1.65)). The same study also evaluated the effect of SCU on mood at 3 months, and the results showed a small significant effect in favour of SCU (WMD −6.30 (95% CI −7.88 to −4.72)).[221]

DISCUSSION

Given the well-known negative side effects of commonly prescribed drugs to control behavioural disturbances (BPSD) in patients with dementia, non-pharmacological interventions have gained increasing attention in recent years as an alternative first-line approach to treat BPSD. This overview addresses the evidence supporting the efficacy of these interventions in community and residential care settings. We identified a number of SRs, which often focused on single interventions although, in several instances, multicomponent interventions were also examined. With the present study, using the primary studies included in the SRs, we have created a compendium of the types of non-pharmacological interventions, including the component of each single intervention, the dosage (when available) and the duration of the treatment.

In the absence of a validated taxonomy, we categorised the interventions according to the following classification: sensory stimulation interventions; cognitive/emotion-oriented interventions; behaviour management techniques (further subdivided according to the recipient of the intervention, ie, the person with dementia, the caregiver or the staff); multicomponent interventions and other interventions, such as exercise and animal-assisted therapies.

Among sensory simulation interventions, the only convincingly effective intervention for reducing behavioural symptoms (specifically agitation and aggressive behaviour) was music therapy. According to the most comprehensive review of music therapy, this treatment also reduced anxiety. However, the evidence supporting the effectiveness of music therapy was limited by moderate, but significant, heterogeneity, probably related to the variability of the intervention (eg, type of music, active involvement, such as singing/playing a musical instrument and dancing, or passive involvement, such as listening) and the heterogeneity of the patient population in terms of the severity of dementia and the type of dementia. The efficacy of aromatherapy and massage therapy, both associated with conflicting results, remains unknown. Light therapy and SMST therapy did not show any noteworthy effect for clinical practice.

The body of evidence concerning cognitive/emotion-oriented interventions, which include reminiscence therapy, SPT and validation therapy, had important methodological limitations. The quality of the primary studies was low, as reported by the review authors, and the sample size of the studies was not powered to detect statistically significant effects. Even when it was possible to combine studies in a meta-analysis, for example, for SPT, the pooled estimated effect was not statistically significant. Added to these shortcomings was the variability in the length and type of the interventions and the multitude of outcomes measured. Overall, convincing evidence supporting the effectiveness of these psychological interventions was lacking.

The most frequently assessed intervention in several trials was behavioural management techniques. The elements in this type of intervention included behavioural or cognitive–behavioural therapy, functional analysis of specific behaviour, individualised behavioural reinforcement strategies, communication training and other therapies, such as habit training, progressive muscle relaxation and token economies.[31] The body of evidence supporting the effectiveness of behavioural management techniques includes positive and negative studies. Among the types of behavioural management techniques which aimed to enhance communication skills, formal caregiver training and dementia mapping provided in residential care were found to be effective at reducing agitation. The evidence was convincing when the intervention was supervised by healthcare professionals, with the effectiveness possibly persisting for 3–6 months.

There is some evidence that multicomponent interventions that use a comprehensive, integrated multidisciplinary approach combining medical, psychiatric and nursing interventions can reduce severe behavioural problems in nursing home patients.

Other interventions such as animal-assisted and exercise therapy did not show any convincing effect on any BPSD.

Strengths of this overview

The present overview represents a substantial update of a previous overview,[31] using a search strategy launched in 2009, that provided a comprehensive synthesis of the evidence about non-pharmacological interventions on BPSD. We systematically searched reviews available in four electronic databases and systematically collected the evidence regarding non-pharmacological interventions for the treatment of behavioural disturbances in patients with dementia. To allow the identification of SRs of all potential non-pharmacological interventions, we used a highly sensitive search strategy by avoiding the inclusion of any specific name of non-pharmacological interventions. We also assessed the methodological quality of the reviews using the AMSTAR criteria. Another strength of the present overview was the adoption of a systematic and transparent method, and the use of duplicate, independent reviewers who performed the phases of study selection, data abstraction and data interpretation separately.[38]

Limitations of the interpretation of the results

Overall, the SRs had a number of methodological limitations that could have affected the confidence in the reported results. First, the heterogeneity of the types and characteristics of the interventions, even within the same class of non-pharmacological interventions, was the most significant problem that emerged from the present study. One implication is that there are serious methodological issues that question the correctness, in our opinion, of combining studies in a meta-analysis, as

some authors have previously performed. Moreover, in some studies, the description of the interventions is too vague to allow a complete understanding of what was actually performed. In addition, even in cases in which the intervention is well characterised, the dosage of the intervention, and the means used for its delivery, varied considerably. For example, in the case of music therapy, music interventions such as listening to music via headphones, based on participants' musical preferences,[87] differed from listening, playing percussion instruments, singing, movement or dance[86] and was observed across all nine trials combined in the meta-analysis. In the case of aromatherapy, there were several essential oils that were used in the primary studies, but in some instances, even when similar components were used (eg, Melissa essential oil), the mode of administration differed among trials. Similarly, there was great variation in the intensity (from 2500 to 10 000 lux), duration (1–9 hours), frequency of exposure (10 days to 10 weeks) and type of device used (Dawn-Dusk Simulator[222]), when light therapy was investigated for behavioural problems in dementia.

The variation in the characteristics of the interventions was particularly pronounced in the trials ascribed to behavioural management techniques. The trials used different conceptual frameworks, and sometimes broad and quite generic descriptions, to describe the interventions that at times were difficult to interpret and which influenced the content and quality of evidence of the SRs. In this area, it is therefore difficult to produce a satisfactory classification, which implies that different SRs did not consider the same group of studies, even when they clearly investigated non-pharmacological interventions specifically designed to improve behavioural management.

Finally, the arbitrary age cut-off of the patients (more than 60 years of age) and the exclusion of reviews published before 2009 constitute other limitations of the present overview. We did not evaluate the methodological quality of the primary studies included in the reviews, as this will be the scope of our next publication, in which we will apply the GRADE criteria.[38]

CONCLUSION

This overview succeeded in providing a complete and up-to-date compendium of non-pharmacological interventions in older people with dementia, using recently published SRs and meta-analyses. The most promising treatments appeared to be music therapy and some behavioural management techniques, particularly those involving caregiver-oriented and staff-oriented interventions. Despite the considerable number of published articles included in this overview, the evidence supporting the efficacy of non-pharmacological interventions is limited due to methodological quality and sample size and to the presence of important variations in the taxonomy of the non-pharmacological interventions, the outcomes assessed and the tools used to evaluate the outcomes.

Author affiliations
[1]Geriatrics and Geriatric Emergency Care, Italian National Research Center on Aging (IRCCS-INRCA), Ancona, Italy
[2]Servicio de Geriatría, Hospital Universitario Ramón y Cajal, Madrid, Spain
[3]Department of Internal Medicine (Geriatrics), Ghent University, Ghent, Belgium
[4]Landspitali University Hospital Reykjavik, Reykjavik, Iceland
[5]Department of Medicine for the Elderly, Woodend Hospital, Aberdeen, UK
[6]Department of Medicine, University College Cork, Cork, Ireland
[7]'Golgi Cenci' Foundation, Milan, Italy

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Contributors IA, JMR, AC, RS, AC-J and DO conceived and designed the study. The manuscript of this protocol was drafted by IA, JMR, AC, RS, AC-J, AdG and BHM and revised by MP, AnG, FMT and GDA. IA and JMR designed the search strategies; IA, JMR, FMT and GDA performed the search, screening and assessment independently. AC arbitrated disagreements during the review. All authors contributed to data analysis and critical revision of the paper; additionally every author approved the final version.

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Differential Responses of Individuals with Late-Stage Dementia to Two Novel Environments: A Multimedia Room and an Interior Garden

Seiko Goto[a], Naveed Kamal[b,1], Helene Puzio[c,1], Fred Kobylarz[d] and Karl Herrup[e,*]
[a]*Department of Landscape Architecture, Rutgers University, New Brunswick, NJ, USA*
[b]*Department of Psychology, Rutgers University, Piscataway, NJ, USA*
[c]*Department of Biology, Rutgers University, New Brunswick, NJ, USA*
[d]*Department of Family Medicine and Community Health, Robert Wood Johnson Medical School, New Brunswick, NJ, USA*
[e]*Department of Cell Biology and Neuroscience, Piscataway, NJ and Division of Life Science, Hong Kong University of Science and Technology, Hong Kong*

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Abstract. The purpose of this study was to determine the responses of individuals with advanced dementia to two novel sensory environments in a nursing home facility. The first was a multisensory Snoezelen room; the second was a temporary Japanese garden. Subjects viewed each environment twice a week for 15 minutes during the study. Stress was measured using heart rate and informant-based behavioral changes. By these criteria, the garden-viewing group showed positive behavioral changes while the responses of the subjects in the Snoezelen group were more negative. The response of the subjects' pulse rate was most dramatic. During the 15 minutes in the garden, the average rate (all subjects/all visits) was significantly less than in their residential room. In the Snoezelen room, we detected little or no change. The impact of the garden could also be seen in the negative behavioral signs elicited upon returning the subjects to the garden room after the installation had been replaced with plants and furniture arranged with no formal design. We propose that exposure to a small interior Japanese garden could be an effective intervention for individuals suffering from late stage Alzheimer's disease.

Keywords: Dementia, heart rate, Japanese garden, nursing home, Snoezelen room

INTRODUCTION

Studies of non-pharmacological treatments for Alzheimer's disease (AD) include a wide array of approaches. These interventions include horticulture therapy, sensory therapy, cognitive therapy, behavioral therapy and naturalistic approaches—applied alone or in combination [1]. In general, the goal is to integrate the therapeutic modality into the dementia patient's daily routine. The interventions should be cost-effective, as measured by caregiver time and institutional resources, and should be easily applied at long-term institutions of different sizes, locations, and staffing. The desired outcome is an improved quality of life for the patient and the easing of some of the symptoms caused by AD including agitation, anxiety, depression, loss of cognitive functioning, loneliness, and boredom. Any or all of these symptoms can be detrimental to the living environment in care centers

[1]These authors contributed equally to this work.

*Correspondence to: Karl Herrup, Department of Cell Biology and Neuroscience, Piscataway, NJ, USA. Tel.: +1 732 445 3306; E-mail: herrup@biology.rutgers.edu.

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such as nursing homes and impact both the individual and their caregiver.

Our earlier work in healthy elderly patients exposed to different outdoor gardens had demonstrated that during brief periods of time, changes in an individual's heart rate could serve as a reasonably useful measure of an increase or decrease in an individual's level of comfort or stress. This physiological measurement was obtained with a non-invasive monitoring system and thus was ideally suited for determining the response of a population of individuals with dementia. To test this application, we identified a nearby nursing home facility that had previously installed a Snoezelen room to use as a non-pharmacological means of improving the behavioral symptoms of individuals with dementia in the facility. The Snoezelen room concept was originally developed in the Netherlands in the 1970s for therapeutic application in cases of cognitive disorders, such as autism and AD. It integrates a wide array of equipment that consists of auditory, visual, olfactory, and tactile stimulation that aims to stimulate a patient's senses through controlled stimuli in a calm, comforting environment [2]. Applied to AD, Snoezelen therapy is meant to directly stimulate the senses instead of utilizing environmental enrichment activities [3]. Sensory stimulation has been seen to "be effective in reducing negative or antisocial behavioral patterns, increasing sociability and interest in the outside world, improving personal hygiene habits, and causing residents to smile more often" [2]. The intent is to help subjects relax by using as many of their senses as possible. The Snoezelen approach is modified to be more passive when applied in an AD setting. The modifications are meant to make the environment more accessible to the individual with severe cognitive impairment since they can no longer perform the actions that are required by more active therapies. Also, Snoezelen rooms can be customized to fit the need of different patients, making the room potentially useful for all of the residents. "Historically, the identification of high preference stimuli has played a crucial role in establishing and maintaining positive behaviors in people with profound developmental disabilities" [3, 4].

Supporting the Snoezelen approach, research has shown that sensory interventions (aromatherapy, thermal bath, calming music, and hand massage) have moderate efficacy in reducing a variety of difficult behaviors. In a meta-analysis reviewing 30 experiments, Kong et al. [1] found that although results can vary greatly among studies, of the different types of non-pharmacological interventions they studied, only sensory interventions made a statistically significant beneficial difference on symptoms such as agitation in patients with dementia. Studies like these indicate that the sensory elements of the environment greatly affect the individual's well-being. Despite these promising results, we take note of the observations of Knight et al. [5] that "relatively few studies have analyzed the effect of Snoezelen or multisensory stimulation and research trials using a multisensory approach vary widely".

In addition to the improved outcomes noted from these types of man-made sensory stimuli, numerous studies have documented the positive effects of exposure to nature on the quality of life of individuals with cognitive decline. The spirit of this approach is in line with those that underlie the other sensory interventions. Working with plants has proved to have a calming, soothing effect on people with dementia. Individuals with AD who become involved in horticultural therapy show delayed mental deterioration [6] and increases in cognitive functioning [7]. Different horticultural activities have been shown to produce therapeutic benefits, providing opportunity for creativity, self-expression, social interaction, sensory stimulation, and increasing self-esteem. In addition to these active engagements with horticulture, other studies have shown that even passive exposure to nature fosters psychological well-being, reduces stress, and promotes physical health [8], and high order cognitive functioning. Ulrich argues that environmental enrichment achieved with plants can be effective in reducing stress and anxiety in patients, visitors, and staff [8, 9]. More recently, Friedrich [10] has reported that exposure of people with AD to a garden setting can help address memory deficits in people with AD, relieve stress and improve the sense of well-being for patients, staff and family members. These healing gardens are designed with features that provide a safe accessible therapeutic environment for visitors, staff, and patients that are tailored to fit the specific needs of dementia patients, such as non-reflective walkways and wide continuous paths that provide direct exposure to nature. This connection with nature has been found to be an integral component in the treatment of adverse psycho-behavioral conditions, such as depression and aggression, and can improve satisfaction within the facility. With the implementation of the French Alzheimer Plan 2008–2012, the French now require the use of healing gardens and green space throughout their facilities, further illustrating the point that a direct link to nature is a fundamental aspect of treatment of AD and its comorbid symptoms [11].

Our previous study was a first attempt at refining this approach. The subjects of this study were all healthy

elderly Caucasian residents of an assisted living facility. We found that the level of acceptance of viewing a garden depends on its design and the Japanese-style garden was most favored [12]. Indeed, Japanese gardening is a form of representation of beloved landscape. It is a pictorial representation of nature to be viewed from certain specific viewing points, unlike a Chinese garden or the flower gardens in horticulture therapy in which people physically interact with the elements of nature. The Japanese Zen garden and tea garden were developed specifically to calm one's mind by viewing scenery. They use small elements in nature, such as a boulder or a shrub, to represent parts of a natural vista in order to fit a broad landscape into the confines of a small garden. We are aware of no scientific study that has examined the calming effect of viewing these gardens; however, gardens have been used for mediation for hundreds years. Since Japanese gardens are designed to invoke a sense of nature through observation in relatively small spaces, we found this is the most suitable garden style to apply to the institutions dedicated to the care of people with AD.

In the current study, we have used a Snoezelen room as an independent novel stimulus to compare and contrast the effects of its multisensory stimulation with exposure to a natural environment—in this case a temporary Japanese style garden installed in a comparably sized room in the same nursing home facility. The garden served as both a point of comparison for the Snoezelen intervention and enabled us to extend our quantitative assessment of the effectiveness of viewing gardens to a population suffering from dementia. We used both behavioral and physiological measures of the subjects' response so that we could observe both overt subject responses as well as the reactions of their biological state to the various interventions. As our subjects were quite advanced in their disease, we limited our outcome measures to informant-based observations of behaviors during the viewing process and an easily determined physiological measurement, pulse rate. It was our hypothesis that the philosophy and design style of the Japanese garden would be particularly effective in individuals where the ability to interact with their surroundings was compromised by a severe dementing illness. We further hypothesized that this response would be most apparent in their physiological reaction, i.e., their pulse rate. We found that unlike previous studies that focused on individuals who retained ability to interact easily with their environment, in a population with advanced dementia, the Snoezelen room was a less successful intervention. The Japanese garden, by contrast, proved robust in its ability to reduce measures of stress and improve indices of well-being.

METHODS

Subjects

Human volunteers (subjects) were residents of the Francis E. Parker Memorial Home in Piscataway, New Jersey. Institutional review board approvals for the protection of human subject at Rutgers University and Robert Wood Johnson Medical School were obtained and informed consent forms were signed by relatives or legal guardians. Invitation letters for the study were sent to the guardians through the nursing home. Once subjects had been identified for potential participation in the study, the research staff contacted the family or legally authorized representatives of the residents to obtain consent. The surrogate consent form was utilized. There was no cost to the subject to participate.

The subjects were tested in two groups, 18 individuals (6 men and 12 women) were recruited to participate in 2010, and 18 individuals (5 men and 13 women) were recruited in 2011. Subjects in both groups were residents of the nursing home for at least 6 months and had not used the Snoezelen room in the past. Chart reviews showed demographic characteristics of the subjects including average age (88 ± 4), ethnicity (100% white), and Mini-Mental Status Exam scores (<12). The principal diagnosis was AD (70%) followed by other dementias (30%). Secondary diagnosis included depression (30%), Parkinson's disease (15%), hypertension (58%), cerebrovascular disease (30%), and coronary artery disease (50%). The primary nursing home physician prior to participation in the study had previously diagnosed subjects with depression and behavioral issues on admission to the facility. They were evaluated by geropsychiatry as needed. A few subjects were on cholinesterase inhibitors and others were on antidepressants and antipsychotic medications. All drugs were maintained at steady doses during the study. Six subjects out of 18 participated in all of the studies. Three of the subjects died during the course of testing and full data sets could not be compiled for them.

Snoezelen room intervention

The Snoezelen room of the nursing home where this study was conducted was a windowless quiet room ($17' \times 20'$), equipped with a comfortable chair and a sofa, a bubble lamp that changed color (blue, yellow, red, green) automatically, fiber optic lights that also

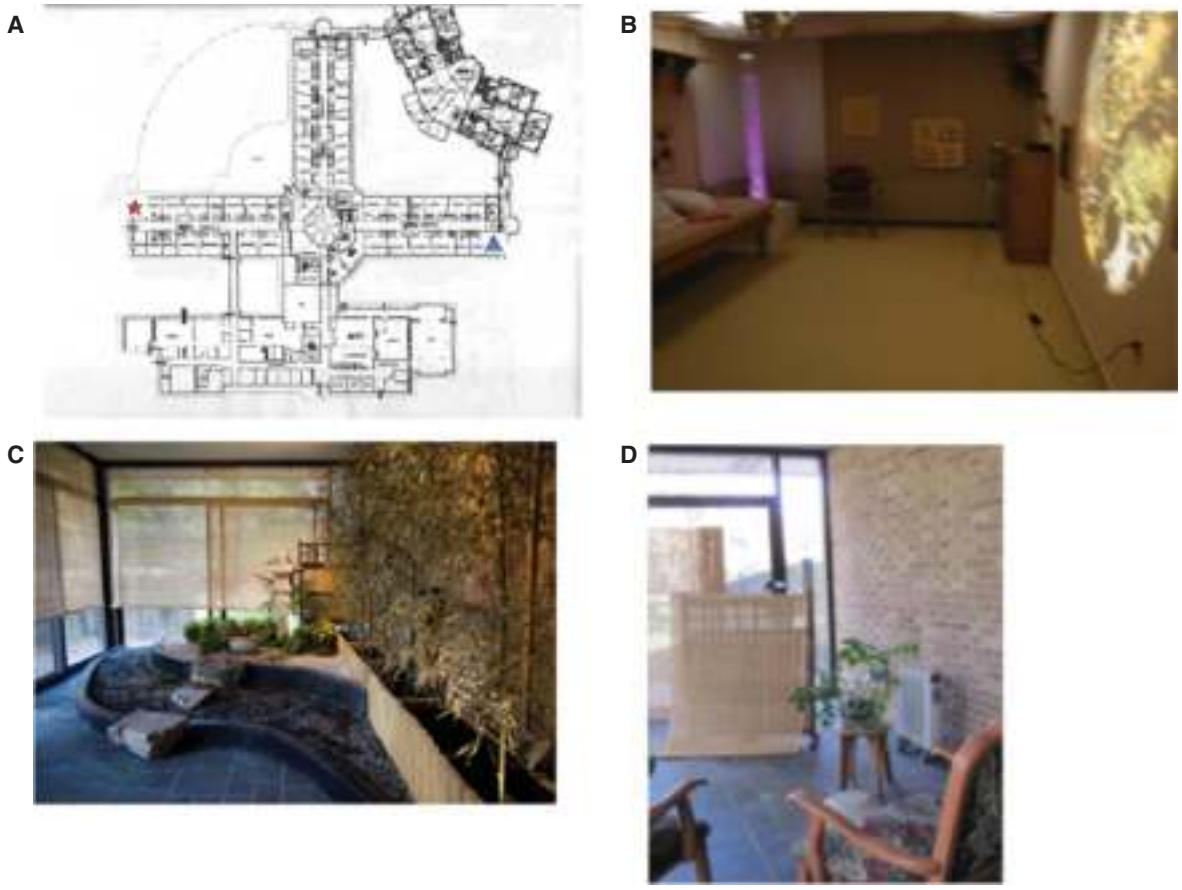

Fig. 1. Overview of the setting of the experiment. A) The layout of the parker home is shown and the Japanese garden is indicated with the ★ and the Snoezelen room is indicated by the ▲. B) The view of the Snoezelen room is shown. C) The view of the Japanese garden is shown. D) The view of the alternate control room (the garden after it was demolished) is shown.

changed color, a disco globe, a projector to display a moving image on a blank wall, an audio set for music, musical instruments, tactile toys, and a small aerosol apparatus to deliver aroma therapy (Fig. 1B). The room can be dimmed with soft lighting to achieve various lighting effect. The carpet and walls were a warm beige color to aid in relaxation and the ceiling was draped in soft white curtains that help lessen the harshness of the fluorescent lights. The wall was also finished with soft textile, which is comfortable to touch. The aide who brought the individual to this room was able to choose the elements to be used according to the subjects' need. For this study, we used the projector to display a woodland nature scene, the audio set to fill the room with sounds of a natural environment, the aroma generator filled with cedar scent, the fiber optic lights and the bubble lamp. We set the room lighting to dim in order that the subjects would be able to experience the projector and lighted objects more distinctly.

Garden intervention

We constructed a temporary small Japanese-style indoor garden in the patio room of the nursing home (Fig. 1A). The temporary garden was constructed in an indoor space approximately 12' × 20' with two windowed walls. The space was previously used as a storage room in the nursing home. The garden was composed of small plants, sand, rocks, bamboo screens, and a stone lantern (Fig. 1C). Though initially planned with a waterway to introduce the sound and sight of running water, safety concerns related to contamination of the closed water system led us to fill the waterway with artificial moss. To reproduce the sound of the waterway in the original design, an MP3 player with external speakers was used to provide background nature sounds. At the conclusion of the intervention, the garden was dismantled. The room was then filled with a few pieces of furniture and a few potted plants.

In this state, it was our intent to use the area as a control space to test responses after the 6 weeks of the garden intervention (Fig. 1D).

Our best estimate is that the costs of the two installations are comparable. The garden created for this study cost $9,000 including materials, installation, and dismantling at the end of the experiment. The Snoezelen room was installed in 2000 and according to records at the nursing home the cost was $5,000 for the materials without installation. It is likely that these costs have gone up in the intervening years leading us to estimate rough parity in the resources required to set up either environment.

Behavioral assessment

Subjects were exposed to either the garden or Snoezelen Room for 15 minutes two times per week. The garden intervention was continued for a period of 4 weeks; exposure to the Snoezelen Room was continued for 3 weeks. We could not conduct continuous 4 weeks' study for the Snoezelen room because of events of the institution. Visits were scheduled only for daytime hours: 9:30–11:30 and 1:30–3:30. During each session, heart rate was assessed using a simple fingertip heart rate monitor. For each session and for each subject, the research assistant filled out the "Behavioral Assessment Check List." and noted any specific behavioral changes during the observation.

The willingness of the subjects to participate in the individual sessions was given a score from one to five. A subject placed in the "absent" category indicated that the subject could not visit because of a physical or other condition unrelated to garden/Snoezelen room itself. A score in the "leave" category was assigned to subjects who insisted on leaving before completing their 15 minute trial. A score in the sleep category was given if the subject fell asleep during the session. The "stay awake" category indicated that the subject stayed awake during the entire session. We assigned subjects into the refuse category if subjects who initially agreed to visit the room refused to enter after they were taken to the room.

All assistants were instructed to make note of any verbalizations by the subjects and score the level of subjects' attention to the environment and motion during the experiment. No transcript was made because most of the verbalizations did not contain any meaning. Entries from assistants' notes were classified into five categories; specific comments about their immediate environment, recall of an old memory, recall of a short term memory, nonsense, and other, a category that included the utterances with no meaning and using no recognizable words. The total number of verbalization in each category was scored. In addition, the research assistant noted the length of time during which the subject appeared to be focusing their attention on their environment (the garden or the Snoezelen room) or on the attending personnel (the research assistant [RA]) or on nothing in particular. This focusing activity was given a score ranging from 0–4: 4 represented a strong, continuous focus, 3 represented frequent, but not continuous focus, 2 represented moderate focus, 1 represented occasional episodic focus, and 0 represented a complete lack of focus. A video camera was set up in both rooms to record the interaction of the subjects with the garden so that all sessions could be reviewed if the notes were ambiguous.

The assessment procedures were scripted as follows. The RA arrived in the subject's room and helped to ready the subject for transport. The subject was then escorted to the entrance of the garden or Snoezelen room. The heart rate monitor was mounted on the subject's fingertip. The leads from the monitor were attached to a small laptop computer that was positioned on a table behind the subject, out of their view. The laptop was running the software that recorded and analyzed the pulse plethysmograph data. The assistant turned on the video camera using the remote controller. The subject was then allowed to observe the garden for 15 minutes in the presence of the RA who remained standing behind the chair where the subject was seated. After the trial, the assistant removed the monitor from the subject's finger and turned off the video camera. The subject was then escorted out of the garden by the assistant and the assistant returned the subject to their living quarters

Assessment of pulse rate

In addition to the garden and Snoezelen room interventions, we report qualitative findings from an initial experiment that we were unable to complete. We originally recruited 24 subjects with AD in October 2009. In this initial project, we planned to assess the physiological responses of the subject by way of heart rate monitoring, using an RR interval monitor, Active Tracer AC-301A by GMS. This equipment was identical to that used in our previous study. Although planned for an 8-week period, we stopped this project after only two weeks. Unlike the cognitively intact subjects of our previous study [22], the individuals in the current project suffered from advanced dementia. Most subjects showed strong negative reactions to the leads from

the monitoring machinery, which had to be attached with adhesive-mounted electrodes directly to the skin at three locations on the thorax. Subjects indicated their refusal to attach the leads and those who agreed often became agitated and distressed when we detached the sensors.

The project was then redesigned to incorporate a small finger-ring heart rate monitor in place of the RR interval marker. This method is not sufficient to gather sympathetic and parasympathetic cardiac output separately, thus restricting our analysis exclusively to heart rate. The monitor used was an Iworx IWX/404 and PT 100 model. The equipment detects the slight changes in volume caused by the pulsing of blood through the finger vessels. The signal is sent to a laptop computer situated behind the subject, out of view. The pulse signals were recorded and analyzed by the software provided by the company. For subjects where the contact of the pressure sensitive gauge of the finger monitor was not optimal for the entire session, we manually scanned the traces to find the periods where a reliable pulse rate could be determined. Any test of a subject for which reliable pulse data could not be gathered from at least 3 of the 13 one-minute bins was discarded.

A medical chart review was used to determine basic demographic characteristics, assessment of cognitive status, and medical conditions, which included principal and secondary diagnoses. The protocol for the morning and afternoon sessions was the same. We designed each subject's visiting schedule to take into account their sleeping pattern and planned daily activities. The schedule was pre-cleared with the nurses and other caregivers of the nursing home to ensure their involvement and to avoid scheduling conflicts. Despite these efforts, occasional sessions had to be cancelled to accommodate the visits of relatives and friends, medically necessary appointments with clinical staff, as well as subject illness.

Statistical analysis

Various statistical measurements were required to measure the differences in the subjects' behavioral responses in the different settings. In order to measure the differences in the subjects' attention to the environment, a paired *t*-test was used to measure the significance of subjects who were awake and asleep in the Snoezelen room and Japanese garden (Fig. 2). Measuring the differences in responses of the subjects' motion and affect in the Snoezelen room and Japanese garden required a chi-square test to measure the deviation from the expected responses in the Snoezelen room (Fig. 3). In scored evaluations such as attention to the research assistant and attention to the setting, one-way ANOVA was used to measure if the results were different due to the effect of the location. The significance of differences in heart rates was assessed with by *t*-test.

RESULTS

Participation in the two environments differed substantially

From the outset, the reaction of the subjects to the two sensory environments – the garden and the Snoezelen room differed substantially (Fig. 2). In the garden, the majority of the subjects stayed awake for the entire session, and several subjects asked if they could stay after their session had been completed. No subject requested to stay in the Snoezelen room; indeed, few remained awake for the entire session, and this response to the environment increased following repeated exposures to the room. After one or more visits, many refused to go in or asked to leave. A paired samples *t*-test was conducted to compare the number of subjects that remained awake in the Snoezelen room and the garden setting. There was a significant difference in the scores Snoezelen room ($M = 2.50$, $SD = 2.35$) and the Japanese garden ($M = 12.63$, $SD = 2.35$) conditions; $t(5) = 11.18$, $p < 0.0001$. Note as well that the responses to the garden were not only more positive; they were more consistent from one visit to the next.

The nature of the responses differed between the two rooms

The results of the Behavioral Assessment Check List are presented in Fig. 3. The RA noted that virtually all of the subjects sat perfectly still during their time in the Snoezelen room. In the garden, by contrast, over a third of the subjects moved at some point during their session, a highly significant difference as determined by a chi-square test, χ^2 $(3, n = 36) = 50.436$, $p < 0.0001$. While this movement could reflect agitation, other indices gave no indication of this. If anything our simple Behavioral Check List revealed a negative shift in the subjects scores during their time in the Snoezelen room. Although relatively modest in size the shift was significant ($p < 0.02$, two-tailed T-test). In the aggregate we believe that these numbers reflect the subjects' engagement and better mood in the garden.

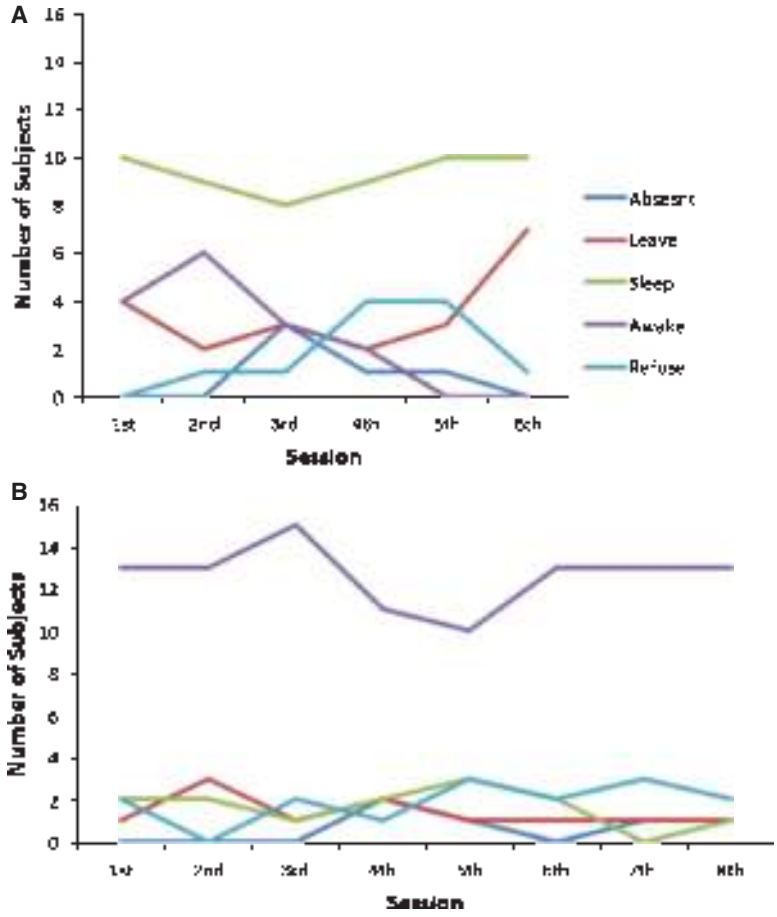

Fig. 2. State of subjects in the Snoezelen Room (A) and Japanese Garden (B).

Consistent with the other observations, the subjects in the Snoezelen room focused most frequently on nothing in particular. Figure 3 is a summary representation of these data. In tabulating these results several aspects of the data stand out. In the Snoezelen room, the focus, if any, was largely on the projected image of the woodland scene or on the strings of lights. Apart from these visual elements of the room, the subjects showed little interest in objects whose purpose was sound or touch, or made any comments related to the smell from the aromatherapy. In the garden, the focus was primarily on the plants in the installation. This was unexpected since in the design of the garden, a stone lantern was positioned in such a way as to be the central architectural element and natural focal point for the viewer.

We also scored the subjects verbal expressions. In keeping with their more alert state, the percentage of subjects who uttered any sort of expression in the garden (56%) was more than double that of the participants while in the Snoezelen room (24%). We also noted that there was a pattern to the type of verbalization. We assigned each comment to one of four groups: comments related to the room or the institution (comments); recollections of past events (old memory); memories of recent happenings (short-term memory); and nonsense or other. The total score is greater than the total number of participants because one subject could make comments in two or more categories. In the garden room, participants expressed their feeling not only about the garden ("beautiful" or "nice") but also expressed critiques on the garden design (e.g., "the finish of the planter edge is rough."). We noted that the descriptions of the old memories could be quite detailed. For example, one subject related a long story about how he had served in Japan during the Second World War and returned after the war to do some travelling. A former architect remarked that he appreciated Japanese architecture because Frank Lloyd Wright was his favorite architect, and Wright supposedly had many

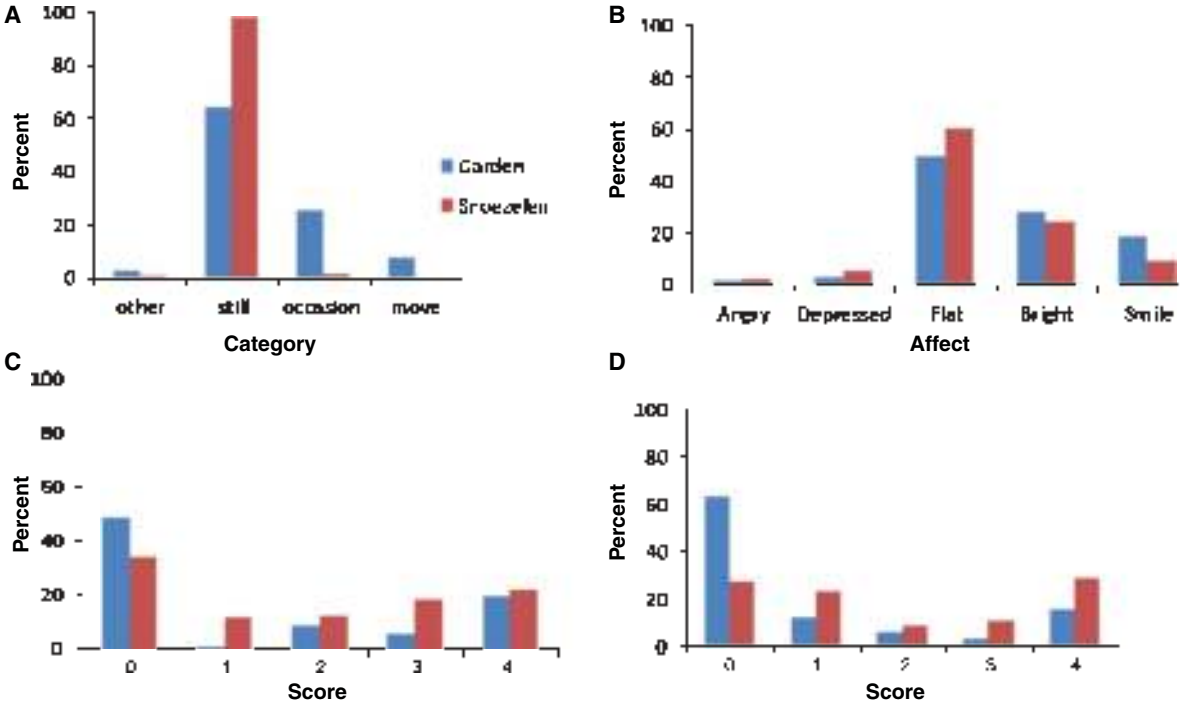

Fig. 3. Comparison of the behavior of the subjects in both the Snoezelen room and Japanese Garden. Four set of graphs are the comparative summary of the movement, the affect and mood of the subject, and the attention to the assistant, and the attention to the setting during the sessions in the Snoezelen Room and Japanese garden. A) The movement of the subjects is recorded. B) The overall emotional state of the subjects in the setting is measured. C) The subject's attention to the assistant is recorded on a scale from 1 to 5. D) The subject's attention to the setting is measured and recorded on a scale from 1 to 5.

inspirations from Japanese designs. He too made many comments on how to improve the garden design. Other subjects talked about the gardens they had made. Comments that we assigned to the category of short term memories included remarks such as how the flowers in the garden had been replaced (which they occasionally were). Some subjects commented about the outside scenery they had seen during their previous session. The simplest type of short term comment was the occasional subject who remarked, "I came here before." We also observed that there were subjects who were not only verbal but showed a desire to interact with their environment. Many subjects tried to reach out their hand to touch the plants. Indeed, one subject wanted to draw picture of the garden and requested a pen and paper.

In the Snoezelen room, the verbalizations were much more rare. When they occurred, the content of the comment was rarely related to the Snoezelen room. For example, among the 6 subjects who participated in both the garden room and Snoezelen room studies, 4 subjects were capable of verbal expression. In the garden room, all of these 4 subjects made comments on the garden; the 2 other subjects were not verbal at all, yet kept awake and murmured to themselves. In the Snoezelen room, 4 subjects fell asleep immediately and 2 asked if they could leave early.

Qualitative observations from the first Japanese garden study

As described in the Methods, our initial protocol called for the use of an RR interval monitor to track the heart rate variability, the same equipment we had used successfully in our previous study [22]. Unfortunately, transferring the protocol to the subjects with advanced dementia in the nursing home setting proved impossible; the placement and removal of the adhesive electrode leads proved stressful for the subjects. It was the consensus of both the researchers and the local IRB, therefore, that this first garden study be terminated after two weeks. This adverse response precluded our obtaining sufficient quantitative data for analysis and none is included in the current report. Nonetheless, a number of qualitative observations made during this first attempt proved interesting. We noted one subject who the nursing home staff described as experiencing periods of agitation that made her difficult

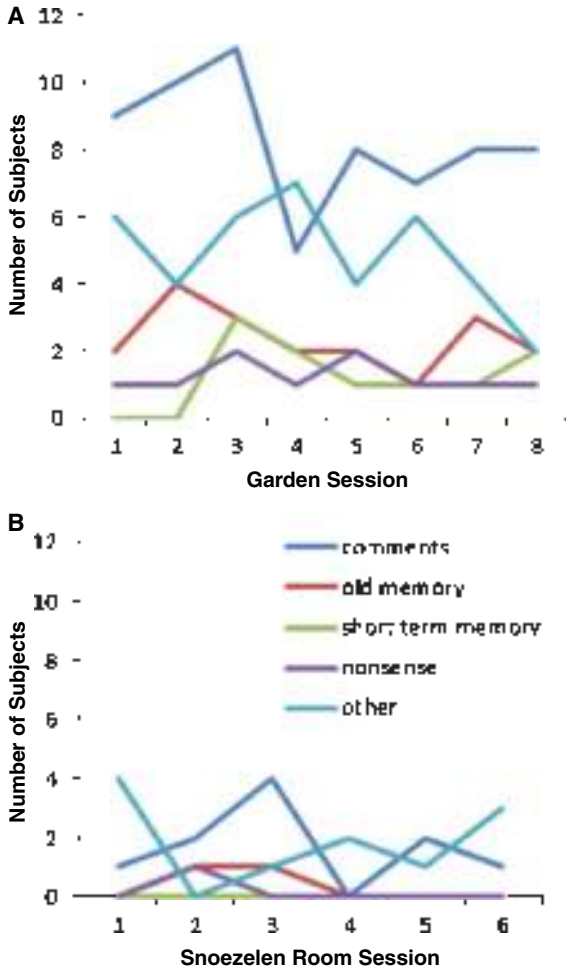

Fig. 4. Comparison of the content of the comments made by subjects in both the Snoezelen Room (B) and the Japanese Garden (A). TAs measured the comments made by the subjects during the session and categorized it on various factors (short term memory, long term memory, nonsense, etc.).

to manage. Upon entering the garden, however, she immediately calmed down. She asked to stay in the garden for 20 minutes (5 minutes longer than the assigned exposure period), and appeared to emerge very happy. Her calm mood lasted into the evening. We also were struck that, despite their severe dementia, many subjects remembered their previous 15-minute garden visit when invited to visit the garden a second time. An example of this behavior involved an unplanned intervention. Unbeknownst to us, a cricket had hidden in one of the plants and happened to be singing during some of the sessions during the first week. Four subjects experienced the garden for the first time during one of those sessions. Although they each heard the insect, none of the subjects commented on it at the time. For administrative reasons, the second session for these subjects had to be delayed until the following week. By this time the cricket had disappeared and could no longer be heard. At their next session, however, three of the subjects asked the research assistant where the cricket was. The natural history of these subjects' dementia was such that their normal ability to recall recent events had deteriorated, and thus their ability to recall the sound of cricket in the garden after 10 days stood out. These observations are descriptive; we report them here as they capture the extent to which the exposure to the garden environment had a noticeable effect on the behavior and bearing of the subjects and because they are consistent with those observed during the second garden study described above.

The biological responses

During the rest of our study, we were able to obtain more quantitative measures of the subjects' response to the garden and the Snoezelen room. We asked whether the types of physiological changes we had observed in our previous study of healthy, cognitively intact individuals [22] could be found in these more severely affected subjects. Using the simple finger pulse plethysmograph we monitored the average heart rate (beats per minute, bpm) of all subjects for each 1-minute interval of the viewing session.

The first measurements were from the subjects exposed to the garden. As can be seen in Fig. 5A, the average heart rate was slightly elevated in the first minute or two of the session, then declined fairly steadily throughout the 15-minute session (around 0.15 to 0.2 bpm/min). This decline occurred even though the subjects were active and awake during the entire session. After obtaining the data from the garden viewing sessions, we repeated the heart rate measurements while the subjects were in their room. This was a familiar environment to which the subjects had all become accustomed, and during these sessions the subjects' heart rate changed very little and indeed rose slightly during the final minutes. If we use only the final 6 minutes of the session, the subjects' response to the garden and their own room differ significantly ($p = 0.034$)

When we repeated these observations using the Snoezelen room as the intervention, the average initial heart rate for most subjects was relatively constant. When we tracked this rate over the 15-minute sessions, in the Snoezelen room, we noted variability, but little change in this average rate (Fig. 5B). Over the entire session the subjects' pulse rate rose by an average 0.06 bpm/min; but during the final 10 minutes, the rate declined by 0.11 bpm/min. Recall that in this

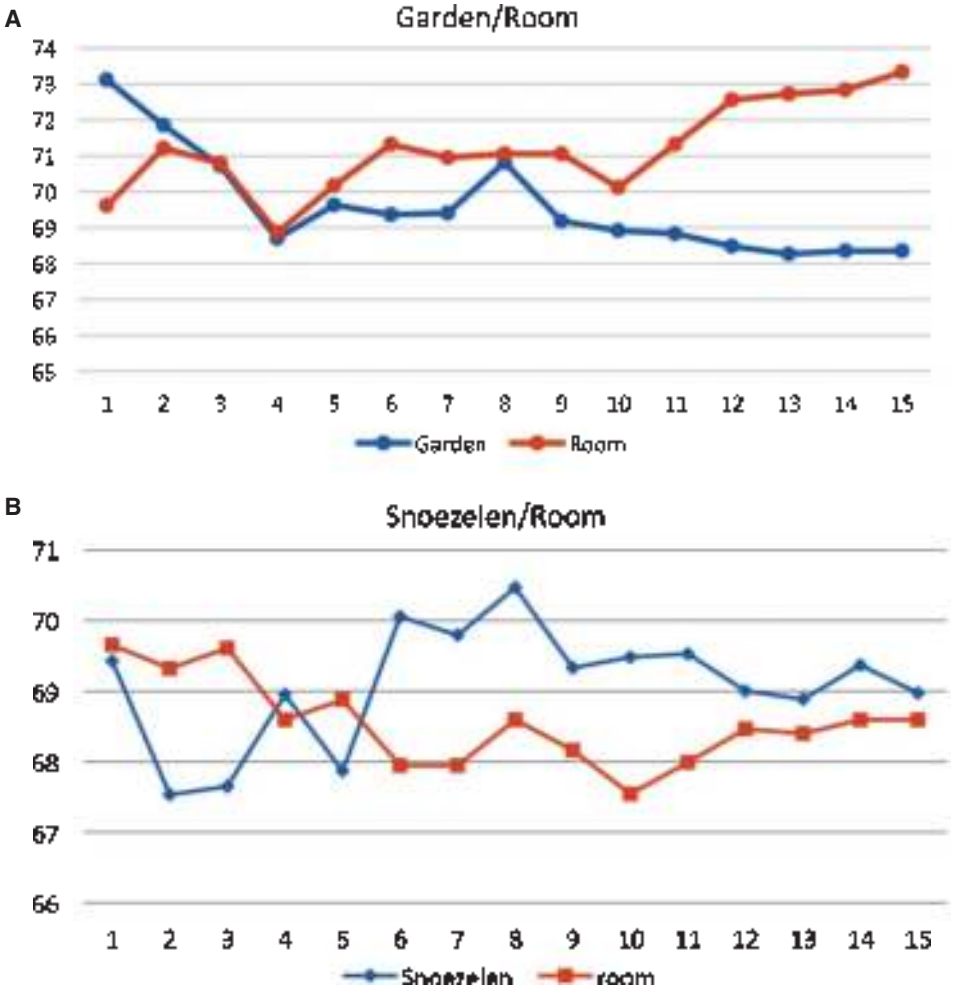

Fig. 5. Comparison of the heart rates of the subjects in the Snoezelen Room, Japanese garden, and control room. A) The average heart rates of all subjects spending 15 minute sessions in the Japanese garden and control room are compared. B) The average heart rates of all subjects spending 15 minute sessions in the Snoezelen room and control room are compared.

environment, most subjects had fallen asleep by the end of the session. As we had done with the garden, we also monitored the same subjects during a 15-minute session in their room (Fig. 5B, red). Again we saw little change in the heart rate during this observation period and in this case the subjects' responses in the Snoezelen room and their residential space did not differ significantly ($p = 0.34$).

There was nearly a year's gap between the two interventions – Snoezelen room and garden. Nonetheless 6 of the subjects were able to participate in both. We analyzed this group of subjects separately to determine if there was a difference in the patterns observed. Their average heart rates declined in the garden but were steady to slightly elevated in their room and this difference was significant for the last six minutes of the session ($p = 0.01$). By contrast their average heart rates were relatively steady in the Snoezelen room and in their residence and any apparent differences between the lines (during the final 6 minutes) was not significant ($p = 0.32$). We performed a similar analysis on the subset of individuals whose chart suggested a problem with depression and found that the patterns of these individuals and the non-depressed cohort were similar.

An attempt at a control space

After the garden observation period, the temporary Japanese garden was dismantled, and the bamboo screens were taken down. To avoid taking the subjects to a completely empty room we placed a potted plant, two chairs, two space heaters, and some bamboo

screens in the same area. The bamboo screens were put up vertically toward the patio doors to screen the direct sun (Fig. 1D). The subjects were taken to the former garden room following the same protocol as previously described for the garden. Fifteen out of 18 subjects visited this space; 7 immediately fell asleep, 4 subjects including the subjects who wanted to stay longer in the garden refused to go into the room once they saw the garden was dismantled, and 4 subjects remained in the room but requested to leave earlier than 15 minutes. The four subjects who remained in the empty room asked the assistant, "What happened?" "It should be the garden." Clearly the four subjects who remained in the room remembered the garden had been there. The subjects expected to see the garden, having no knowledge of its disassembly and assuming that garden sessions were now part of their daily routine and were strongly disappointed at the loss of a favorable environment. We hypothesize that it was this disappointment and sadness that led to these negative responses.

DISCUSSION

The responses described in this small study reaffirm the positive effects of contact with a natural environment and provide a unique window through which to view the interactions between a patient with dementia and their institutional environment. Individuals suffering from advanced dementia were exposed to two carefully designed environments—the multisensory Snoezelen room and a small interior Japanese garden—in a series of short exposures. Based on both our qualitative and quantitative measures, and despite the severe cognitive impairment of our subjects, the responses to the two environments were consistent and considerably different.

The Snoezelen room is meant to stimulate the senses; however, the subjects did not interact with most items even when the assistant offered them. Most subjects fell asleep, perhaps due to the fact that the room was dimly lit (in contrast to the garden). During their more limited periods of wakefulness, the researchers noticed that the patients responded most often to the moving nature scene. The other stimuli, such as the lava lamp or the light strands, would capture a subject's attention, but only momentarily. Soon they would grow tired of these and look back at the images of nature. The rotating nature scene had enough complexity to evoke a response in some subjects, such as naming the animals and the type of landscape, but was soothing and relaxing enough to calm the patients rather than excite or anger them. Yet, even the rotating scenes appeared to hold the subjects' interest, perhaps because the scenes were repeated every minute.

Previous research has shown improvement in individuals with dementia when they are exposed to a Snoezelen room [13]. However, these benefits were only seen briefly during the sessions and were lost immediately afterwards [14]. One of the limitations of a Snoezelen room when used with patients with dementia, however, is that the room was designed for children with autism, or children and adults with mild to profound sensory and learning disabilities [2]. Autism spectrum is a childhood disorder and although individuals with autism are compromised in other ways, they typically have the ability to actively explore and interact with the stimuli of the room. When used with patients with dementia, by contrast, the Snoezelen room must be used in a more passive ways [2]. Individuals with AD or other dementias are typically restricted in their motor as well as their cognitive abilities in part because of their age and in part because the limitations imposed by the disease. As a result, when "residents are unable to move or change positions by themselves and spend long periods of time immobile, staring into space ... [boredom ensues that can] ... trigger agitation in residents with dementia 54.9% of the time" [2]. The subjects in our study illustrate this well. Those who appeared to retain more cognitive functioning refused to enter the room, recalling that they disliked their original experience and complaining that they were wasting their time. Note that although their short-term memory was compromised overall, these subjects were able to recall having been in the room before. Beyond this response, those in whom the disease had progressed to its most advanced stage seemed outwardly indifferent to the room altogether. Collecting quantitative data is difficult in these subjects and few studies on the impact of a Snoezelen environment have been done on advanced AD patients.

In the Japanese garden, by contrast, the subjects stayed awake, were alert and spoke. Their speech often reflected complex thoughts - stories based on old memories, comments based on short-term memory, as well as remarks expressing their immediate responses to the environment. These varied and individual responses suggest that the garden stimulated an engagement of the subjects with their environment that differed markedly from the Snoezelen room as well as from their normal state. Several anecdotes underscore this point. For example, after hearing that one subject had given a verbal account of events that had occurred in his twenties, the nursing home staff expressed amazement

at the length as well as the detail of his description. Staff had viewed the subject as being non-verbal and none of them had heard these stories before. Family members reported similar anecdotes. A daughter of one of the subjects reported that her mother would normally close her eyes during an activity, yet during the exposures to the garden her eyes remained open for the entire session. The wife of one subject commented that being in the garden had brought back memories for her husband from his career as an architect. The subject unfortunately passed away during our experiment (his quantitative data are not included), but the wife commented that "he was so happy talking about Frank Lloyd Wright and architecture"; it pleased her to see "his passion come back" just before he died. The example of the cricket recalled by several of the subjects in the first aborted study also reflects this type of response.

A second measure of the impact of the two environments on our subjects was the response of the average heart rate during the exposure. This is a wholly different metric from the behaviorally oriented measures such as attention and verbalizations. The use of pulse as a measure of stress has been adopted by many researchers. Enhanced stress is known to lead to an increased sympathetic output and a subsequent increase in heart rate. The reverse situation is studied less frequently, but has proven equally true over short time frames. Using a wide range of stimuli, researchers have found that reduced stress is correlated with a reduction in pulse rate [15, 16]. The differences in the average rates were not noticeable, but the pattern of the rates during the 15 minutes of the session fit well with the qualitative observations. We observed a relatively flat pattern for the Snoezelen room where the subjects were mostly passive and often asleep. In the Garden room we found that the subjects pulse rate initially increased then fell, perhaps as the subject became adjusted to the new environment. Even after this phase, however, we found that the rate continued to slowly decrease during the remainder of the session.

Our use of pulse rate as an outcome measure can be seen in the context of the concepts of evolutionary psychology, as well as the work of Nassauer [17, 18]. From these vantage points, individual preferences for a particular setting are in part independent of learned and cultural preferences and reflect instead more hardwired responses [19]. While we assume that the behavioral responses of our subjects to the garden or the Snoezelen room reflected both their "nature" and their "nurture", we propose that the changes in their pulse rate reflect only this hardwired innate response ("nature"). This allows us to use pulse rate as a reliable reflection of our subjects' responses independently of their cognitive status or ability to communicate. Use of heart rate variability (HRV) to assess the sympathetic and parasympathetic output status of individuals with AD has been explored previously [20, 21], but studies such as these relied on more sophisticated cardiac output measures. We attempted to use such methods, but found them incompatible with the advanced stage of our subject's dementia.

The findings reported here take on added significance when seen in conjunction with our earlier study of elderly individuals exposed to different garden styles [22]. In this study, we examined a population of similar average age as the one reported here; however, they suffered from no cognitive impairment. Despite this difference in cognitive capacity, the subjects in the previous study also showed a significant reduction in heart rate during a 15-minute exposure to a Japanese style garden. Rather than using a Snoezelen room, however, Goto et al. used two comparably sized natural spaces to serve as comparison environments. The first was an herb garden that had been designed by a professional landscape architect; the second was a simple green space with a lawn and a single tree. Both behavioral and physiological measures of stress were reduced in the Japanese garden compared to the other two environments, and we believe that it was the design principles inherent in the Japanese style garden that produced the difference in the response of the subjects.

It should also be stressed that though our results are significant, we view them as a pilot study only. In particular, we have only established data for our subjects during the exposures themselves. We were not able to monitor whether there were any long-lasting effect of the exposure in the state of the subjects and so cannot say whether there was any persistent benefit from the exposures.

The imagery of nature offered by the Japanese garden appears to improve health outcome in late stage dementia patients. A review of preliminary studies in horticulture therapy have shown reduction of pain, improved attention, decreased stress, and decrease in antipsychotic medication [23]. It is hypothesized that humans subconsciously react positively to nature settings because homo sapiens evolved in a natural environment. Thus viewing the garden should have positive outcome since it embodies nature and submerges the viewer in a natural setting. Most groups preferred the quiet garden setting; however, the AD group in particular preferred the activity garden, which

deviates from the Japanese garden philosophy in which the imagery of nature is created to offer serenity of mind. This phenomenon requires further study, as we found that our subjects preferred the Japanese garden as opposed to the more stimulating Snoezelen room.

The Japanese garden is unique in its philosophy. It is meant to be a representation of the larger world of nature, not a symbol of a human activity. This is in contrast to the strong references to humanism, individualism, or a specific code of ethics that have had important influences in shaping the design of Western gardens. While symbolism is certainly present in Japanese gardens, its purpose is to communicate a deep veneration of nature, and a unique fascination with and adaptation to the complex relationship between the natural world and mankind. In this way, its design is grounded in far more than the iconic stone lantern. The positioning of the elements it is meant to create a near fathomless depth of meaning, but to do so in a small, seemingly simple, landscape. The exact identification of an object is not always necessary as the intent is not to create a strictly realistic representation. Rather, the composition is meant to serve as an allusion to nature that engages the imagination of its viewer. A humble rock rising out of white sand captures the attention and engages the imagination. One moment it appears as an island rising out of the sea; the next it seems a crouching cat ready to pounce. These types of allusions engage the mind at every level – conscious and subconscious. Indeed, the style of the Japanese garden evolved over hundreds of years to help practitioners of meditation achieve their desired mental state.

Our hypothesis is that this philosophy links directly to the observations cited above, that views of nature can have a positive impact on health outcome. If viewing nature can reduce stress, then viewing a garden, whose design is meant to create an entire natural world in the mind of the viewer, should be particularly effective. Taken together with our observations of the responses of the subjects in the nursing home, the suggestion emerges that the philosophical principles that guide the design of the Japanese garden, interact in a direct way with the innate preferences of an individual, i.e., their "nature". Thus, when the sensory, motor and cognitive capacities of an individual (the components of their "nurture") are degraded during the course of a dementing illness, a garden may prove to be a non-pharmacological intervention that is particularly effective at decreasing stress and improving the quality of life for both subject and caregiver.

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DISCLOSURE STATEMENT

Authors' disclosures available online (http://www.j-alz.com/disclosures/view.php?id=2310).

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Potential of Snoezelen room multisensory stimulation to improve balance in individuals with dementia: a feasibility randomized controlled trial

Kelsey Klages, Aleksandra Zecevic, Joseph B Orange and Sandra Hobson

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Potential of Snoezelen room multisensory stimulation to improve balance in individuals with dementia: a feasibility randomized controlled trial

Kelsey Klages[1], Aleksandra Zecevic[2], Joseph B Orange[3] and Sandra Hobson[4]

Abstract

Objective: To investigate the influence of multisensory stimulations in a Snoezelen room on the balance of individuals with dementia.

Design: Randomized controlled trial.

Setting: Canadian long-term care home.

Participants: Twenty-four residents (average age 86 years), in a long-term care home diagnosed with dementia, were assigned randomly to intervention and control groups. Nineteen participants completed the study.

Interventions: Nine intervention group participants completed 30-minute Snoezelen room sessions twice a week for six weeks. Sessions were guided by participants' preferences for stimulation. Interactions with tactile, visual and proprioceptive sensations were encouraged. Ten control group participants received an equal amount of volunteer visits.

Main outcome measures: The Functional Reach Test, the eyes-open Sharpened Romberg and the Timed Up and Go Test with and without dual task, assessed static and dynamic balance at baseline and after the intervention. Falls frequencies were recorded six weeks before, during and after intervention. A journal was kept of observations in Snoezelen room.

Results: Split-plot MANOVA analyses revealed no significant effects of unstructured Snoezelen room sessions on participants' balance. There were no multivariate effects of time ($F(4,14) = 1.13$, $P = 0.38$) or group ($F(4,14) = 0.63$, $P = 0.65$). Group membership did not alter falls frequency. However, observations of participants' interactions with elements of the Snoezelen room, such as imagery-induced head and eye movements, vibrating sensations and kicking activities, captured events that can be used to create specific multisensory balance-enhancing stimulations.

[1]Health and Rehabilitation Sciences, Elborn College, The University of Western Ontario, London, Ontario, Canada
[2]School of Health Studies, Faculty of Health Sciences, The University of Western Ontario, London, Ontario, Canada
[3]School of Communication Sciences and Disorders, Elborn College, The University of Western Ontario, London, Ontario, Canada
[4]School of Occupational Therapy, Faculty of Health Sciences, Elborn College, The University of Western Ontario, London, Ontario, Canada

Corresponding author:
Kelsey Klages, Health and Rehabilitation Sciences, Elborn College, The University of Western Ontario, 1201 Western Road, London, ON, Canada N6G 1H1
Email: kklages5@gmail.com

Conclusions: Although the null hypothesis was not rejected, further investigation of a potential to influence balance in individuals with dementia through Snoezelen room intervention in long-term care homes is warranted.

Keywords
Snoezelen room, balance, dementia

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Introduction

Individuals with dementia have a two to three times greater risk of falling compared to age-matched controls.[1,2] There are few empirically derived or tested falls prevention programmes available for individuals with dementia. The risk factors for falls among persons with dementia are multifactorial in nature and include both intrinsic (person-related) and extrinsic (environment-related) influences.[3] Individuals with dementia often have increased postural sway and reduced ability to balance, which can result in falls.[4] The central nervous system must process and integrate sensory information from visual, vestibular and somatosensory systems in order to regulate motor movements necessary to maintain balance.[5] Neurological impairments, seen in those with dementia, can produce declines in the central integration among visual, vestibular and somatosensory systems, putting individuals at increased risk for falls due to balance impairments.

One therapeutic approach being used increasingly in long-term care homes for both relaxation and stimulation of individuals with dementia is a Snoezelen room. Users of a Snoezelen room are exposed to effects of touch, lights and colours, sounds, smells, and tastes to stimulate and to sooth. Snoezelen is useful particularly for children or adults with developmental issues, brain injuries or autism, as well as individuals with dementia. Results reveal minor improvements in attention/concentration, mood and communication, and reduced expression of negative behaviours, although comprehensive reviews have cautioned the lack of clear evidence.[6,7] The multisensory stimulations might possess the potential to provide a safe environment for balance-enhancing activities. Vibrating objects, swinging chairs and activities designed to encourage visual tracking of movement provide proprioceptive, vestibular and visual stimulants that can optimize cue integration. It is possible that simultaneous exposure to these sensations produce unique challenges for the central nervous system to maintain balance. Snoezelen rooms may have the potential to improve sensory system integration and, subsequently, to influence balance, although no systematic study to date has examined this influence.

Currently, there are no published studies investigating the effects of Snoezelen rooms on balance among individuals with dementia. Westlake et al. examined whether sensory specific balance training, eye tracking activities, head movement drills and surface balance activities improved the balance of healthy older adults.[8] They found a significant effect on one of three outcome measures: a participant's ability to detect body motion or velocity discrimination. However, this type of training programme did not capture fully the variety of cues or the unique simultaneous multistimulant environment of the Snoezelen room.

The rationale for the use of Snoezelen rooms is based on providing a safe, sensory environment that places few demands on complex cognitive abilities but capitalizes on remaining

sensorimotor capacities of people with dementia.[6] The purpose of this study was to investigate the influence of multisensory stimulations in the Snoezelen room on balance and falls among individuals with dementia residing in a long-term care home.

Method

This randomized controlled two-group study consisted of a six-week pre-intervention period, a six-week intervention period, and a six-week post-intervention period. Research was conducted at an urban, not-for-profit long-term care home located in Ontario, Canada. With over 390 residents, staff in the long-term care home provide comprehensive care to residents who collectively have an average age of 86 years. The local University Health Sciences Research Ethics Board and the administrative officers of the facility approved the study. All participants were informed about the study details and, if assent was given, explicit written consent for participation was obtained from participants' substitute decision makers.

Residents with cognitive deficits, evaluated by scores of less than 25 out of a maximum of 30[9] on the Standardized Mini-Mental State Exam,[10] who understood simple walking instructions, who were able to walk with minimal assistance, and who had not attended a Snoezelen room in the three months prior to this study were recruited. Exclusion criteria included: a history of seizures, legal blindness, profound hearing loss, history of limb fractures, and extrapyramidal system disruptions manifested by the inability to remain motionless or to initiate movement.

A total of 24 eligible residents were recruited. Prior to the commencement of the study a computer-based random number generator was used to randomly select 12 numbers out of 24. These numbers were assigned to the intervention group. The remaining 12 numbers were allotted to participants in the control group. As multiple recruitment packages were sent out simultaneously, and the participants were assigned a number in chronological order when a signed consent document was received, recruitment order and group allocation were unpredictable.

Participants in the intervention group completed individual 30-minute sessions of stimulation and relaxation in the Snoezelen room twice a week for six weeks, with at least two days separating the two weekly sessions. Continuity of diurnal scheduling was attempted; however, sessions were not always delivered at the same time of day. Sessions were structured around each participant's preferences; however, activities that stimulated tactile, visual and proprioceptive sensations were encouraged by the facilitator (KK). These activities included: wearing and touching vibratory shoes and pillows, swinging in a hanging hammock, throwing or kicking differently shaped balls, and eye-tracking and head-moving activities using image projectors, bubble machines and water panels. Other multisensory activities in the room included listening to background music, smelling scents from an aroma diffuser and playing percussion musical instruments such as a drum or tambourine. To document qualitatively balance-related activities or behaviours, the facilitator kept a detailed journal of each session, recording activities that potentially had balance-enhancing effects (e.g. challenging body postures, single-leg standing or vibration stimulation of feet). Both positive and negative reactions to elements of the room were recorded, such as agitation or emotional responses to cues. The facilitator and participants developed a trusting relationship to ensure that each participant felt safe and secure during interactions with the Snoezelen elements in the room.

Participants in the control group received one-on-one visits by a volunteer to account for the intervention groups' individual interactions with the facilitator in the Snoezelen room. Elders and volunteers engaged in activities that were of interest to the control group participants, such as listening to readings of the newspaper, looking at magazines, playing cards or a board game, and talking. These activities took place in the resident's room or the hallway

adjacent to her or his room. In four cases participants preferred to receive visits in the lounge area. This was permitted as long as volunteers censored the possibility of multiple simultaneous sensations.

Four tests used to determine pre- and post-intervention balance included the Functional Reach Test,[11] the Sharpened Romberg,[12] and the Timed Up and Go Test with[13] and without[14] a cognitive dual task. The Sharpened Romberg only included an eyes-open trial with participants standing in a tandem stance for a maximum of 30 seconds. The Timed Up and Go Test with cognitive dual task protocol of counting backwards by threes from a random number between 20 and 100[14] was altered to counting up by ones with best capability, to ensure the cognitive challenge was manageable for study participants with advanced stages of cognitive impairment. In the current study, the random number was pre-set between 20 and 100 in advance by the research team. The Functional Reach Test and Sharpened Romberg are tests of static balance whereas the Timed Up and Go Tests with and without a cognitive dual task are tests of dynamic balance. Other more frequently used balance tests, such as the Berg Balance Scale,[15] were omitted due to the complexity of test instruction, test length and general lack of suitability for participants with dementia. For each of the four tests, two trials were conducted, and the average time or length were calculated and analysed. All assessments were performed between 1 and 5 pm.

Secondary outcome measures included frequency of falls recorded in the pre-, during and post-intervention periods. Nursing staff at the facility used the 'progress notes' section of resident charts to keep a chronological and detailed record of falls that included description of the event and details about injury. An investigator reviewed all charts and extracted adverse events for each of the three six-week periods of the study. The investigator administering assessment tests and recording primary and secondary outcome measures was not blind to group allocation.

A split-plot MANOVA was conducted to examine differences between groups (intervention vs. control group) in pre- and post-intervention periods for the four balance tests. Within-group (pre-intervention vs. post-intervention) changes over time also were analysed using a split-plot analysis. Frequency of falls before, during and after intervention were analysed using simple *t*-tests. Bonferroni corrections were applied to secondary analyses to correct for multiple comparisons. The *P*-value was set at 0.05 with corrections yielding $0.05/3 = 0.017$. It is acknowledged that this sample size limits inferences due to low power.

Results

During the intervention period, two participants from the intervention group withdrew because of a lack of interest in the Snoezelen room. Two participants in the control group and another one in the intervention group were excluded from the analysis because of incomplete data. The incomplete data set for these three participants resulted from their refusal to attempt a test and an inability to comprehend instructions for one or more of the tests. Split-plot analyses of the final data set included measurements from 9 intervention and 10 control group participants (Figure 1).

Although the intervention group was significantly younger, with an average age of 84 (SD 6.6) years compared to 89 (SD 3.2) years in the control group ($P = 0.01$), the two groups had comparable average standardized Mini-Mental State Examination scores (Table 1). The split-plot MANOVA analysis revealed no significant effects of the Snoezelen room intervention on the balance of residents with dementia. The multivariate effect of time was negative from pre- vs. post-intervention ($F(4,14) = 1.13$, $P = 0.38$). The multivariate effect of group also was negative pre- vs. post-intervention ($F(4,14) = 0.63$, $P = 0.65$). Because time and group main effects were not significant, it was not surprising that the multivariate interaction effect of time by

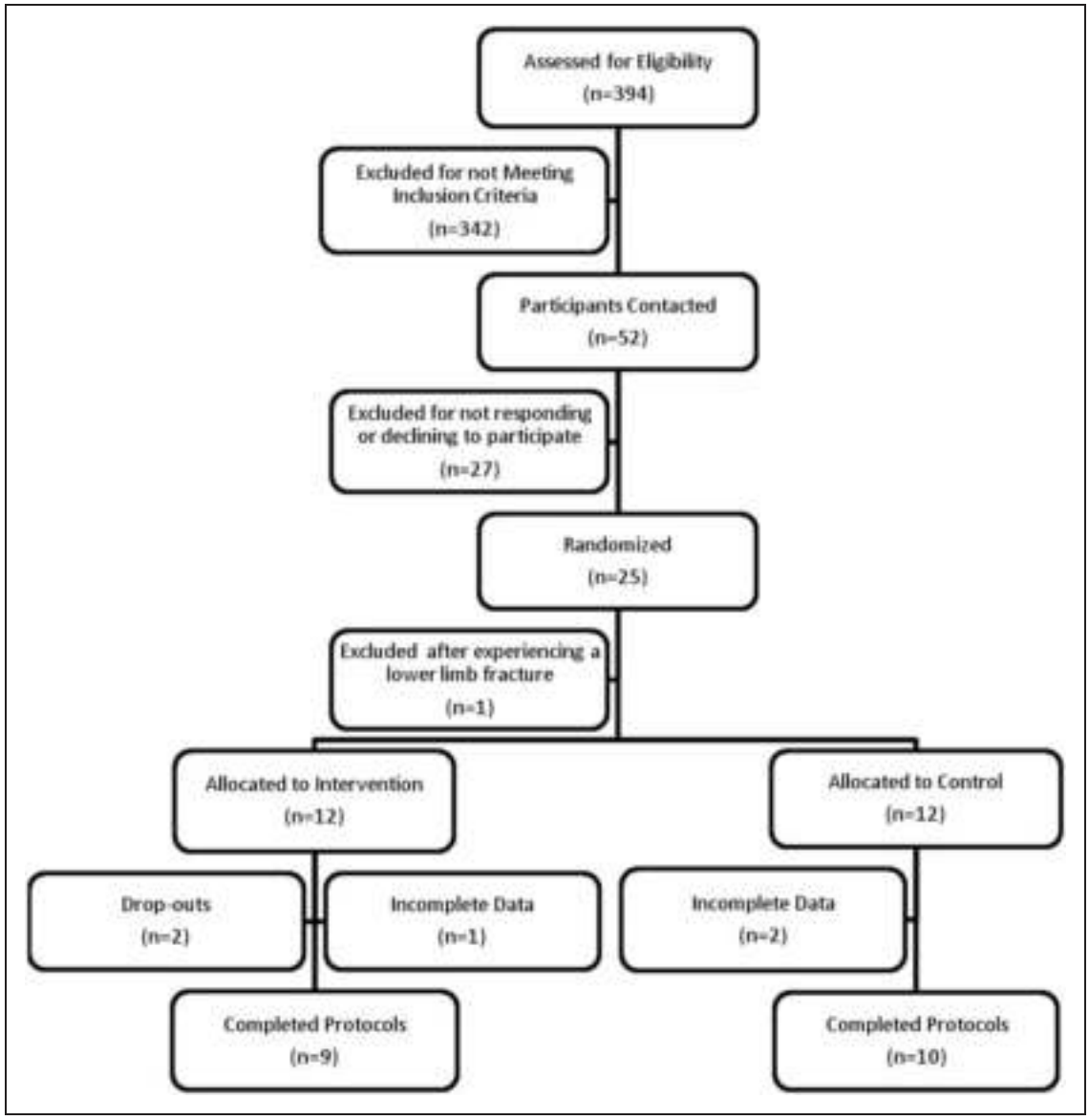

Figure 1. Participant flow in the study.

group also was not statistically significant ($F(4,14) = 0.92$, $P = 0.48$). Both intervention and control groups showed trends toward small balance improvements over time on all tests, although none were statistically significant (Table 2).

Secondary outcome analysis included results from all 24 participants who started the study. Over 18 weeks of the study period, there were 16 falls in the intervention group and 44 falls in the control group. One participant in the control group was an outlier, responsible for 21 of

44 falls in this group. Results for this individual were atypical, so these data were removed from further analysis. Before, during and after intervention there were 5, 7 and 4 falls in the intervention group and 8, 8 and 7 falls in the control group, respectively. Frequency of falls in the intervention group did not change significantly over the course of the intervention ($t(11) = -0.167$, $P = 0.504$) or after the intervention ($t(11) = 0.083$, $P = 0.586$). Similarly, frequency of falls between intervention and control groups was not significantly different in pre- ($t(23) = 1.09$, $P = 0.29$), during ($t(23) = 1.23$, $P = 0.47$) and post-intervention ($t(23) = 0.74$, $P = 0.47$) periods.

Despite negative statistical findings, journal-recorded observations of participants' activities in the Snoezelen room suggest that certain activities have the potential to improve balance. Fibreoptic visual objects and pictures projected on the wall of the Snoezelen room were the visual stimuli. All participants were recorded as moving their heads and following the imagery with their eyes. This occurred to varying degrees in many sessions, with engagement levels depending on which room elements were used. For instance, the image projector cued a great deal of head movement, whereas bubble tubes mainly caused eye movements. Although all participants were exposed to vibrating sensations, six actively sought out or expressed enjoyment when exposed to massages from vibrating pillows. Two participants enjoyed this stimulation during every session for the entire length of the session, and other four enjoyed vibration sensation in over 6/12 sessions, for varying amounts of time. Two of these six participants also enjoyed vibrating shoes, in 4/12 sessions for up to 5 minutes each time.

Three participants engaged in kicking a giant beach ball back and forth with the facilitator in 6/12 sessions for an estimated 4 minutes. When standing, this activity required balancing on one foot and lining up their swinging leg to make contact with the ball. The challenge of kicking the ball increased in the darkened environment of the Snoezelen room. For this activity, after 1 minute of standing and kicking, participants would sit down and continue to kick the ball. Two participants repeatedly chose to sit and

Table 1. Participant demographic information

	Intervention group ($n = 9$)		Control group ($n = 10$)	
Variable	Mean	SD	Mean	SD
Women	7		6	
Use of mobility aid	4		5	
Age	84	6.6	89	3.2
Height (cm)	162	7.3	167	12.6
Weight (kg)	62	8.8	66	22.5
SMMSE	12 [4–22]	7.4	13[2–22]	6.4

SMMSE, Standardized Mini-Mental State Examination.

Table 2. Mean scores and standard deviations for tests pre- and post-intervention period

	Intervention group				Control group			
	Pre-		Post-		Pre-		Post-	
Test	Mean	SD	Mean	SD	Mean	SD	Mean	SD
FRT (cm)	11.3	5.8	11.8	3.8	10.3	8.8	11.9	5.8
SR (seconds)	21.5	7.0	23.7	10.6	24.7	6.8	29.4	1.9
TUG (seconds)	34.9	22.6	31.9	8.4	32.2	20.0	28.4	11.3
TUGc (seconds)	43.9	22.5	36.2	9.7	36.1	21.0	35.1	18.0

FRT, Functional Reach Test; SR, Sharpened Romberg; TUG, Timed Up and Go; TUGc, Timed Up and Go with dual task.

swing in a hammock hanging from the ceiling. One participant spent 8/12 sessions and the other spent 4/12 sessions exclusively in this activity. Interestingly, while resting in a hammock, without her glasses and with limited visual cues, one participant could not feel the swinging motion until the facilitator substantially increased the magnitude, within safety limits, of force applied to the hammock. Other activities enjoyed by participants included playing musical instruments, smelling a variety of scents provided by the aroma diffuser, and touching tactile objects such as fibreoptics, stress balls and soft blankets.

Discussion

Results from the four static and dynamic balance tests used in this study suggest that unstructured Snoezelen room sessions provided to individuals with dementia on a one-to-one basis for six weeks have no significant effects on enhancing balance or reducing falls. There were no significant changes in balance test scores and falls rates frequency within groups over time, or between the intervention versus the control group. This conclusion should be interpreted with caution within the context of low statistical power due to the limited number of participants in this study as well as to the study's exploratory nature.

Observations of participants' activities during Snoezelen room sessions suggested a potential for the creation of structured programmes that might impact balance of individuals with dementia. Many activities in the Snoezelen room promote head and eye movement, which can have a positive effect on balance.[8,16] Vibration, which triggers proprioception cueing effects through stretching of muscle spindles, is provided in the Snoezelen room through vibrating shoes and pillows. The literature shows that proprioceptive stimulation through vibration can affect postural orientation even when vibration is terminated.[17] Whole-body vibration can have positive effects on the balance and mobility of individuals with Parkinson's disease after a three-week intervention programme and at a four-week follow-up. However, this vibration was usually delivered while participants were standing on a platform.[18] One-leg stance or narrowed support base exercises also have been shown to increase balance.[19] Kicking the giant beach ball back and forth forced one-leg stance situations. This was a challenging exercise for the participant yet the room provided a safe and encouraging environment in which to practise these skills.

Another potential balance-enhancing activity in the room was swinging in the hanging hammock, which could provide cueing of vestibular receptors in the inner ear that provide information to the central nervous system about head position and movement.[5] This stimulation is similar to rocking-chair therapy, which also holds vestibular cueing potential for those with dementia.[20]

The current study design permitted each participant to have unique experiences in the Snoezelen room with different levels of interaction with multisensory stimulations, depending on participants' interests, mood and functional levels. It is possible that these stimuli were too unstructured and too few to have a significant effect on proprioception, the vestibular system, vision and/or balance. However, the study's aim was to determine whether the multisensory stimulation had any effect on balance when Snoezelen room stimulations were used in the way the room was designed and intended, without structured exercise programming or training. Two observational studies with a small number of participants that investigated the physical implications of the room produced results showing reduction of unnecessary body movements[21] and increased active looking and attentiveness.[22]

The ability to improve the balance of individuals with dementia is limited due to already compromised somatosensory systems and central nervous system deteriorations. Rare, empirically derived prevention programmes are available for individuals with dementia with limited evidence that the risk for falls can be modified among these individuals.[3] Some evidence

shows that physical training and targeted strength, stamina, suppleness, coordination and cognitive activation have positive effects on falls prevention and balance in individuals with dementia.[23,24] However, these trials were small-scale studies and the effectiveness of falls prevention in individuals with dementia has yet to be determined.[25]

Encouraging mobility and exposure to risky situations in less physically able individuals through balance interventions can be counter-productive to falls reduction.[26] Turning the focus from a physical activity intervention, some researchers in the area believe that an intervention specifically targeting executive function or attention would decrease falls in this population because intact executive function is required for normal motor control.[27] In the current study, it is possible that the Snoezelen intervention improved attention and concentration in participants leading to the small balance improvement trends. Despite the negative statistical findings, the link between sensory-specific activities and balance warrants further investigation due to the positive observations noted. Sensory environments of the Snoezelen room offer a resourceful venue in which to explore balance-enhancing potential in greater depth and detail.

The exploratory nature of this study and the small number of participants limit the generalization of findings. Validity and reliability of selected outcome measures have not been comprehensively studied in the context of testing individuals with dementia. It is possible that performances on the tests were influenced by variable disease pathologies, fluctuating levels of attention, multiple medications, diverse medical and psychiatric comorbidities, and motor impairments, among other factors. There is potential for measurement bias because the investigator was not blinded to study group allocation. Although recommended by the scientific literature,[6] the six-week period may have been too short to allow adequate engagement of participants with balance-enhancing stimulants of the room.

Examining the utility of Snoezelen room to enhance balance is difficult due to inconsistencies in which Snoezelen elements were used by participants, variability of the room elements, and facilitator and participant values.[6] We specifically targeted a wide range of Snoezelen element options that were implemented based on participants' interests and preferences. We believe that such individualization of approaches is a strength, even in light of methodological weakness considerations. Establishing Snoezelen as a beneficial therapeutic intervention is complicated by heterogeneous research designs, weak methodologies and small number of completed studies, which make meta-analyses difficult.[7] Nevertheless, these limitations need to be interpreted in light of substantial challenges encountered when conducting research with older, cognitively impaired residents in long-term care institutions.

Recommendations for future research

Based on lessons learned in this project, there are several recommendations for future studies. Other outcome measures should be explored, such as body velocity discrimination, passive joint positioning sensation, body sway, head velocity or the Berg Balance Scale. Comorbidities, acute health issues, medications, fatigue, muscle strength and endurance, familiarity with the task and management of pain also should be recorded and reported because they can represent major confounders in the accurate measurement of balance and of the frequency of falls. It is recommended for future studies that the causes of falling be recorded to determine whether falls occurred due to balance impairments or to other factors such as incontinence, environmental hazards or poorly designed or used assistive devices. Knowledge of the severity of dementia can be helpful in adjusting to fluctuating levels of awareness, attention and memory capacity that cause interferences in completing activities in the Snoezelen room. When the participant shows interest,

hands-on activities can keep these individuals engaged and connected with the stimulants.

Clinical messages

- Six weeks of unstructured, biweekly, 30-minute Snoezelen room sessions did not positively influence balance in individuals with dementia residing in a long-term care home.
- Observations of participant interactions with elements of the Snoezelen room suggest that the room potentially could provide specific and structured balance-enhancing activities to long-term care residents.

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Úlceras por presión

Prevención, tratamiento y consejos desde la farmacia

La úlcera por presión (UPP) es una necrosis de la piel y el tejido subcutáneo de una zona sometida a presión entre dos planos duros, los huesos del paciente y el soporte (cama o silla), que provoca una disminución del aporte de oxígeno y nutrientes a esa zona, por el aplastamiento de los vasos sanguíneos que se produce.

Este tipo de lesiones aparece principalmente en pacientes inmovilizados durante mucho tiempo y tiene una baja tendencia a la cicatrización espontánea. Constituye un importante problema de salud pública, dadas las repercusiones que ocasiona en la calidad de vida de los pacientes, la prolongación de la estancia hospitalaria y el aumento del gasto de material y de los cuidados por parte del personal de enfermería. Por todo ello, es muy importante realizar una adecuada prevención para evitar la aparición de las UPP.

Se sabe que la mayoría de las UPP podrían haber sido evitadas con la aplicación de un adecuado protocolo de prevención, por eso, cada vez más, el problema de las UPP está teniendo repercusiones legales, ya que el hecho de que un paciente ingrese por una patología determinada y deba prolongar su estancia en el hospital debido a la aparición de una lesión de este tipo lleva cada vez más a los familiares a denunciar la falta de cuidados adecuados para prevenir la UPP.

Es muy importante tener en cuenta que la prevención no sólo se debe realizar a nivel hospitalario, también resulta imprescindible implantar medidas de prevención en el propio domicilio del paciente, cuando sus condiciones así lo precisen.

Una vez se han desarrollado estas lesiones, es necesario llevar a cabo tratamientos efectivos para que no se produzcan complicaciones en los pacientes y además hay que continuar con las medidas de prevención establecidas para impedir que aparezcan nuevas UPP.

El Grupo Nacional de Úlceras (GNEAUPP) realizó el primer Estudio Nacional de Úlceras por Presión en España con el objetivo de poder dimensionar el problema de las UPP, así como algunos aspectos relacionados con las tendencias de prevención en instituciones de Atención Primaria, hospitalaria y sociosanitaria.

La tabla 1 resume algunos de los resultados encontrados que indican que hay una mayor prevalencia de UPP en el ámbito hospitalario, que se presenta con mayor frecuencia entre 71 y 90 años, que es más frecuente en mujeres que en varones, que la zona más afectada es el sacro y que la utilización de superficies especiales para el manejo de la presión es mayor en los centros sociosanitarios.

ÁNGELA BOSCH
FARMACÉUTICA.

Tabla 1. Prevalencia de las UPP por edad, sexo y localización

	Atención primaria	Hospitales	Centros sociosanitarios
Prevalencia UPP	8,34%	8,81%	7,6%
Edad mayoritaria (años)	71-90	71-90	71-90
Varones	37%	46,7%	32,7%
Mujeres	60,6%	52,3%	65,8%
Localización mayoritaria	Talón	Sacro	Sacro
Uso de SEMP	38,5%	63,5%	70,5%

A partir de los resultados obtenidos en este estudio puede afirmarse que las UPP constituyen, hoy día, un importante problema de salud, que su prevención aún no es considerada como una prioridad y también que a pesar de que afecta primordialmente a las personas mayores, también hay que tener en cuenta su impacto en pacientes más jóvenes.

Cuidados específicos

Piel

Hay que examinar el estado de la piel, como mínimo una vez al día, para detectar rápidamente la aparición de la lesión. En su fase más temprana consiste en un eritema cutáneo que no palidece en piel intacta tras 30 minutos de haber cesado la presión. Se debe actuar sobre ella de inmediato y evitar que progrese a estadios más avanzados prestando mayor atención a las prominencias óseas (sacro, talones, caderas) y a las zonas expuestas a humedad por incontinencia, transpiración o secreciones.

Ha de mantenerse en todo momento la piel del paciente limpia y seca y se utilizarán jabones o sustancias limpiadoras que no agredan la piel, evitando la fricción cuando se realice su secado.

No es aconsejable usar sobre la piel alcoholes, como el de romero, ya que su utilización no sólo no beneficia el estado de la piel, sino que incluso la perjudica y en lugar de mantenerla en condiciones adecuadas de hidratación, produce el efecto contrario, es decir, la reseca debido a sus propiedades astringentes y produce vasoconstricción en la zona aplicada, lo que hace disminuir la microcirculación y, por tanto, ayuda a la aparición de la lesión.

Características y aplicación de los AGHO

Resulta conveniente aplicar cremas hidratantes procurando su completa absorción. En los puntos de apoyo, donde hay riesgo de desarrollo de UPP y la piel se encuentra intacta, se recomienda la utilización de ácidos grasos hiperoxigenados (AGHO).

La aplicación de AGHO en las zonas de riesgo de desarrollo de UPP es una medida que forma parte de los protocolos de prevención de UPP, que se llevan a cabo en los hospitales más importantes de España.

Los AGHO son una mezcla de ácidos grasos que han sido sometidos a un proceso de hiperoxigenación que les confiere su eficacia terapéutica.

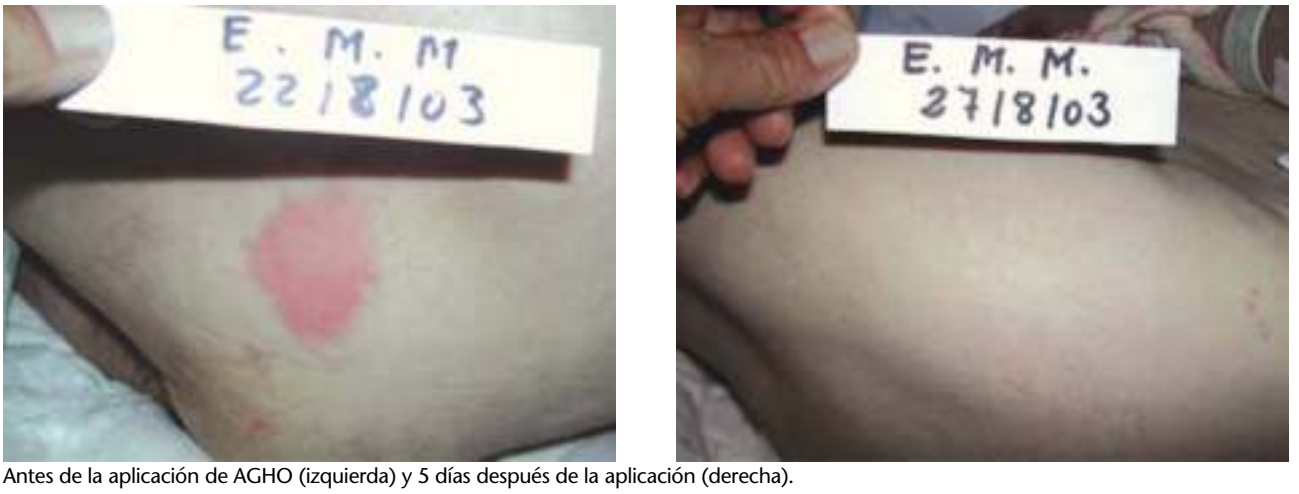
Protegen la piel frente a las causas que originan la aparición de las UPP, evitan la deshidratación cutánea y restauran la película hidrolipídica, aumentan la resistencia al rozamiento, mejoran la troficidad cutánea, impulsan la renovación celular y mejoran la microcirculación sanguínea evitando la isquemia tisular.

Los AGHO acompañados de extractos de plantas medicinales como *Hypericum perforatum* (hierba de San Juan), que confiere una acción cicatrizante, lenitiva, antiséptica, antiinflamatoria y reepitelizante, gracias a su composición en taninos y aceites esenciales, y *Equisetum arvense* (cola de caballo) rica en ácido silícico con actividad reafirmante del tejido dérmico, elastificante y reepitelizante, constituyen el tratamiento más novedoso en la prevención y tratamiento de las UPP de grado I.

La aplicación de los AGHO es muy cómoda y sencilla, con lo que, por una parte, reduce el tiempo de dedicación del personal de enfermería y, por otra, resulta adecuado para la utilización en el domicilio del paciente, ya que no requiere de personal sanitario especializado.

Si se previene la aparición de UPP de grado I, se está previniendo sus complicaciones posteriores, como son las UPP de grado II, III y IV.

Aplicación de AGHO en el talón.



Antes de la aplicación de AGHO (izquierda) y 5 días después de la aplicación (derecha).

Manejo de la presión

La presión mantenida sobre determinadas zonas del cuerpo es el factor más importante en la aparición de UPP, ya que genera un proceso isquémico en los tejidos implicados como consecuencia de una disminución del aporte de oxígeno y de nutrientes a esa zona.

Para minimizar el efecto de la presión hay que intentar mejorar la movilidad del paciente y realizar cambios posturales cada 2-3 horas cuando se encuentra encamado y, en el caso de que el paciente pueda moverse por sí solo, es conveniente que realice cambios de postura cada 15 min. Se debe evitar que el paciente se apoye directamente sobre sus lesiones, el contacto directo de las prominencias óseas entre sí y el arrastre a la hora de efectuar las movilizaciones para reducir la fricción.

Pueden resultar útiles las superficies especiales de apoyo (tabla 2), en especial, las que permiten manejar

Tabla 2. Superficies de apoyo

Estáticas
• Colchonetas-cojines estáticos de aire
• Colchonetas-cojines de fibras especiales (siliconizadas)
• Colchonetas de espumas especiales
• Colchones-cojines viscoelásticos
Dinámicas
• Colchones-colchonetas-cojines alternantes de aire
• Colchones-colchonetas alternantes de aire con flujo de aire
• Camas y colchones de posicionamiento lateral
• Camas fluidificadas
• Camas bariátricas
• Camas que permiten el decúbito

CONSEJOS DESDE LA FARMACIA

Algunas consideraciones sobre las UPP y su cura

- Teniendo en cuenta que todas las UPP están contaminadas por bacterias, debe realizarse un diagnóstico clínico, basado en la inflamación, el dolor, el olor y el exudado purulento
- La infección de una UPP puede estar influenciada por el déficit nutricional, la obesidad, la diabetes, neoplasias, edad avanzada, incontinencia, y por fármacos como los inmunosupresores y los citotóxicos
- Si transcurridas 2-4 semanas, la úlcera no evoluciona favorablemente, pueden utilizarse apósitos que contienen plata en malla de carbón activado o recurrir a antibióticos locales como la sulfadiazina argéntica o el ácido fusídico
- Para evitar que se formen abscesos o que la lesión se cierre en falso hay que rellenar parcialmente las cavidades y tunelizaciones con productos basados en los principios de la cura húmeda y evitar que se deseque el lecho de la úlcera y se lesione el tejido periulceral
- La cura en ambiente húmedo ha demostrado una mayor efectividad en este tipo de lesiones frente a la cura tradicional

y distribuir la presión, como colchonetas-cojines estáticos de aire, de fibras y espumas especiales, alternantes de aire y camas fluidificadas, entre otras.

En las zonas de especial riesgo para el desarrollo de este tipo de lesiones, como son los talones, se pueden utilizar sistemas de protección local ante la presión, siempre que sean compatibles con otras medidas de prevención, que faciliten la inspección de la piel y que no la dañen cuando se retiren, como los apósitos tipo bota-botín que se colocan y se retiran con mucha facilidad.

También hay que tener en cuenta que los diferentes dispositivos que se utilizan en los pacientes, como pueden ser las sondas, mascarillas o catéteres, pueden provocar problemas de rozamientos y de presión sobre la piel y que, en estos casos, será útil la aplicación de AGHO.

Soporte nutricional

Es imprescindible una adecuada nutrición para favorecer la cicatrización de las UPP e incluso para evitar su aparición.

Habitualmente, los pacientes que desarrollan UPP reúnen una serie de condiciones, que dificultan una correcta nutrición, como pacientes de edad avanzada con problemas de inapetencia, carencia de dientes, o bien pacientes con problemas neurológicos o bajos grados de conciencia.

Por ello, si la dieta habitual del paciente no cubre sus necesidades, hay que recurrir a suplementos nutricionales formulados especialmente para pacientes con heridas crónicas.

Clasificación

Las UPP se clasifican en cuatro grados en relación al aspecto y profundidad de las lesiones:

- *Grado I.* Eritema cutáneo que no palidece en piel intacta. En pacientes de piel oscura, observar edema, induración, decoloración, calor local.
- *Grado II.* Pérdida parcial del grosor de la piel que afecta a la epidermis, dermis o ambas, puede tener aspecto de abrasión, ampolla o cráter superficial.
- *Grado III.* Pérdida total del grosor de la piel que implica lesión o necrosis del tejido subcutáneo, que puede extenderse hacia abajo, pero no por la fascia subyacente.
- *Grado IV.* Pérdida total del grosor de la piel con destrucción extensa, necrosis del tejido o lesión en músculo, hueso o estructuras de sostén como el tendón o la cápsula articular.

Elección del apósito

- El apósito debe ser biocompatible, proteger la herida de agresiones externas físicas, químicas y bacterianas, mantener el lecho de la úlcera continuamente húmedo y la piel circundante seca, eliminar y controlar exudados y tejido necrótico mediante su absorción, dejar la mínima cantidad de residuos en la lesión, ser adaptable a las localizaciones difíciles, respetar la piel perilesional y ser de fácil aplicación y retirada
- Hay que considerar la localización de la lesión, su estado, la gravedad de la úlcera, la cantidad de exudado, la presencia de tunelizaciones, el estado de la piel perilesional, los signos de infección, el estado general del paciente, el nivel asistencial y los recursos disponibles, la relación coste/efectividad y la facilidad de aplicación en contextos de autocuidado
- Podemos distinguir cinco tipos de apósitos basados en la técnica de la cura en ambiente húmedo: alginatos, poliuretanos, hidrocoloides, apósitos combinados (hidrocoloides con absorbentes o con hidrofibra de hidrocoloide) e hidrogeles

No debe limpiarse la herida con antisépticos locales como povidona yodada, clorhexidina, agua oxigenada, ácido acético o solución de hipoclorito, porque todos son productos químicos citotóxicos y su uso continuado puede provocar problemas sistémicos por su absorción en el organismo

Tratamiento. Directrices generales

Una vez se ha realizado una adecuada valoración inicial del paciente, en cuanto a los factores de riesgo a desarrollar una UPP (inmovilidad, incontinencia, edad avanzada, falta de higiene corporal, desnutrición, estado mental) y se ha valorado la lesión (tabla 3), se realizará su tratamiento, que en el caso de una UPP de grado I consistirá en aliviar la presión en la zona afectada y en la utilización de AGHO para conseguir una mejora de la resistencia de la piel y minimizar el efecto de la anoxia tisular (tabla 4).

En cuanto a las úlceras de estadio II, III y IV, el tratamiento debe incluir el desbridamiento de tejido necrótico, la limpieza de la herida, la prevención y abordaje de la infección bacteriana con antibióticos locales y, por último, elegir un producto que mantenga continuamente el lecho de la úlcera húmedo y a temperatura corporal.

El tejido necrótico debe ser eliminado, ya que es un medio ideal para la proliferación bacteriana e impide el proceso de curación. Las características del tejido a desbridar y la situación global del paciente condicionan el tipo de desbridamiento a realizar.

Tabla 3. Parámetros de la valoración de la lesión

- Localización de la lesión
- Grado de la úlcera (I, II, III y IV)
- Dimensiones
- Existencia de tunelizaciones, excavaciones y trayectos fistulosos
- Tipos de tejidos presentes en el lecho de la lesión (necróticos, esfacelados, granulados)
- Estado de la piel perilesional (íntegra, lacerada, macerada)
- Secreción de la úlcera (escasa, profusa, purulenta, hemorrágica, serosa)
- Dolor
- Signos clínicos de infección local (exudado purulento, mal olor, bordes inflamados)

Quirúrgico

Es la forma más rápida de eliminar áreas adheridas a planos profundos. Es un procedimiento cruento que requiere conocimientos clínicos, destreza, técnicas y material estéril. Debe realizarse por planos y en diferentes sesiones, comenzando por el área central y liberando el tejido desvitalizado. Como la técnica es dolorosa se aconseja aplicar un antiálgico tópico, como gel de lidocaína al 2%. La hemorragia es una de las complicaciones más frecuentes. Se controla con apósitos hemostáticos y, en caso de necesidad, con la sutura del vaso sangrante.

Químico

Hay en el mercado diferentes productos enzimáticos, proteolíticos o fibrinolíticos, que se utilizan como agentes de detersión química de los tejidos necróticos. La colagenasa es una de las sustancias más empleadas. Favorece el desbridamiento y el crecimiento del tejido de granulación. Cuando vaya a utilizarse se recomienda proteger la piel periulceral con una película barrera, pasta de cinc o silicona.

Tabla 4. Cuidado local de las úlceras de grado I

ALIVIAR LA PRESIÓN EN LA ZONA AFECTADA
UTILIZACIÓN DE AGHO
Para mejorar la resistencia de la piel y minimizar el efecto de la anoxia tisular
ALIVIAR LA PRESIÓN MEDIANTE APÓSITOS
• Efectivos en el manejo de la presión
• Que permitan la visualización de la lesión al menos una vez al día
• Reductores de la fricción
• Que no dañen la piel sana
• Compatibles con la utilización de productos tópicos para el cuidado de la piel

Autolítico

Se produce por la conjunción de tres factores, la hidratación del lecho de la úlcera, la fibrinólisis y la acción de las enzimas endógenas sobre los tejidos desvitalizados. Es la forma de desbridamiento menos traumática, no requiere de habilidades clínicas especiales y es bien aceptada por los pacientes, si bien es más lenta. Todos los apósitos capaces de producir condiciones de cura húmeda y los hidrogeles en estructura amorfa producen desbridamiento autolítico.

Mecánico

Son técnicas no selectivas y traumáticas en creciente desuso, al existir alternativas menos molestas y con menor riesgo. Se realiza la abrasión mecánica mediante rozamiento, la irrigación a presión de la herida o la utilización de apósitos humedecidos que al secarse a las 4-6 horas se adhieren al tejido necrótico, pero también al tejido sano, que se arranca con la retirada del apósito.

Limpieza

Para limpiar la lesión se utiliza suero salino fisiológico y se usa la mínima fuerza mecánica para la limpieza de la úlcera y su secado posterior. No debe limpiarse la herida con antisépticos locales como povidona yodada, clorhexidina, agua oxigenada, ácido acético o solución de hipoclorito, porque todos son productos químicos citotóxicos y su uso continuado puede provocar problemas sistémicos por su absorción en el organismo. ■