Hábitos alimenticios, actividad física y estilos de vida en diferentes poblaciones

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TESI DOCTORAL

Hábitos alimenticios, actividad física y estilos de vida en diferentes poblaciones.

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Memòria presentada per optar al Grau de Doctor per la Universitat de Lleida

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Vida

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ABSTRACT

Introduction: It has been observed that the regular practice of physical activity (PA) has numerous health benefits. Likewise, eating behaviours, the degree of adherence to the Mediterranean Diet and sleep habits have shown an opportunity to increase people's quality of life.

Objective: The general objective of the Doctoral Thesis is, through four studies (3 cross-sectional and one longitudinal), to discover and study the relationships established between different lifestyles and physical activity in a representative sample of different population groups.

Method: Study I. The participants were 600 university students from the city of Lleida. Subjects completed an International Physical Activity Questionnaire (GPAQ) and a food frequency questionnaire (CFC) and finally the tobacco and alcohol consumption questionnaire. Physical activity levels and lifestyles were the variables studied. Study II. A total of 1,492 people with a mean age of 38 years old participated in the study, where they completed two questionnaires, one the IPAQ and the other on Adherence to the Mediterranean diet. Physical activity levels and adherence to the Mediterranean diet were the study analysis variables. Study III. It is a longitudinal study, the sample was made up of 32 women, a physical activity program was applied to them for three months, two days a week. The variables studied were levels of physical activity, anthropometric measurements, adherence to the Mediterranean diet and lipid profile. Finally, Study IV had a sample of 954 school children. The children completed two questionnaires, one on Physical Activity and the other on Sleep Quality.

Results: Study I. University students showed an active behaviour, and, of these, a high percentage has a high level of physical activity practice. The young university students showed deficient eating behaviours considering the recommendations of the different official organizations. Study II. The general results r suggests that, for both sexes, regular cycling is positively associated the levels of adherence to the Mediterranean diet. Study III. They confirm that a 3-month exercise program of 2 hours per week it increases adherence to regular PA practice and improves the physical condition of the participants. It is observed that increases in the practice of PA were associated with improvements in AMD, and this association was maintained over time. Finally, in study IV. It was observed that the sleep quality is generally better in school-age boys than in girls, likewise, it was found that greater physical activity is associated with better sleep quality.

Conclusions: The doctoral thesis analyzes the association between different healthy habits and provides new evidence on the need to promote them throughout the life cycle. Among these habits, it is necessary to pay attention to the relationship between physical activity and diet and the association between PA and sleep quality. Therefore, it is necessary to propose prevention strategies that include interventions in these areas. This can be beneficial in terms of preventing health and promoting well-being in all types of populations. We believe that these findings will contribute to new and future research on this topic, in order to help carry out more effective interventions.

RESUMEN

Introducción: Se ha observado que la práctica regular de actividad física (AF) tiene numerosos beneficios sobre la salud. Así mismo las conductas alimentarias, el grado de adherencia a la Dieta Mediterránea (AMD) y los hábitos de sueño han demostrado ser una oportunidad para aumentar la calidad de vida de las personas.

Objetivo: El objetivo general de la Tesis Doctoral es, a través de cuatro estudios (3 transversales y uno longitudinal), conocer y estudiar las relaciones que se establecen entre los diferentes estilos de vida y la AF en una muestra representativa de diferentes grupos poblacionales.

Método: Estudio I. Los participantes fueron 600 universitarios de la ciudad de Lleida. Los sujetos completaron un cuestionario internacional sobre actividad física (GPAQ) y un cuestionario de frecuencia de consumo de alimentos (CFC) y finalmente el de consumo de tabaco y alcohol. Los niveles de actividad física y los estilos de vida fueron las variables estudiadas. Estudio II. Un total de 1492 personas con una media de edad de 38 años participaron en el estudio, completaron dos cuestionarios IPAQ y el ADM. Los niveles de AF y la ADM fueron las variables análisis de estudio. Estudio III. Se trata de un estudio longitudinal cuya muestra estuvo compuesta por 32 mujeres a las que se les aplicó un programa de actividad física durante tres meses, dos días a la semana. Las variables estudiadas fueron: niveles de actividad física, medidas antropométricas, adherencia a la dieta mediterránea y perfil lipídico. Finalmente, el Estudio IV, tuvo una muestra de 954 niños escolares. Los niños completaron dos cuestionarios, uno sobre Actividad física y otro sobre Calidad del sueño.

Resultados: Estudio I. Los estudiantes universitarios mostraron un comportamiento activo y, de estos, un alto porcentaje tiene un alto nivel de práctica de actividad física. Los jóvenes universitarios mostraron comportamientos alimentarios deficientes teniendo en cuenta recomendados por los diferentes organismos oficiales. Estudio II. Los resultados generales sugieren que, para ambos sexos, el ciclismo practicado de forma regular se asocia positivamente con niveles de adherencia a la dieta mediterránea. Estudio III. Confirman que un programa de ejercicio de 3 meses de 2 horas por semana aumenta la adherencia a la práctica habitual de AF y mejora la condición física de los participantes. Se observa que los aumentos en la práctica de AF se asociaron con mejoras en AMD, y esta asociación se mantuvo en el tiempo. Finalmente, en el estudio IV. Se observó que la calidad del sueño es generalmente mejor en los niños en edad escolar que en las niñas, así mismo, se constató que una mayor actividad física se asocia con una mejor calidad del sueño.

Conclusiones: La tesis doctoral analiza la asociación entre diferentes hábitos saludables y aporta nuevas evidencias sobre la necesidad de fomentarlos a lo largo de todo el ciclo vital. Entre esos hábitos es necesario prestar atención a la relación existente entre AF y alimentación y la asociación entre AF y calidad de sueño. Por ello, es necesario plantear estrategias de prevención que contemplen intervenciones en estos ámbitos. Esto puede resultar beneficioso en términos de prevención de la salud y favorecer el bienestar en todo tipo de poblaciones. Creemos que estos hallazgos contribuirán a nuevas y próximas investigaciones en esta temática, con el fin de ayudar a realizar intervenciones más efectivas.

RESUM

Introducció: S'ha observat que la pràctica regular d'activitat física (AF) té nombrosos beneficis sobre la salut. Així mateix, les conductes alimentàries, el grau d'adherència a la Dieta Mediterrània i els hàbits de son han demostrat ser una oportunitat per augmentar la qualitat de vida de les persones.
Objectiu: L'objectiu general de la Tesi Doctoral és, a través de quatre estudis (3 transversals i un de longitudinal), conèixer i estudiar les relacions que s'estableixen entre els diferents estils de vida i l'activitat física en una mostra representativa de diferents grups poblacionals.
Mètode: Estudi I. Els participants van ser 600 universitaris de la ciutat de Lleida. Els subjectes van completar un qüestionari internacional sobre activitat física (GPAQ) i un qüestionari de freqüència de consum d'aliments (CFC) i, finalment, el de consum de tabac i alcohol. Els nivells d'activitat física i els estils de vida van ser les variables estudiades. Estudi II. Un total de 1492 persones amb una edat mitjana 38 anys van participar a l'estudi, on van completar dos qüestionaris un sobre activitat física (IPAQ) i l'altre sobre l'adherència a la dieta mediterrània. Els nivells d'activitat física i l'adherència a la dieta mediterrània van ser les anàlisis variables d'estudi. Estudi III. Es tracta d'un estudi longitudinal, la mostra del qual va estar composta per 32 dones a les que se'ls va aplicar un programa d'activitat física durant tres mesos, dos dies per setmana. Les variables estudiades van ser: nivells d'activitat física, mesures antropomètriques, adherència a la dieta mediterrània i perfil lipídic. Finalment, l'Estudi IV va tenir una mostra de 954 nens escolars, els nens van completar dos qüestionaris un sobre Activitat física i un altre sobre Qualitat del son.
Resultats: Estudi I. Els estudiants universitaris van mostrar un comportament actiu i, d'aquests, un percentatge alt té un alt nivell de pràctica d'activitat física. Els joves universitaris van mostrar comportaments alimentaris deficients tenint en compte les recomanacions pels diferents organismes oficials. Estudi II. Els resultats generals suggereixen que, per a tots dos sexes, el ciclisme practicat de manera regular s'associa positivament amb majors nivells d'adherència a la dieta mediterrània. Estudi III. Confirmen que un programa d'exercici de 3 mesos i 2 hores per setmana augmenta la adherència a la pràctica habitual d'AF i millora la condició física dels participants. S'observa l'augment de l'AF es van associar amb millores a l'AMD, i aquesta associació es va mantenir en el temps. Finalment, a l'estudi IV. Es va observar que la qualitat del son és generalment millor en els nens en edat escolar que en les nenes, així mateix, es va constatar que una activitat física més gran s'associa amb una millor qualitat del son.
Conclusions: La tesi doctoral analitza l'associació entre diferents hàbits saludables i aporta noves evidències sobre la necessitat de fomentar-los al llarg de tot el cicle vital. Entre aquests hàbits cal parar esment a la relació existent entre activitat física i alimentació i l'associació entre AF i qualitat de son. Per això, cal plantejar estratègies de prevenció que contemplen intervencions en aquests àmbits. Això pot resultar beneficiós en termes de prevenció de la salut i afavorir el benestar de tota mena de poblacions. Creiem que aquestes troballes contribuiran a noves i properes investigacions en aquesta temàtica, per tal d'ajudar a fer intervencions més efectives.

TABLA DE CONTENIDOS

PROYECTO DE INVESTIGACIÓN Y FINANCIACIÓN

La presente tesis doctoral se realizó principalmente como resultado de los siguientes proyectos de investigación

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Título del proyecto: Grup de recerca consolidat Moviment Humà. Generalitat de Catalunya, 021 SGR 01619

Entidad financiadora: Generalitat de Catalunya

Referencia de la concesión: 021 SGR 01619.

Durada: des de/d' 01/09/2016 - **hasta** actualidad

Investigador/a principal: Joaquin Reverter Masia

Título del proyecto: Envelliment actiu, qualitat de vida i relacions intergeneracionals

Entidad financiadora: Institut de Desenvolupament Social i Territorial.Universitat de Lleida

Referencia de la concesión: INDEST2016

Durada: des de/d' 30/10/2016 **hasta** 30/10/2018

Investigador/a principal: Fidel Molina i Joaquín Reverter Masia

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Título del proyecto: Evaluación de diversos parámetros de salud y niveles de actividad física en la escuela primaria y secundaria

Entidad financiadora: Càtedra ASISA-UdL "Salut, Educació i Qualitat de Vida" 2020-2021.

Referencia de la concesión: ASISA-2017

Durada: des de/d' 30/01/2020 **hasta** 30/02/2021

Investigador/a principal: Joaquín Reverter Masia

PUBLICACIONES DERIVADAS DE LA TESIS

Publicación 1

Title: Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university

Authors: Vicenç Hernández-González, Rosa Arnau-Salvador, Carme Jové-Deltell, Carme Mayolas-Pi, Joaquín Reverter-Masià.

eISSN: 0120-0011

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Area: General Medicine

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Contribution of the candidate: Rosa Arnau Salvador is the main author of the article, and was responsible for the conceptualization, data acquisition, project administration, and first draft of the manuscript. Additionally, he contributed to the design of the study and validation of the manuscript.

Publicación 2

Title: Physical activity from cycling and effects on the Mediterranean diet. project: ASISA.

Authors: Rosa Arnau-Salvador, Vicenç Hernández González, Rafel Cirer-Sastre, Francesc Corbi-Soler, Joaquín Reverter-Masià.

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Reference: Arnau-Salvador, R., Hernández-González, V., Cirer-Sastre, R., Corbi-Soler, F. & Reverter-Masià. J. (2019). Physical activity from cycling and effects on the Mediterranean diet. project: ASISA. Acta Médica Mediterránea, 2019, vol. 35, no 4, p. 1893-1896

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Publicación 3

Title: Effectiveness of a physical activity intervention programme on the integral health of university professors.

Authors: Rosa Arnau-Salvador, Vicenç Hernández González, Rafel Cirer-Sastre, Francesc Corbi-Soler, Álvaro de Pano-Rodríguez, Joaquín Reverter-Masià.

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Publicación 4

Title: Physical Activity and Sleep Quality in Primary School children: mediation of sex and maturational stage.

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PARTICIPACIÓN EN CONGRESOS DERIVADOS DE LA TESIS

1.- Comunicación: Actividad física y calidad del sueño en niñas/os españoles (A propósito de un caso). 22 congreso Nacional de Farmacéuticos, Sevilla (2022). Comunicación

2.- Comunicación: Evaluación de diversos parámetros de salud y niveles de actividad física de primaria y secundaria. 22 congreso Nacional de Farmacéuticos, Sevilla (2022). Comunicación

3.- Comunicación: Repercusión de la actividad física en bicicleta sobre algunos hábitos de estilos de vida saludables. I Congreso Internacional de Ciencias de la Actividad Física y el Deporte, Valencia (2019). Comunicación

4.- Comunicación: Sedentarismo y condición física en mujeres mayores de 65 años en la Ciudad de Lleida. I Congreso Internacional INDEST: desenvolupament social i territorial, Lleida (2017). Comunicación

5.- Comunicación: Estudio sobre niveles de actividad física y calidad del sueño en niños de Lleida. I Congreso Internacional INDEST: desenvolupament social i territorial, Lleida (2017). Comunicación

6.- Comunicación: Actividad física de una universidad catalana. El caso de la Universidad de Lleida. 1r Congreso Internacional IEI: Valores de una sociedad cambiante: educar en red, Lleida (2017). Comunicación.

7.- Comunicación: Hábitos alimenticios y consumo de tabaco y alcohol en estudiantes de la universidad de Lleida. 1r Congreso Internacional IEI: Valores de una sociedad cambiante: educar en red, Lleida (2017). Comunicación.

8.- Comunicación: Hábitos de alimentación y de salud de estudiantes de una universidad catalana. XX Congreso Nacional de Farmacéuticos, Castellón (2016). Comunicación.

LISTA DE TABLAS Y FIGURAS

LISTA DE ABREVIACIONES

PA: Physical Activity

GPAQ: Global Physical Activity Questionnaire

PAQ-C: Physical Activity Questionnaire for older children

UDL: University of Lleida

SD: Standard Deviation

MD: Mediterranean Diet

MS: Maturational Stage

ADM: Adherence Mediterranean Diet

IPAQ: International Physical Activity Questionnaire

MEDAS: Mediterranean Diet Adherence Screener

BMI: Body Mass Index

PSQI: Pittsburgh Sleep Quality Index

PARTE I – INTRODUCCIÓN

1 Introducción

1.1 Estilos de vida

En la actualidad, los hábitos alimenticios, la actividad física y los estilos de vida saludables son temas de gran importancia y trascendencia a nivel global. La forma en que nos alimentamos y la cantidad de actividad física que realizamos tienen un impacto directo en nuestra salud y bienestar. Además, estos aspectos están estrechamente relacionados con factores socioeconómicos, culturales y ambientales que varían significativamente entre diferentes poblaciones (CSD, 2010).

El estilo de vida o los hábitos de salud que las personas adoptan a lo largo de la vida influye en su calidad de vida y en la forma en que éstas envejecen. Estos estilos de vida pueden ser definidos como un patrón de comportamiento que engloba hábitos, actitudes, conductas, tradiciones, actividades y decisiones que adopta una persona, o un grupo de personas, como respuesta a las diversas circunstancias en las que el ser humano se desarrolla, y que son susceptibles de ser modificadas (Sanabria et al., 2007). Hoy en día está altamente demostrado que los patrones de conducta modificables que la persona adopta a lo largo de su vida se relacionan directamente con la predisposición a la enfermedad, la funcionalidad o la discapacidad. De ahí que un estilo de vida adecuado pueda ser un factor determinante en una longevidad satisfactoria y plena (Rizzuto et al., 2014).

Un estilo de vida saludable se basa en la combinación de una alimentación adecuada y equilibrada, así como en la práctica regular de actividad física. La promoción de hábitos saludables para la adopción de estilos de vida sanos, en particular los relacionados con la actividad física, el sueño y la alimentación, es una de las principales funciones de trabajo de los profesionales de la salud y la educación. (Schlessman et al., 2011).

Concretamente, dentro de los hábitos alimenticios, se ha confirmado que el consumo de ciertos grupos de alimentos tiene un efecto significativo en la calidad de vida (Zhang et al., 2022; Tan et al., 2018). En particular, se ha observado una asociación positiva entre el consumo de frutas y verduras y la salud subjetiva y la calidad de vida de la población. Estas conductas junto con la práctica regular de actividad física y la calidad del sueño son factores determinantes en la Calidad de Vida.

Entre los patrones dietéticos que se enfatizan para promover el consumo de frutas y verduras se encuentra la dieta mediterránea (DM) (Castelló & Tubianosa, 2020). Esta dieta prioriza el consumo de alimentos poco procesados, frescos y de temporada y se caracteriza por incluir el consumo diario de frutas, verduras, aceite de oliva como principal grasa de adición, pan y

cereales (preferentemente sus productos integrales), productos lácteos, hierbas y especias, ingesta frecuente de frutos secos, huevos, legumbres y pescados y moderada de carnes rojas.

Asimismo, la falta de actividad física se ha convertido en un problema de salud pública en muchas partes del mundo. El sedentarismo, impulsado por los avances tecnológicos y el estilo de vida moderno, ha llevado a un aumento en los índices de obesidad y enfermedades crónicas. El nivel de actividad física también puede variar entre diferentes poblaciones debido a diversos factores, como la disponibilidad de espacios recreativos, la infraestructura urbana, las ocupaciones laborales y las actividades de ocio preferidas (Casajús & Vicente-Rodríguez, 2011)

Es sustancial destacar que tanto la actividad física como una alimentación equilibrada se han asociado con una menor mortalidad (Tian et al., 2017), una mayor autoevaluación de la salud (Södergren et al., 2012) y una mejor calidad de vida relacionada con la salud (Kwon et al., 2015).

La comprensión de los diferentes hábitos alimenticios, niveles de actividad física y estilos de vida en diversas poblaciones es fundamental para abordar los desafíos relacionados con la salud y promover intervenciones efectivas. A través de la investigación y el análisis de estos aspectos, es posible desarrollar estrategias adaptadas a las necesidades y características específicas de cada grupo poblacional.

1.1.1 Actividad física

El término AF cubre cualquier forma de movimiento corporal que resulte en un gasto de energía por encima del nivel basal. Por lo tanto, la actividad física incluye todas las actividades diarias, incluidas las domésticas (p. ej., jardinería), ocupacionales (p. ej., de camarera) y de ocio (p. ej., ejercicio), así como el transporte activo (p. ej., ir en bicicleta a la escuela) (Caspersen et al., 1985; Lang et al., 2016).

La práctica habitual de actividad física reduce la grasa corporal, mejora los perfiles de lípidos y lipoproteínas, mejora el control glucémico, mejora el sistema inmunológico y reduce el estrés oxidativo (Greene et al., 2012; Nikolaidis et al., 2007). En cambio, una mala actividad física ha sido asociada a fragilidad y dependencia funcional (Greene et al., 2012). Por eso, algunos determinantes de la aptitud física, como la capacidad aeróbica, la movilidad, la fuerza muscular o la estabilidad, se han convertido en indicadores de un envejecimiento saludable (Nikolaidis et al., 2007).

Se considera que una persona mantiene un EV físicamente activo cuando la AF está presente en su día a día como un hábito de vida. A lo largo de los años, diversas entidades han invertido esfuerzos en diseñar protocolos y establecer recomendaciones necesarias sobre la práctica de

AF y los niveles aconsejados, ajustando las directrices de acción según los diferentes grupos poblacionales (Segarra Romero, 2020).

Según la Organización Mundial de la Salud, para obtener estos beneficios y considerar que un sujeto es activo, los adultos deben practicar al menos 150 minutos de actividad aeróbica de intensidad moderada o 75 minutos de intensidad vigorosa a la semana o una combinación equivalente de ambas intensidades físicas (OMS, 2020).

Hay evidencia de que la AF regular se asocia con un mejor funcionamiento psicológico, incluida una mejor calidad del sueño (Brand et al., 2010; Kalak et al., 2012). Además, la actividad física junto con una dieta equilibrada es de los comportamientos de salud más importantes y fáciles de influir que reducen efectivamente los riesgos sobre la misma (Lachat et al., 2013; Organización Mundial de la Salud [OMS], 2014).

La actividad física, la salud y el sueño son tres elementos interrelacionados que desempeñan un papel fundamental en nuestro bienestar general. En la sociedad actual, cada vez más personas se preocupan por llevar una vida saludable y equilibrada, lo que ha generado un creciente interés en estos temas. En este sentido, en 1992, Bouchard, Shepard y Stephens, desarrollaron un modelo que asociaba la AF y la salud (Figura 1) entendiéndolo como un modelo complejo que tiene en cuenta el nivel de AF habitual, la condición física y la salud.

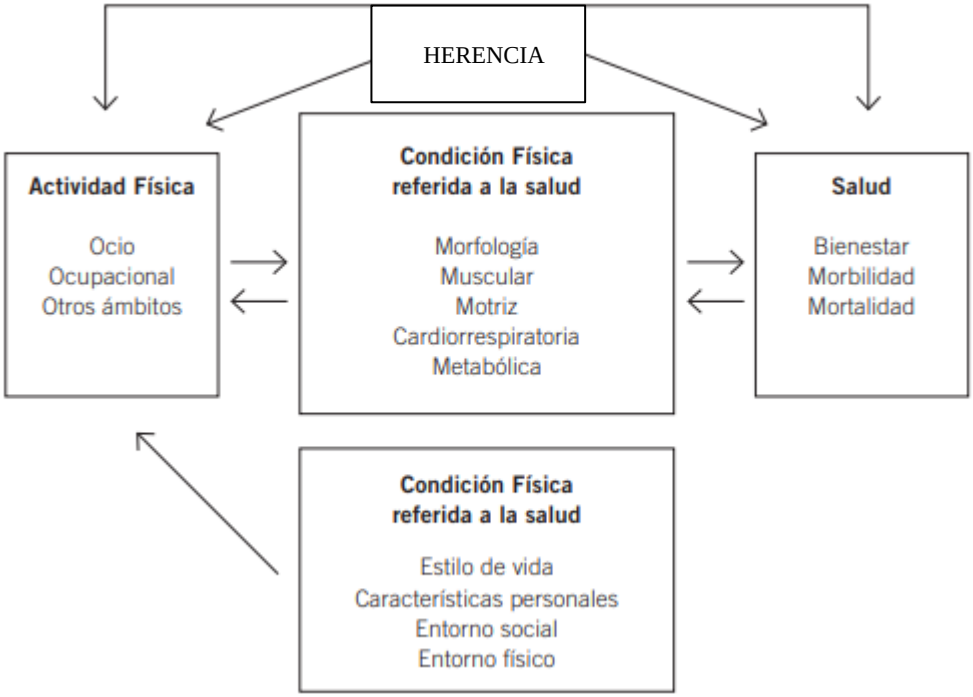

Figura 1. Perspectivas sobre la relación entre Actividad Física y Salud (Bouchard y cols., 1993).

La actividad física regular es un elemento esencial para mantener un estilo de vida saludable

(Fleig et al., 2015). Cuando nos movemos y ejercitamos nuestro cuerpo, no solo mejoramos nuestra condición física, sino que también fortalecemos nuestros sistemas cardiovascular y musculoesquelético. Además, la actividad física regular ayuda a controlar el peso corporal, reduce el riesgo de desarrollar enfermedades crónicas como la diabetes o enfermedades cardíacas, y mejora el estado de ánimo al liberar endorfinas, conocidas como las hormonas de la felicidad.

1.1.2 Alcohol y Tabaco

El consumo de alcohol y tabaco son dos problemas de salud pública que han afectado a la sociedad durante décadas. Afortunadamente, existe una creciente evidencia que sugiere que la actividad física regular puede desempeñar un papel fundamental en la prevención y reducción del consumo de alcohol y tabaco (Ramos-Valverde, 2009).

El sedentarismo y el estilo de vida poco saludable son factores de riesgo comunes para el consumo de alcohol y tabaco. Las personas que llevan una vida activa y participan en actividades físicas regulares tienden a adoptar hábitos más saludables en general, incluyendo una menor tendencia a consumir estas sustancias adictivas (Polo-Gallardo et al., 2017).

El consumo de sustancias tóxicas se ha asociado a la aparición de problemas de salud tanto agudos como crónicos. Los efectos perjudiciales son especialmente importantes sobre el sistema cardiovascular (Morentin et al., 2018).

La adopción de conductas no saludables entre los más jóvenes no solo se está incrementando, sino que se está estableciendo a edades cada vez más tempranas (D'Amicoet al., 2020). Autores como Villasana et al., (2020) o Ortega et al., (2013) sugieren que las conductas que se instauran en la adolescencia como fumar, beber alcohol, alimentarse de frutas y verduras o realizar ejercicio físico suelen perdurar en el tiempo y en cualquier caso resultan difíciles de modificar; por consiguiente, si la conducta adquirida no es saludable se necesita de un elevado nivel de concienciación y motivación para modificarla más adelante (Ortega, Ruiz & Castillo, 2013; Villasana et al., 2020)

El consumo de alcohol y tabaco son hábitos ampliamente extendidos en la sociedad y particularmente en la juventud, lo que no permite prever que a medio plazo disminuyan de forma importante los problemas de salud relacionados con estos hábitos en esta población. Los estilos de vida nocivos, entre los que se incluyen conductas de riesgo como el consumo de tabaco, alcohol y otras drogas, representan un tema relevante en nuestra sociedad, que precisa de un abordaje multifactorial y multidisciplinario (Ariza et al., 2003; Martínez-Pastor et al., 2009).

Según el informe de la OMS, entre los años 2000 y 2015 se produjo un descenso del consumo de tabaco, pasando del 33,3% al 24,9%. Además, ese mismo informe señalo que para

el año 2025 se reduciría hasta el 20,9% (OMS, 2019). A pesar de que la prevalencia de consumo de tabaco ha disminuido en los países desarrollados, continúa siendo el factor de riesgo susceptible de ser prevenido que más enfermedad y muerte causa en el mundo (Global Burden, 2018).

Autores como Martínez Pastor et al., (2009) expresan la necesidad de propiciar hábitos y estilos de vida sanos en los jóvenes en todas sus etapas de desarrollo, a través de la prevención y la promoción de hábitos de salud.

Existen múltiples mecanismos a través de los cuales la actividad física puede influir en la prevención y reducción del consumo de alcohol y tabaco. En primer lugar, el ejercicio regular ayuda a reducir el estrés y la ansiedad, que son factores desencadenantes comunes para el consumo de estas sustancias. Además, la actividad física libera endorfinas y otras sustancias químicas en el cerebro que pueden proporcionar una sensación de bienestar y placer, lo que puede reducir la necesidad de recurrir al alcohol y tabaco como medios para obtener gratificación (Warburton et al., 2006).

Además, la actividad física puede actuar como un mecanismo de distracción, ocupando el tiempo y la energía que de otra manera se destinarían al consumo de alcohol y tabaco. Participar en deportes, ejercicios aeróbicos, actividades al aire libre o incluso caminar pueden proporcionar una alternativa saludable y gratificante a estos comportamientos adictivos (Estrada et al., 2016).

A medida que la conciencia sobre los efectos negativos del consumo de alcohol y tabaco aumenta, es fundamental promover e incentivar la actividad física como parte de una estrategia integral de prevención y reducción de estos hábitos. Las políticas de salud pública deben fomentar la educación sobre los beneficios de la actividad física y promover la disponibilidad de espacios y programas deportivos accesibles para todas las personas (Méndez & Ruiz-Esteban, 2020; Canto et al., 2021).

En conclusión, la actividad física regular desempeña un papel crucial en la prevención y reducción del consumo de alcohol y tabaco. Al adoptar un estilo de vida activo, las personas pueden no solo mejorar su salud general, sino también reducir la probabilidad de caer en hábitos adictivos. La promoción de la actividad física debe ser un componente clave de las estrategias de prevención y tratamiento relacionadas con el consumo de alcohol y tabaco, con el objetivo de mejorar la calidad de vida de las personas y reducir la carga de enfermedades asociadas a estas sustancias.

1.1.3 Alimentación

La alimentación y la actividad física son dos componentes fundamentales para el bienestar y la salud de las personas. Una alimentación equilibrada y la práctica regular de ejercicio físico son aspectos clave para mantener un estilo de vida saludable y prevenir enfermedades (Gómez Candela et al., 2009)

En la actualidad, el ritmo de vida acelerado, los hábitos alimentarios poco saludables y el sedentarismo son problemas cada vez más frecuentes en nuestra sociedad. Esto ha llevado a un aumento alarmante de enfermedades relacionadas con la mala alimentación y la falta de actividad física, como la obesidad, la diabetes tipo 2 y enfermedades cardiovasculares (Esposito et al., 2011; Martínez-Gonzalez, et al., 2009; Tourlouki, et al., 2010)

La dieta es uno de los factores más influyentes para la salud (Mayolas-Pi et al., 2017), y concretamente, la Dieta Mediterránea (DM) tradicional es considerada una de las más saludables.

La DM es un patrón de alimentación común que se encuentra en Italia, Grecia, España y otros países de la cuenca del Mediterráneo e (Fung, et al., 2009; Mitrou, et al., 2007). Este patrón engloba hábitos alimentarios nutritivos caracterizados por un alto consumo de verduras, frutas frescas, legumbres y cereales, que sirven como fuentes importantes de fibra y antioxidantes, así como un consumo moderado de alcohol. El pescado, los frutos secos y el aceite de oliva también garantizan un alto consumo de ácidos grasos monoinsaturados (Bach-Faig et al., 2011). La adherencia a la dieta mediterránea se agrupa con otras conductas saludables, como el ejercicio físico y la abstención tabáquica, y está relacionada con el nivel educativo (Irala-Estévez et al., 2000) y la edad (Grosso et al., 2014).

Esta descripción queda reflejada en la figura 2 con la pirámide de la dieta mediterránea de la Fundación Dieta Mediterránea:

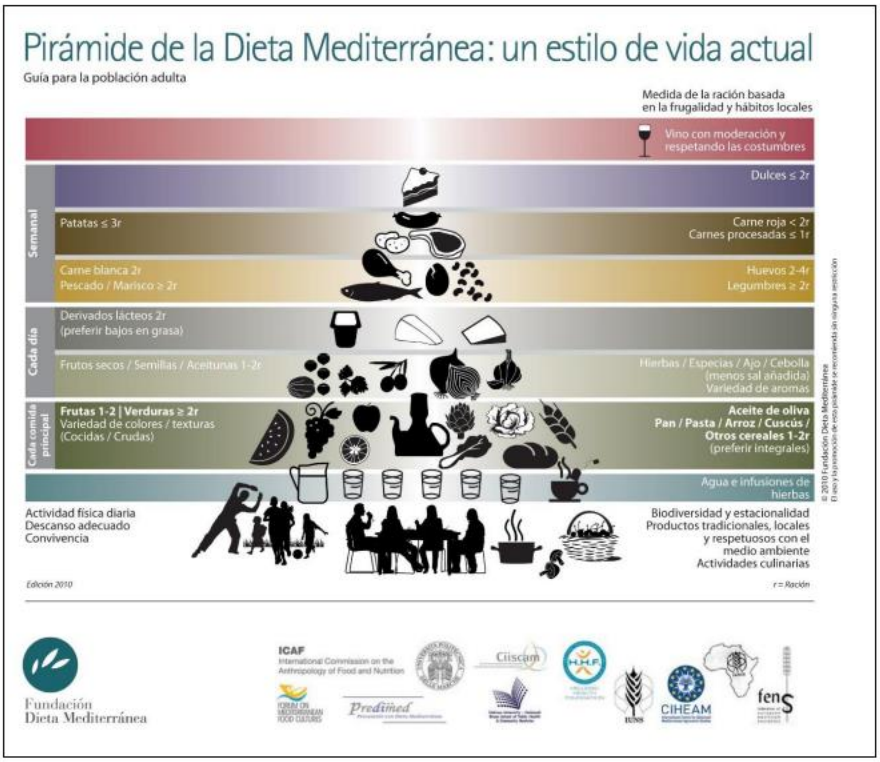

Figura 2. Pirámide de la Dieta Mediterránea

A lo largo de los años, numerosos trabajos han evaluado los efectos de DM con numerosos resultados, como se resume en varias revisiones sistemáticas y metaanálisis (Dinu et al., 2018; Serra-Majem et al., 2019; Sánchez-Sánchez et al., 2020). La evidencia más consistente y sólida de los beneficios para la salud de DM se ha observado para los factores de riesgo cardiovascular y la incidencia de enfermedades cardiovasculares (Dinu et al., 2018; Becerra-Tomas et al., 2020), pero una gran cantidad de literatura también demostró los beneficios potenciales de DM para una amplia gama de otros resultados de salud.

Recientes revisiones destacan el factor protector de la DM sobre numerosas enfermedades crónicas y degenerativas como el síndrome metabólico, el riesgo cardiovascular, la aterosclerosis, el cáncer, la diabetes, la obesidad (Mayolas-Pi et al., 2017; Schröder et al., 2011). Además, estudios recientes han reportado que las poblaciones que no adhieren a la DM tienen mayor riesgo de diabetes tipo II y obesidad (Kheirat et al., 2018; Arslan et al., 2017).

En resumen, una buena alimentación y la práctica regular de ejercicio físico son elementos esenciales para mantener un estilo de vida saludable. Adoptar hábitos alimentarios equilibrados y mantenerse activo físicamente no solo previene enfermedades, sino que también contribuye a mejorar la calidad de vida y promueve el bienestar general.

1.1.4 Sueño

El sueño, es un proceso biológico necesario para el funcionamiento adecuado del organismo. Durante el sueño, nuestro cuerpo se regenera y se recupera de las actividades diarias. Dormir lo suficiente y tener un sueño de calidad es crucial para mantener un buen estado de salud. La falta de sueño puede tener efectos negativos en nuestra salud física y mental, como la disminución de la atención, la memoria y la capacidad de tomar decisiones, así como un mayor riesgo de padecer enfermedades cardiovasculares, diabetes y depresión (Ohayon et al., 2017; Tambalis et al., 2018).

En los últimos años, el sueño ha ganado atención en la investigación y se ha sugerido enfáticamente que se aumente la conciencia sobre el sueño como un comportamiento de salud importante (Perry et al., 2013; Chaput & Dutil, 2016). En particular, un sueño reparador y de buena calidad no solo reduce los riesgos para la salud con posibilidades de recuperación y rejuvenecimiento (Eek et al., 2012; Barber, 2014), sino que también puede facilitar la calidad de vida al mejorar el bienestar (Palmer & Alfano, 2017).

Estudios previos encontraron, por ejemplo, que la duración inadecuada del sueño y la mala calidad del sueño se asocian con una dieta poco saludable y la inactividad física (Grandner et al., 2015; Kittle et al., 2016). En esa misma línea, el estudio de Ferranti et al., (2016) demostró que dormir las horas recomendadas y una buena calidad del sueño se asociaron positivamente con una mayor ingesta de fibra dietética y consumo de frutas y verduras. Sin embargo, la duración inadecuada del sueño también cambió los ritmos circadianos y los niveles hormonales y contribuyó a la obesidad y la diabetes (Frank et al., 2017). Un estudio muy interesante de Liu et al., (2012) halló que las personas que realizaban más actividad física consumían más frutas y verduras y que dormían adecuadamente, tenían más probabilidades de reportar un mejor estado de ánimo. Otro trabajo, argumentó firmemente que el sueño también debe tenerse en cuenta para mejorar la salud, y debe prestarse tanta atención como la actividad física y la ingesta de frutas y verduras, ya que parece razonable que estos múltiples comportamientos de salud influyan en la salud general (Chaput & Dutil, 2016).

Las Guías Canadienses de Actividad Física y la Fundación Nacional Americana del Sueño recomiendan estas horas al día de sueño según la edad de los sujetos (Tremblay et al., 2016; Ross et al., 2020; Hirshkowitz et al., 2015):

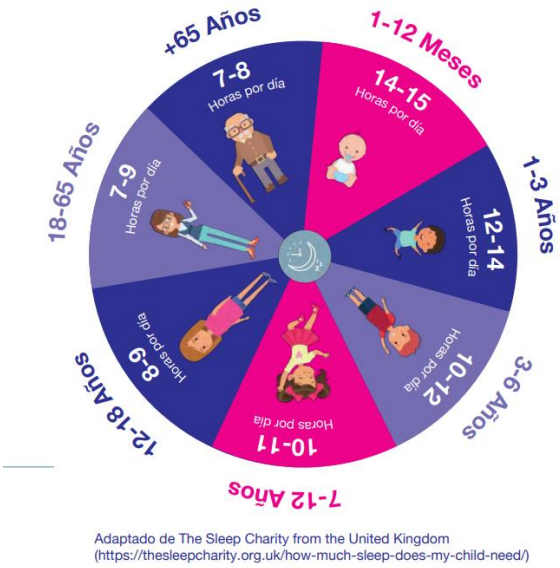

Figura 3. Recomendaciones de horas de sueño

Para todas las edades es crucial tener horarios regulares para acostarse y levantarse. Desde hace décadas, se ha resaltado la importancia de ejercitarse regularmente para mejorar la condición física, fortalecer los músculos, controlar el peso y reducir el riesgo de enfermedades crónicas (WHO, 2020). Sin embargo, en nuestro afán por maximizar los beneficios de la actividad física, solemos pasar por alto un elemento esencial para el rendimiento y la recuperación: el sueño (WHO, 2020).

El sueño es una necesidad biológica básica que desafortunadamente ha sido subestimada en el ámbito de la actividad física. A menudo, se le da mayor importancia al tipo de ejercicio, la duración o la intensidad, dejando de lado el tiempo de descanso adecuado. Sin embargo, investigaciones recientes han demostrado que el sueño y la actividad física están intrínsecamente relacionados, y su combinación puede tener un impacto significativo en la salud y el rendimiento deportivo (Tambalis et al., 2018; Roth et al., 2007; Riemann et al., 2017; Mindell & Williamson, 2018).

Durante el sueño, nuestro cuerpo realiza procesos de recuperación y reparación a nivel físico y mental. El sistema inmunológico se fortalece, los músculos se reparan, se consolida la memoria y se regula el equilibrio hormonal. Además, el sueño adecuado mejora la concentración, la atención y el estado de ánimo, lo cual es fundamental tanto para los atletas de alto rendimiento como para las personas que buscan mejorar su condición física (Ryff, Singer, & Love, 2004).

Así mismo, la actividad física regular también puede influir en la calidad y cantidad de sueño que experimentamos. El ejercicio regular ayuda a reducir el estrés, la ansiedad y los

problemas de insomnio, lo que puede conducir a un sueño más profundo y reparador. Sin embargo, es necesario comprender cómo equilibrar adecuadamente la actividad física y el descanso, ya que un exceso de ejercicio o una falta de tiempo de recuperación pueden afectar negativamente la calidad del sueño y, a su vez, disminuir los beneficios de la actividad física (Álvarez & Ayas, 2004; Lenfant, 2006).

A medida que avanzamos en nuestra comprensión de cómo el sueño y la actividad física se complementan mutuamente, podemos adoptar un enfoque más holístico hacia nuestra salud y bienestar. Al darle la importancia que merece al sueño y considerarlo como una parte esencial de nuestro programa de actividad física, estaremos en el camino hacia un estilo de vida más equilibrado y saludable.

2 Objetivos

El **objetivo general** de la presente tesis doctoral es ampliar el conocimiento científico sobre las relaciones que se establecen entre los diferentes estilos de vida y la actividad física en una muestra de diferentes grupos poblacionales.

En detalle, los **objetivos específicos** de cada uno de los artículos que componen la tesis doctoral son:

Artículo 1: Describir y conocer los niveles de actividad física y hábitos de salud de estudiantes universitarios de una universidad catalana.

Artículo 2: Conocer la relación entre los desplazamientos en bicicleta y la adherencia a la dieta mediterránea entre la población adulta que trabaja o estudia en una ciudad de la comunidad catalana.

Artículo 3: Evaluar la efectividad de un programa de ejercicio a mediano plazo, así como su impacto sobre la condición física, la adherencia a la dieta mediterránea e indicadores bioquímicos de salud.

Artículo 4: Analizar la actividad física y calidad del sueño en niños de Educación Primaria: mediación del sexo y etapa madurativa.

PARTE II – MATERIAL Y MÉTODOS

3 Metodología

En la siguiente tesis abordamos diferentes aspectos relacionados con los hábitos de salud y actividad física en diferentes tipos de población. En este contexto, el artículo 1 de la presente tesis, proporciona información sobre los niveles de hábitos de actividad física y salud de los estudiantes de la Universidad de Lleida (UDL) y pretende dar respuesta al objetivo 1 de la tesis doctoral. El segundo artículo del trabajo y que está vinculado al objetivo 2, pretende conocer la relación entre los desplazamientos en bicicleta y la AMD entre la población adulta que trabaja o estudia en la ciudad de Lleida. En el artículo 3, centra su interés en la repercusión de un programa de ejercicios a corto y medio plazo y su impacto y su relación con la AMD y diversos indicadores bioquímicos de salud e intenta responder al objetivo 3. Y por último el artículo 4, que responde al objetivo, relacionar la influencia del nivel de AF sobre la calidad del sueño en niños/as para una población representativa de estudiantes de primaria.

La información metodológica general del estudio se resume en la siguiente tabla:

Tabla 1. Cuadro resumen de la metodología utilizada la tesis doctoral actual

Artículos	Diseño del estudio	Sujetos	Grupos participantes Pre-Postest1-Postest2	Variables principales del estudio	Método
I. Physical activity, eating habits and tobacco and alcohol use in students of a Catalan University	Estudio transversal, observacional y descriptivo	♂ 290 ♀ 310 Edad media: 21.69 años	600	Nivel de Actividad Física (en el trabajo, para desplazarse, en el tiempo libre) Consumo de tabaco y consumo del alcohol Frecuencias de consumo de alimentos.	Cuestionario de Actividad física: GPAQ Cuestionario de Consumo de tabaco y consumo de alcohol Cuestionario de frecuencia de consumo de alimentos (CFC)
II. Physical activity from cycling and effects on the Mediterranean Diet. Project: ASISA	Estudio transversal y descriptivo	♂ 777 ♀ 715 Edad media: 38.05 años	1492	Actividad Física y entrenamiento (bajos, medios y altos niveles de actividad física), Adherencia a la Dieta Mediterránea (consumo y hábitos de alimentación)	Cuestionario de Actividad Física: IPAQ Cuestionario de Adherencia a la dieta Mediterránea: MEDAS
III. Effectiveness of a Physical Activity intervention Programme on the integral Health of University Professors	Estudio longitudinal	♀ 32 Edad media: 61.06 años	32-31-28	Actividad física, medidas antropométricas, IMC, Adherencia a la Dieta Mediterránea (consumo y hábitos de alimentación), perfil lipídico (colesterol total, colesterol LDL, colesterol HDL, glucosa, ácido úrico, triglicéridos, Condición física.	Cuestionario de Actividad física: IPAQ Antropometría: estadiómetro de pared (Seca-240, Hamburg, Germany), pesó con la balanza electrónica (Tanita TBF300, Illinois, USA) IMC: se calculó según Quételet (KG/m2) Cuestionario de Adherencia a la dieta mediterránea: MEDAS Perfil lipídico: análisis bioquímicos
IV. Physical activity and Sleep Quality in Primary School children: mediation of sex and maturational stage	Estudio transversal, descriptivo, comparativo y correlacional.	♂ 429 ♀ 525 Edad media: 10.5 años	954	Niveles de actividad física y Calidad del sueño	Cuestionario de Actividad física: PAC-C versión niños Cuestionario de Calidad del sueño: The Pittsburgh Sleep Quality Index

♂ Masculino; ♀ Femenino; GC Grupo Control; IMC Índice de Masa Corporal; LDL lipoproteínas de baja densidad; HDL lipoproteínas de alta densidad; IPAQ International Physical Activity Qüestionary; MEDAS “Mediterranean Diet Adherence Screener”.

PARTE III – ARTÍCULOS PUBLICADOS

ARTÍCULO 1

PHYSICAL ACTIVITY, EATING HABITS AND TOBACCO AND ALCOHOL USE IN STUDENTS OF A CATALAN UNIVERSITY

Physical activity, eating habits and tobacco andalcohol use in students of a Catalan university

Actividad física, hábitos alimenticios y consumo de tabacoy alcohol en estudiantes de una universidad catalana

| Abstract |

Introduction: University populations are considered as vulnerable groups when it comes to acquiring health habits.

Objective: The aim of this study is to know the levels of physical activity and health habits of the students of the University of Lleida.

Methods: Healthy habits and the practice of physical activity in university students were evaluated through the Global Physical Activity Questionnaire (GPAQ). Also frequency of food consumption through the (CFC) questionnaire and finally the consumption of tobacco and alcohol.

Results: 600 students from the University of Lleida participated during the period 2014-2015. 30.7% of them smoked, while 96.7% reported alcohol consumption, and 75.5% practiced physical activity. More than 62% of male students practiced physical activity between 3 and 7 days a week compared to 33.5% of women (p=0.000). More than 30% of the students ingested fruit every day and 65% did so atleast 4 days a week. 19.4% of women and 7.9% of men consumed fruit daily, finding significant differences (p=0.001).

Conclusions: 30% of the participant did not meet the minimum recommendations of physical activity. A high percentage of participants have a low fruits and vegetables consumption and a high prevalence of risk of alcohol consumption. An educational intervention by universities is suggested to encourage the practice of healthy habits in students.

Keywords: Physical Activity; Tobacco; Feeding Behavior; Students; Alcoholism (MeSH)

| Resumen |

Introducción. La población universitaria se considera un colectivo vulnerable a la hora de adquirir hábitos de salud.

Objetivo. Conocer los niveles de actividad física y los hábitos de salud de los estudiantes de la Universidad de Lleida.

Materiales y métodos. Se valoraron los hábitos saludables y la práctica de actividad física en estudiantes universitarios mediante el cuestionario Global Physical Activity Questionnarie. También frecuencia de consumo de alimentos mediante el cuestionario de (CFC) y finalmente el de consumo de tabaco y alcohol.

Resultados. Participaron 600 estudiantes de la Universidad de Lleidadurante el periodo 2014-2015; 30.7% fumaba, 96.7% consumía alcohol y 75.5% practicaba actividad física. Más del 62% de los hombres practicaban actividad física entre 3 y 7 días a la semana frente al 33.5% de las mujeres (p=0.000). Más del 30% de estudiantesingirió fruta cada día y 65% lo hizo al menos 4 días a la semana; en específico, 19.4% de las mujeres y 7.9% de hombres consumía fruta a diario, encontrándose diferencias significativas (p=0.001).

Conclusiones. El 30% de los estudiantes no cumple con las recomendaciones mínimas de actividad física. Un alto porcentaje de los participantes tiene escaso consumo de frutas y legumbres y presenta elevada prevalencia de consumo de riesgo de alcohol. Se sugiere unaintervención educativa en estudiantes y por parte de las universidades respecto a la práctica de hábitos saludables.

Palabras clave: Actividad física; Tabaquismo; Conducta alimentaria; Estudiantes; Alcoholismo (DeCS).

Introduction

The promotion of healthy habits, particularly those related to physical activity (PA) and eating, is one of the primary work functions of health and education professionals. (1)

University students are a vulnerable group in terms of the influence of current lifestyles according to trends, usually characterized by health-risk behaviors. These behaviors include diets saturated in fat that lead to high cholesterol levels, low consumption of fruits and vegetables (2) and high levels of tobacco and (3) alcohol use (4) and sedentary lifestyle (5). Therefore, universities are a strategic place to promote, on the one hand, patterns of behavior that favor health and, on the other, effective ways that lead to increased participation in healthy habits. (6)

It is of great interest for public health to know the evolution and trends of the university population, especially regarding sedentary lifestyles and healthy habits. (7) This allows establishing strategies to prevent and promote health, particularly among social groups that are consolidating their lifestyles and whose future behavior should be a model to imitate. (5) In Catalonia, Spain, the Secretaria General de l'Esport (General Secretary of Sports) promotes the University Sports of Catalonia Strategic Plan 2013-2020 (PEUC), which shows the need to analyze the current situation in the different Catalan universities to establish specific action plans in each institution to promote physical activity.

Several studies have attempted to determine proper levels of physical activity and health in university students to establish prevention and health promotion strategies. (8-11) With the aim of developing education and intervention actions aimed at introducing possible modifications in the behavior of university students, it is essential to determine which habits are predominant. To obtain this type of information, questionnaires are usually used (12), including the Global Physical Activity Questionnaire (GPAQ) — recommended by the World Health Organization —, which was elaborated to study PA and eating habits, and has acceptable levels of reliability and validity. (13,14)

The objectives of this study were to know the levels of physical activity and health habits — feeding and consumption of tobacco and alcohol— of the students of the University of Lleida (UDL) and to identify inappropriate behaviors related to healthy habits.

Materials and methods

Design

This is a cross-sectional, observational and descriptive study on eating habits and behaviors related to physical activity in students of the UDL enrolled during the period 2014-2015.

Participants

A non-probabilistic sample was taken for convenience, stratified by sex and studies completed, and representative of the UDL students, which implies a confidence level of 95% and a maximum sampling error of ±5%. The population consisted of 290 men (48.3%) and 310 women (51.7%), with an average age of 21.69 years [standard deviation (SD): 4.61]. Trained surveyors applied 600 questionnaires using a face to face modality and convenience with respect to the places, days and times of greatest transit of students within the university.

Measurements

To estimate PA, the Spanish version of the GPAQ was used (15), which consists of a series of questions grouped into domains: work, transport and recreation. The questions about work and recreation inquired about the frequency and duration of different types of PA according to their intensity. Regarding diet, the food frequency questionnaire (CFC) validated for the Spanish population was used (16). the questions sought to know about the intake of fruits and vegetables, frequency of consumption, etc. In addition to knowing whether they consumed alcohol and tobacco and the frequency with which they did so (17).

Participants provided their informed consent in writing and the study was evaluated and approved by the Ethics and Good Practices Committee of the UDL on April 10, 2014.

Statistical analysis

The statistical program SPSS Statistics version 20.0 was used for analysis. The exact chi-square test was applied to evaluate the differences in PA according to sex and alcohol and tobacco use, while the student's t-test was used to evaluate the differences in the time of practice of PA according to sex and free time.

Results

The research involved 600 subjects, 290 (48.3%) men and 310 (51.7%) women, with an average age of 21.6 years (SD: 4.61).

When examining the variables tobacco use, alcohol consumption and PA (Figure 1), it was found that 30.7% of students smoked and 96.7% reported alcohol consumption. When distributing the sample by sex, tobacco use was higher in women than in men (34.8% vs. 26.2%, p=0.027). Regarding alcohol consumption, a very similar percentage was found in men and women (96.9% vs. 96.5%, p=0.623). The question about whether students travel by foot or bicycle for at least consecutive 10 minutes showed that 73.8% of the sample did so, with a higher percentage observed in women (78% vs. 69.3%; p=0.019).

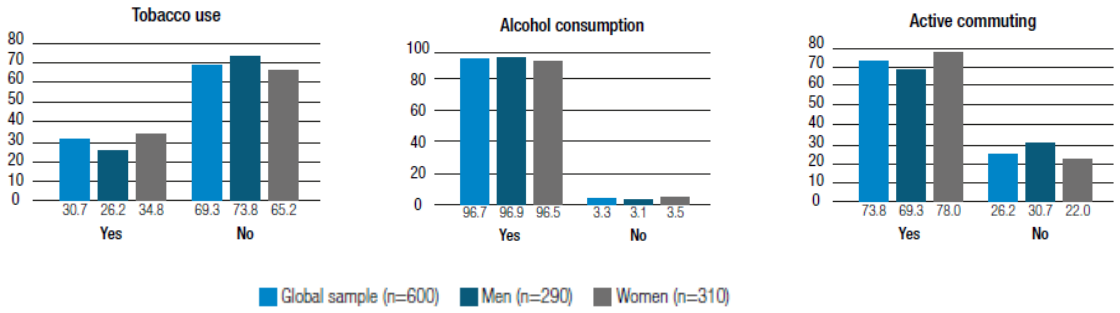

Figure 1. Descriptions of health habits. Source: Own elaboration

Table 1 shows that most university students practiced vigorous (66.2%) or moderate (63.5%) PA. With respect to the number of days they practiced vigorous PA, 62% of men and 33.5% of women did it between 3 and 7 days a week. For moderate PA, 54% of men and 33% of women practiced it between 3 and 7 days per week. In both cases, significant differences were found (p=0.000).

Table 1. Descriptive index of physical activity practices

Frequency	Vigorous						Moderate					
	Global sample		Men		Women		Global sample		Men		Women	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Every day	22	3.7	11	3.8	11	3.5	36	6.0	16	5.5	20	6.5
5-6 days per week	78	13.0	54	18.6	24	7.7	81	13.5	55	19.0	26	8.4
3-4 days per week	184	30.7	115	39.7	69	22.3	143	23.8	87	30.0	56	18.1
1-2 days per week	113	18.8	41	14.1	72	23.2	121	20.2	45	15.5	76	24.5
No	203	33.8	69	23.8	134	43.2	219	36.5	87	30.0	132	42.6
Total	600	100	290	100	310	100	600	100	290	100	310	100

f: frequency. Source: Own elaboration

Table 2 shows the time, expressed in minutes, that students spent on PA; for the most part, the practices were over 60 minutes.

Table 2. Time spent doing physical activity

Duration	Vigorous						Moderate					
	Global sample		Men		Women		Global sample		Men		Women	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
<60 min	148	24.7	74	25.5	74	23.8	160	26.6	73	25.2	87	28.1
61-100 min	108	18.0	66	22.8	42	13.5	55	9.2	38	13.1	17	5.5
>100 min	139	23.2	81	27.9	58	18.7	140	23.3	75	25.9	65	21.0
0 min	205	34.2	69	23.8	136	43.9	245	40.8	104	35.9	141	45.5
Total	600	100	290	100	310	100	600	100	290	100	310	100

f: frequency. Source: Own elaboration

Table 3 shows that more than 30% of respondents ingested fruit every day and more than 65% did so at least 4 days a week. When analyzing daily vegetable consumption, it was found that women ingested more than men (19.4% vs. 7.9%; p=0.001).

Table 3. Description of eating habits

Variable		Fruits						Vegetables					
		Global sample		Men		Women		Global sample		Men		Women	
		f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Daily consumption	0 days	24	4.0	11	3.8	13	4.2	17	2.8	10	3.4	7	2.3
	1 day	27	4.5	12	4.1	15	4.8	51	8.5	29	10.0	22	7.1
	2 days	52	8.7	22	7.6	30	9.7	125	20.8	72	24.8	53	17.1
	3 days	77	12.8	42	14.5	35	11.3	121	20.2	59	20.3	62	20.0
	4 days	76	12.7	33	11.4	43	13.9	94	15.7	50	17.2	44	14.2
	5 days	88	14.7	47	16.2	41	13.2	66	11.0	26	9.0	40	12.9
	6 days	50	8.3	23	7.9	27	8.7	34	5.7	15	5.2	19	6.1
	7 days	197	32.8	93	32.1	104	33.5	83	13.8	23	7.9	60	19.4
	DK/DA	9	1.5	7	2.4	2	0.6	9	1.5	6	2.1	3	1.0
	Total	600	100	290	100	310	100	600	100	290	100	310	100
Number of servings per day	0 servings	20	3.3	9	3.1	11	3.5	13	2.2	9	3.1	4	1.3
	1 serving	261	43.5	130	44.8	131	42.3	399	66.5	204	70.3	195	62.9
	2 servings	226	37.7	106	36.6	120	38.7	122	20.3	55	19.0	67	21.6
	3 servings	55	9.2	22	7.6	33	10.6	27	4.5	8	2.8	19	6.1
	4 servings	13	2.2	7	2.4	6	1.9	12	2.0	2	0.7	10	3.2
	> 4 servings	8	1.3	5	1.7	3	1.0	4	0.7	0	0.0	4	1.3
	DK/DA	17	2.8	11	3.8	6	1.9	23	3.8	12	4.1	11	3.5
	Total	600	100	290	100	310	100	600	100	290	100	310	100

f: frequency; DK/DA: do not know/do not answer. Source: Own elaboration

Discussion

Most students drink alcohol at least once a month, without significant differences between men and women. While it is true that few students do it between 1 and 2 days per week, this figure is higher than that found by other authors (18), who also reported higher alcohol consumption in men than in women. The results of this research are above those found by Castañeda-Vázquez & Romero-Granados (19), since more than one third of the population studied use alcohol on weekends and more than 40% do so occasionally. One of the main problems of university students is binge drinking, which has been described by several authors (20,21).

In turn, tobacco is also used by one third of the students, a figure similar to that reported by Castillo-Viera & Sáenz-López (22) in students of the University of Huelva, although tobacco consumption in this age group is studied in a very superficial way (3). In addition, prevention campaigns in this type of population are difficult and insufficient, so it is important to continue

conducting research on lines of action and their effectiveness for controlling smoking at the youngest possible age.

Regarding transport, most of the students in this study move actively, whether by walking or cycling or any other means of transport. Comparing sexes, women show higher rates of active commuting than men, and they do it more frequently. There is evidence that active commuting to the educational center (school, institute, university, etc.) is an opportunity to increase PA levels in young people and prevent or mitigate the increase of body weight (23-26). One of the main reasons found in this study for high mobility in bicycles is the orographic characteristics of Lleida, which is a small city without significant slopes, so it is not necessary to travel long distances to get anywhere. In consequence, some authors have considered developing strategies based on socio-ecological models (27), actions in relation to urban design, transport systems or resources for recreation and green spaces.

According to different studies, adults aged between 18 and 64 years should accumulate a minimum of 150 minutes per week of moderate aerobic PA or 75 minutes per week of vigorous aerobic PA (or the equivalent combination of both). The present study shows that 75% of university students are regularly active and that, of these, a large percentage have a high level of PA, so the majority are regularly active; this coincides with other studies conducted in university populations (9,11). It was also found that most students who practice PA, do so two or more days a week, so the promotion and awareness campaigns towards the practice of PA should be directed towards a smaller group of students who do not carry out any PA at all.

PA practice had statistically significant differences between sexes. This is a constant pattern, since PA is one of the few health-related behaviors typically more prevalent in men than in women (6,18,28). In this sense, activities that motivate university students to adhere to the practice of PA should be promoted.

Another variable studied was fruits and vegetables intake in students, but data were not encouraging, since only a third of the students consume fruits on a daily basis and only half do it between 3 and 6 days per week. The consumption of vegetables is much lower, since only 1 in 10 students interviewed here do it daily, being more frequent in women. Following the recommendations of the dietary guidelines for the Spanish population (29,30), which suggest the daily consumption of fruits and vegetables, the students of the UDL are still far below the established figures (29,30).

These results show a progressive loss of adherence to the Mediterranean diet, characterized by a high consumption of vegetables and an abundant consumption of fresh fruits, as no student consumed these products (31). The lack of consumption of fruits and vegetables could predict an increase in pathologies derived from poor diet, such as obesity or diabetes (32,33).

University students are a key population to carry out health promotion and prevention

activities, so it is necessary to create strategic education plans that improve the quality of life and promote the acquisition of good eating habits and the performance of PA. Based on the results, the UDL will propose specific strategies for the promotion of healthier lifestyles.

One of the main limitations of this study is that data related to alcohol consumption was self-reported and this means that, although data are reliable, could be biased despite having answered the test anonymously. Socio-economic data that could bias the results were not collected either. However, it is essential to be able to detect risk consumption early in order to modify consumption patterns in a population so vulnerable to its effects. Intervening the university population at risk may provide important benefits, not only in academic terms but in future pathologies derived from the consumption of alcohol and tobacco.

Conclusion

A high percentage of students use alcohol and tobacco regularly. The vast majority of students move actively, especially women. This study shows that a significant amount of university students are regularly active and that, of these, a high percentage has a high level of PA practice. According to the recommendations of different dietary guidelines, students of the UDL are far below in terms of consumption of fruits and vegetables.

References

1) Schlessman AM, Martin K, Ritzline PD, Petrosino CL. The role of physi- cal therapist in pediatric health promotion and obesity prevention: comparison of attitudes. *Pediatr Phys Ther*. 2011;23(1):79-86. http://doi.org/bxp454.
2) Troncoso C, Amaya JP. Factores sociales en las conductas alimentarias de estudiantes universitarios. *Rev. Chil. Nutr.* 2009;36(4):1090-7. http://doi.org/ct36zs.
3) Chelet-Martí M, Escriche-Saura A, García-Hernández J, More- no-Bas P. Consumo de tabaco en población universitaria de Valencia. *Trastor Adict.* 2011;13(1):5-10.
4) Miquel L, Rodamilans M, Giménez R, Cambras T, Canudas AM, Gual A. Evaluación del consumo de riesgo de alcohol en estudiantes universitarios de la Facultad de Farmacia. *Adicciones.* 2016;27(3):190-7. http://doi.org/cm8p.
5) Cancela-Carral JM, Ayán-Pérez C. Prevalencia y relación entre el nivel de actividad física y las actitudes alimenticias anómalas en estudiantes universitarias españolas de ciencias de la salud y la educación. *Rev Esp Salud Pública.* 2011;85(5):499-505.
6) Rodríguez F, Palma X, Romo Á, Escobar D, Aragú B, Espinoza L, *et al.* Hábitos alimentarios, actividad física y nivel socioeconómico en estudiantes universitarios de Chile. *Nutr Hosp.* 2013;28(2):447-55. http://doi.org/b5dq.
7) Escalante Y. Physical activity, exercise, and fitness in the public health field. *Rev Esp Salud Pública.* 2011;85(4):325-8. http://doi.org/bh7s6d.
8) Blasco T, Capdevila L, Pintanel M, Valiente L, Cruz J. Evolución de los patrones de actividad física en estudiantes universitarios. *Revista de Psicología del Deporte.*

1996;5(2):51-63.

9) Pavón-Lores AI, Moreno-Murcia JA. Actitud de los universitarios ante la práctica físico-deportiva: diferencias por géneros. *Revista de Psicología del Deporte.* 2008;17(1):7-23.

10) Moreno-Murcia JA, Pavón-Lores AI, Gutiérrez-Sanmartín M, Sicilia-Camacho A. Motivaciones de los universitarios hacia la práctica físico-deportiva. *Rev. int. med. cienc. acti. fís. Deporte.* 2005;5(19):154-65.

11) Castañeda-Vázquez C, Campos-Mesa MC, Del Castillo-Andrés O. Actividad física y percepción de salud de los estudiantes universitarios. *Rev. Fac. Med.* 2016;64(2):277-84. http://doi.org/cm8q.

12) Craig CL, Marshall AL, Sjöstrom M, Bauman AE, Booth ML, Ainsworth BE, *et al.* International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc.* 2003;35(8):1381-95. http://doi.org/bk5h6s.

13) Armstrong T, Bull F. Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). *J Public Health.* 2006;14(2):66-70. http://doi.org/dhq9nh.

14) Bull FC, Maslin TS, Armstrong T. Global Physical Activity Questionnaire (GPAQ): Nine country reeliability and validity study. *J Phys Act Health.* 2009;6(6):790-804.

15) Organización Mundial de la Salud. Cuestionario Mundial sobre Actividad Física (GPAQ). Ginebra: OMS.

16) Martín-Moreno JM, Boyle P, Gorgojo L, Maisonneuve P, Fernández-Rodríguez JC, Salvini S, et al. Development and validation of a food frequency question naire in Spain. Int J Epidemiol 1993;22(3):512-9

17) Pastor, A. M., Galindo, S. B., Hernández, M. L., Navarro, A. M., Bernal, C. C., & Alemán, J. A. Relación entre el consumo de tabaco y alcohol y el ejercicio físico con el paso por la universidad. Atención primaria. 2009; 41(10), 558-563.

18) Mantilla-Toloza SC, Gómez-Conesa A, Hidalgo-Montesinos MD. Actividad física, tabaquismo y consumo de alcohol, en un grupo de estudiantes universitarios. *Rev. salud pública.* 2011;13(5):748-58. http://doi.org/cm8s.

19) Castañeda-Vázquez C, Romero-Granados S. Alimentación y Consumo de Sustancias (alcohol, tabaco y drogas) del alumnado universitario. Análisis en función del género y la práctica de actividad físico-deportiva. *CCD.* 2014;9:95-105. http://doi.org/bdt7.

20) El Ansari W, Stock C, Mills C. Is Alcohol Consumption Associated with Poor Academic Achievement in University Students? *Int J Prev Med.* 2013;4(10):1175-88.

21) Mc. Cambridge J, Bendtsen M, Karlsson N, White IR, Nilsen P, Bendtsen P. Alcohol assessment and feedback by email for university students: main findings form a randomized controlled trial. *Br J Psychiatry.* 2013;203(5):334-40. http://doi.org/f224fs.

22) Castillo-Viera E, Sáenz-López P. Práctica de actividad física y estilo de vida del alumnado de la Universidad de Huelva. Huelva: Servicio de publicaciones de la Universidad de Huelva; 2008.

23) Segura-Díaz JM, Herrador-Colmenero M, Martínez-Téllez B, Chillón P. Efecto de la precipitación y el periodo estacional sobre los patrones de desplazamiento al centro educativo en niños y adolescentes de Granada. *Nutr Hosp.* 2015;31(3):1264-72. http://doi.org/cm8t.

24) Villa-González E, Rodríguez-López C, Huertas Delgado FJ, Tercedor P, Ruiz JR,

Chillón P. Factores personales y ambientales asociados con el desplazamiento activo al colegio de los escolares españoles. *Revista de Psicología del Deporte.* 2012;21(2):343-9.

25) Chillón P, Molina-García J, Castillo I, Queralt A. What distance do university students walk and bike dayly to class in Spain. *Journal of Transport & Health.* 2016;3(3):315-20. http://doi.org/f88brh.

26) Molina-García J, Sallis JF, Castillo I. Active commuting and sociodemographic factors among university students in Spain. *J Phys Act Health.* 2014;11(2):259-63. http://doi.org/f5v6pk.

27) Sallis JF, Bowles HR, Bauman A, Ainsworth BE, Bull FC, Craig CL, *et al.* Neighborhood environments and physical activity among adults in 11 countries. *Am J Prev Med.* 2009;36(6):484-90. http://doi.org/cz3ztx.

28) Romaguera D, Tauler P, Bennasar M, Pericas J, Moreno C, Martínez S, *et al.* Determinants and patterns of physical activity practice among Spanish university students. *J Sport Sci.* 2011;29(9):989-97. http://doi.org/bsg4mr.

29) Montagnese C, Santarpia L, Buonifacio M, Nardelli A, Caldara AR, Silvestri E, *et al.* European food-based dietary guidelines: a comparison and update. *Nutrition.* 2015;31(7-8):908-15. http://doi.org/f7hzxv.

30) Agencia Española de Consumo, Seguridad Alimentaria y Nutrición. Evaluación y seguimiento de la estrategia NAOS: conjunto mínimo de indicadores. Madrid: Ministerio de Sanidad, Servicios Sociales e Igualdad; 2015.

31) Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S, *et al.* Mediterranean diet pyramid today. Science and cultural up- dates. *Public Health Nutr.* 2011;14(12A):2274-84. http://doi.org/dvhf2f.

32) He K, Hu FB, Colditz GA, Manson JE, Willett WC, Liu S. Changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women. *Int J Obes Relat Metab Disord.* 2004;28(12):1569-74. http://doi.org/dg98df.

33) Palou A, Bonet ML. Challenges in obesity research. *Nutr Hosp.* 2013;28(Suppl 5):144-53. http://doi.org/cm8v.

ARTÍCULO 2

PHYSICAL ACTIVITY FROM CYCLING AND EFFECTS ON THE MEDITERRANEAN DIET. PROJECT: ASISA

Physical activity from cycling and effects on the Mediterranean Diet. Project: ASISA

Actividad física en bicicleta y efectos en la dieta Mediterránea. Proyecto: ASISA

| Abstract |

Introduction: Cycling can facilitate daily physical activity. Several studies have investigated the relationship between active displacement and healthy lifestyles. However, very few studies examine the relationship just between cycling and adherence to the Mediterranean diet.

Objective: The objective of this study was to evaluate the relationship between bicycle displacements of the adult population that work or study in an urban environment and the adherence to the Mediterranean diet (AMD).

Methods: a cross-sectional study was carried out with 1,492 adults in the city of Lleida, Spain. Participants responded to a survey about physical activity and adherence to the Mediterranean Diet from June 2016 to May 2017.

Results: Results of this study with inactive subjects and cyclists provided confirmatory and novel data. Most of the subjects evidence a poor AMD, and cycling was associated with greater AMD.

Conclusions: These findings indicate that competent authorities might promote cycling as a daily routine to reduce sedentary lifestyles, as well as improving public health and well-being in general. In conclusion, more campaigns promoting healthy lifestyles are necessary.

Keywords: Healthy Diet; Health Promotion; Health Public Policy; Motor Activity; Urban Health.

| Resumen |

Introducción. El ciclismo puede facilitar la actividad física diaria. Varios estudios han investigado la relación entre el desplazamiento activo y los estilos de vida saludables. Sin embargo, muy pocos estudios examinan la relación entre el ciclismo y la adherencia a la dieta mediterránea.

Objetivo. El objetivo de este estudio fue evaluar la relación entre los desplazamientos en bicicleta de la población adulta que trabaja o estudia en un entorno urbano y la adherencia a la dieta mediterránea (DMAE).

Materiales y métodos. Se realizó un estudio transversal con 1.492 adultos en la ciudad de Lleida, España. Los participantes respondieron a una encuesta sobre actividad física y adherencia a la Dieta Mediterránea desde junio de 2016 hasta mayo de 2017.

Resultados. Los resultados de este estudio con sujetos inactivos y ciclistas proporcionaron datos novedosos y confirmatorios. La mayoría de los sujetos evidencian una DMAE pobre, y el ciclismo se asoció con una DMAE mayor.

Conclusiones. Estos hallazgos indican que las autoridades competentes podrían promover el ciclismo como una rutina diaria para reducir los estilos de vida sedentarios, además de mejorar la salud pública y el bienestar en general. En conclusión, son necesarias más campañas que promuevan estilos de vida saludables.

Palabras clave: Alimentación Saludable; Promoción de la Salud; Políticas Públicas de Salud; Actividad Motriz; Salud Urbana.

Introduction

Physical inactivity is an important risk factor for many noncommunicable diseases and also shortens life expectancy (1,2). In this regard, active commuting, by walking and/or cycling, is increasingly promoted because of their potential to increase physical activity (PA) levels in the general population (1,3). Active commuting has multiple health benefits: reduces cardiovascular risk, reduces body weight, improves general fitness condition, and increases physical and mental well-being (1). Specifically, cycling has been inversely associated with mortality, for both men and women (2). Cycling as an active displacement provides similar or greater health enhancements than walking, since cycling intensity is greater than by walking (4).

According to the World Health Organization, to obtain these benefits and consider that a subject is active, adults should practice at least 150 minutes of moderate intensity aerobic activity or 75 minutes of vigorous intensity per week or an equivalent combi- nation of both physical intensities.

Diet is one of the most influential factors for health (5). The traditional Mediterranean Diet (MD) is considered one of the healthiest ones. Recent re- views highlighted the protective factor of MD on numerous chronic and degenerative diseases such as metabolic syndrome, cardiovascular risk, atherosclerosis, cancer, diabetes, obesity… (5,6).

Although health benefits of cycling and MD have been widely demonstrated, population adherence to MD (ADM) or to bicycle commuting are low. Moreover, AMD has decreased worldwide in recent decades, especially among the inhabitants of the Mediterranean basin, together with the proportion of active adult subjects (1). Determining how behavioral risk factors are grouped might contribute to the development of future preventive and com- prehensive health interventions. Although several studies have examined the relationship between active displacement and the Mediterranean diet (3,5), none of them studied the relationship between cy- cling and AMD in adults who use this means of transportation daily. The objective of this study was to evaluate the relationship between bicycle travel and AMD among the adult population that works or studies in a dense, Mediterranean/south-ern European urban environment

Materials and methods

Design

This cross-sectional study was based on participants from the physical activity and health survey ASISA/BICI. It is a relatively large study aimed at investigating the risks and benefits of physical activity. Participants were residents in Lleida, Spain. Recruitment was carried out by

trained interviewers on the streets of the city between June 2016 and May 2017.

Participants

A total of 30 random points in the city were selected in order to guarantee the representativeness of the sample. Adults who traveled by bicycle and those who did not were asked to answer some screening questions, and those who met the inclusion criteria were invited to answer an electronic survey. 1,492 cyclists (777 men, 715 women) were included in the study. A control group of inactive subjects was recruited by asking, cyclists to invite subjects of similar sociodemographic status who did not practice physical activity on a regular basis to participate in the study. Out of a total of 1,492 subjects enrolled, 738 were classified as inactive according to the short version of the International Physical Activity Questionnaire (IPAQ) (7) and were consequently included in the control group.

Measurements

Adherence to the Mediterranean Diet

The AMD was evaluated using the Spanish version of the validated questionnaire "Mediterranean Diet Adherence Screener" (MEDAS) (6). The MEDAS consists of 12 questions about the frequency of food consumption and 2 questions about eating habits considered as characteristic of the Spanish MD. Each question is punctuated with 0 or 1 The total score ranges from 0 to 14 and al- lows to differentiate three levels of AMD: low (0- 6), medium (7-8) and high (≥9).

Physical activity and training

The level of physical activity was established by the Spanish version 7 of the short questionnaire of the "International Physical Activity Questionnaire" (IPAQ), which shows acceptable psycho- metric properties. The questionnaire values allow categorizing subjects with low, medium or high levels of physical activity. Subjects with low levels of physical activity were considered inactive. A questionnaire was designed to evaluate the training level of cycling practitioners by recording the volume (h/wk in the last month), frequency (days/wk in the last month) and training experience (years of practice).

The study protocol was approved by the “Research Ethics Committee of the Spatial Didactics Department of the University of Lleida”. nº 02/2016/DEUDL.

Statistical analysis

Statistical analysis was performed using the IBM Statistical Package for Social Sciences (IBM SPSS Statistics, v. 24.0 WINDOWS). Cohort data are presented as mean ± standard deviation or percentage. To measure the differences in the variables of interest, a 2-way ANOVA analysis was performed with two factors between subjects (GROUP: cyclists and inactive, and SEX: male and female). To establish the differences in the qualitative variables, the Chi-square test was ap- plied. Pearson's correlations were used to establish relationships of interest. Differences were considered statistically significant when $p < 0.05$.

Results

Differences between groups in healthy habits

No age differences were observed between groups ($p = 0.383$) (Table 1). In both sexes, cyclists showed lower values of BMI and higher levels of physical activity (all $p < 0.05$) compared with the control group. Volume and frequency of cycling were comparable between the sexes, with no differences in the years of sports practice ($p = 0.394$).

Table 1. Basic characteristics of the subjects and differences between groups

	MEN		WOMEN		p value	
	Cyclists (410)	Inactive (367)	Cyclists (34	Inactive (371)	Group	Sex
Age	39.2 ± 9.9	38.9 ± 8.0	37.8 ± 10.1	36.3 ± 11.2	0.383	0.081
BMI (kg/m^2)	25.3 ± 3.1	26.9 ± 4.5*	22.6 ± 3.3	24.1 ± 4.2*	0.000	0.000
Physical activity (MET-min week)	3489 ± 1964	1015 ± 766*	3011 ± 1591	899 ± 865*	0.000	0.031
			Training			
Current sports experience (years)	3.9 ± 2.9	_	3.1 ± 2.7	_	0.394	0.000
Frecuency last month (days/week)	2.7 ± 1.3	_	2.4 ± 1.2	_	0.000	0.582
Volume last month (hours/weeks)	2.6 ± 1.2	_	2.4 ± 1.3	_	0.000	0.175
			Adherence to Mediterranean Diet			
1. Use olive oil as the main fat for cooking	98	96	95	93	0.144	0.171
2. ≥ 4 tablespoons of olive oil a day	46	45	39	42	0.099	0.610
3. ≥ 2 vegetable servings a day	56	43*	71	68	0.011	0.000
4. ≥ 3 pieces of fruit per day	39	24*	42	24*	0.000	0.001
5. < 1 serving of red meat or sausage a day	53	61*	72	71	0.019	0.000
6. < 1 serving of animal fat a day	93	93	91	92	0.000	0.411
7. < 1 sugary drink a day	81	73*	89	85	0.001	0.001
8. ≥ 7 glasses of red wine a week	14	13	9	8	0.056	0.011
9. ≥ 3 servings of legumes a week	31	33	22	20	0.001	0.000
10. ≥ 3 fish servings a week	37	26*	44	33*	0.009	0.007
11. < 2 commercial cakes or pastries a week	68	51*	77	63*	0.004	0.002
12. ≥ 3 or more portions of nuts a week	43	28*	37	36	0.000	0.000
13. Preferably consume white meat than red mea	79	62*	87	82	0.000	0.000
14. ≥ 2 sometimes a week dish with a traditional sauce of tomatoes, garlic and onions	68	70	51	66*	0.000	0.000
Total score Score <7 (%)	7.8 ± 1.7	7.0 ± 2.0*	8.2 ± 1.0	7.7± 1.5*	0.000	0.000
Score 7-8 (%)	23.9	41.6*	22.1	27.3*	0.000	0.033
Score >9 (%)	41.3	34.3	32.8	39.3	0.019	0.301
	37.1	23.2*	48.3	36.4*	0.000	0.169
* p < 0.05 Inactives vs. cyclists						

Differences between groups in the AMD

The majority of subjects showed low or medium levels of AMD (Table 1). Main deficiencies, with less than 50% compliance, were associated with the consumption of nuts, olive oil, fruit, fish, vegetables and wine. Women showed higher AMD than men ($p = 0.000$). In both sexes, cyclists showed higher AMD than inactive people ($p = 0.000$).

Discussion

The results of the present study with inactive subjects and cyclists provided confirmatory and novel data: the majority of subjects evidenced a deficient AMD, while bicycle displacement was associated with a higher AMD.

The results obtained strongly reinforce data from recent studies suggesting a deficient AMD in the Spanish population, associated with the scarce consumption of olive oil, vegetables, fruits and fish (5,6). It is also confirmed that a very high percentage of people meet the objectives of using olive oil as the main fat for cooking, as well as the low consumption of red meat, animal fat and carbonated/ sugary drinks. Even under these conditions, it was evident that most of the participants were classified in the lowest category of AMD while only less than a half of the cyclists showed a high AMD, which indicates that a high percentage of the population is not adhering to a healthy diet. These results reinforce the need for interventions to promote a healthy diet for both sexes.

Using bicycle for urban commuting presents variate health benefits that are more evidence when presented as an alternative to sedentary lifestyles.8 Determining how behavioral risk factors are associated might contribute to the development of better preventive and comprehensive public health campaigns (8).

Moreover, a better knowledge regarding how diet and physical activity relate is of special interest since in Mediterranean countries, such as Spain, an increase of physical lifestyles among the population might reverse the currently low ADM. Moreover, this would contribute to promote comprehensive public health campaigns aimed to enhance simultaneously active and nutritional behaviors.

We performed a specific analysis to determine the possible association between active commuting and AMD. Previous results established that cycling could be a mediating factor in a satisfactory state of health (1,3,4,5). Our results contribute to the current knowledge suggesting that for both sexes, cycling on a regular basis might increase AMD levels. It was also observed that most urban cyclists comply with the international recommendations of the World Health Organization. Our findings indicate that competent authorities might promote bicycling as a daily

routine to reduce sedentary, as well as improve public health and well-being in general. Finally, more campaigns to promote healthy lifestyles are needed, in order to improve adherence to the Mediterranean diet. The current strategies are insufficient so that most of the population evidenced high AMD.

Limitations and strengths

Some limitations in our study should be considered. First, this study was conducted in only one city. Hence, generalization of our findings is geographically limited. Second, we used a cross-sectional design, which precludes any assumptions about causality. Finally, data was obtained by interviews and questionnaires, which are susceptible to information bias. This study has several strengths, too. The study has high internal validity, with a good representation of bicycle commuting. Moreover, the sample of cyclists was large and complete, which enhances the population representativity for Lleida, Spain. Finally, our study in a southern European city has added evidence to a novel topic, relevant for the sustainability of Mediterranean cities and inhabitants' quality of life.

Future research

Our findings underscored the need for future re- search. There is a need to obtain a clear understanding about the relationship between bicycle commuting and ADM in longitudinal studies. It is probable that other factors might influence this relationship, specially those related with environmental and cultural determinants. Our results present a wide view on the nutritional behavior and active commuting in a city, which is information frequently lacking in scientific literature. These results might direct future researchers and governments to promote more active and healthier lifestyles

Conclusion

These findings indicate that competent authorities might promote cycling as a daily routine to reduce sedentary lifestyles, as well as improving public health and well-being in general. In conclusion, more campaigns promoting healthy lifestyles are necessary.

References

1) Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Physical Activity Series Working Group. Global physical activity levels: surveillance progress, pitfalls,

and prospects. Lancet. 2012; 21(380): 247-57.

2) De Geus B, Van Hoof E, Aerts I, Meeusen R. Cycling to work: influence on indexes of health in untrained men and women in Flanders. Coronary heart disease and quality of life. Scand J Med Sci Sports. 2008; 18: 498- 510

3) Riiser A, Solbraa A, Jenum AK, Birkeland KI, Andersen LB. Cycling and walking for transport and their associations with diabetes and risk factors for cardiovascular disease. J Transp Health. 2018. https://doi.org/10.1016/j. jth.2018.09.002

4) Oja P, Manttari A, Heinonen A, Kukkonen-Harju- la K, Laukkanen R, Pasanen M, et al. Physiological effects of walking and cycling to work. Scand. J Med Sci. Sport. 1991; 1(3): 151-157. https://doi. org/10.1111/j.1600-0838.1991.tb00288.x.

5) Mayolas-Pi C, Munguía-Izquierdo D, Peñarrubia-Lozano C, Reverter-Masià J, Bueno-Antequera J, López- Laval I, et al. Adherencia a la dieta mediterránea en adultos inactivos, practicantes de ciclo indoor y ciclistas aficionados. Nutri hospital. 2017; 35(1): 131-139.

6) Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 2011; 141(6): 1140-5.

7) Toloza SM, Gómez-Conesa A. El Cuestionario Inter- nacional de Actividad Física. Un instrumento adecuado en el seguimiento de la actividad física poblacional. Revi IBERia FisoKinesi. 2007; 10(1): 48-52.

8) Crane M, Rissel C, Standen C, Greaves S. Associations between the frequency of cycling and domains of quality of life. Health Promotion J Austr. 2014; 25(3): 182- 185.

9) Noble N, Paul C, Turon H, Oldmeadow C. Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. Prev Med. 2015; 81: 16-41.

ARTÍCULO 3

EFFECTIVENESS OF A PHYSICAL ACTIVITY INTERVENTION PROGRAMME ON THE INTEGRAL HEALTH OF UNIVERSITY PROFESSORS

Effectiveness of a Physical Activity intervention Programme on the Integral Health of University Professors

Eficacia de un programa de intervención de actividad física sobre la salud integral de profesores universitarios

| Abstract |

Introduction: Physical exercise programs (PA) are common in the scientific literature. However, few studies have evaluated adherence to physical activity after PA interventions.

Objective: This study aimed to test the effectiveness of a long-term physical exercise program in postmenopausal women.

Methods: Longitudinal design. Thirty-two women participated in this study (age 61.6 years). At the beginning of the study, an evaluation of participants' physical condition, adherence to the Mediterranean diet (AMD) and different biochemical parameters were performed. When the initial results were obtained, a PA intervention program was conducted. Three months after the start of the intervention, all the previous parameters were reassessed, and 6 months after the end of the intervention, the parameters were revaluated.

Results: In total, 90% of the women completed the program. The intervention increases the level of PA and improves biochemical parameters. At 6 months after the end of the intervention, the positive effects of the PA program were maintained, especially in agility ($p<0.01$) and resistance ($p<0.000$).

Conclusions: Adherence to PA was observed after a physical exercise program. For the entire study population, the exercise program improved physical condition, and those indicators remained improved after 6 months. Additionally, increases in PA were associated with improvements in AMD.

Keywords: Postmenopausal women, physical activity, adherence, exercise intervention.

| Resumen |

Introducción. Los programas de ejercicio físico (AF) son habituales en la literatura científica. Sin embargo, pocos estudios han evaluado la adherencia a la actividad física después de las intervenciones de AF.

Objetivo. Este estudio tuvo como objetivo probar la efectividad de un programa de ejercicio físico a largo plazo en mujeres posmenopáusicas.

Materiales y métodos. Diseño longitudinal. Treinta y dos mujeres participaron en este estudio (edad 61,6 años). Al inicio del estudio se realizó una evaluación del estado físico de los participantes, la adherencia a la dieta mediterránea (DMAE) y diferentes parámetros bioquímicos. Cuando se obtuvieron los resultados iniciales, se llevó a cabo un programa de intervención de AF. A los 3 meses de iniciada la intervención se reevaluaron todos los parámetros anteriores ya los 6 meses de finalizada la intervención se reevaluaron los parámetros.

Resultados. En total, el 90% de las mujeres completaron el programa. La intervención aumenta el nivel de PA y mejora los parámetros bioquímicos. A los 6 meses de finalizada la intervención se mantuvieron los efectos positivos del programa de AF, especialmente en agilidad ($p<0,01$) y resistencia ($p<0,000$).

Conclusiones. Se observó adherencia a la AF tras un programa de ejercicio físico. Para toda la población de estudio, el programa de ejercicios mejoró la condición física y esos indicadores permanecieron mejorados después de 6 meses. Además, los aumentos en PA se asociaron con mejoras en AMD.

Palabras clave: Mujeres posmenopáusicas, actividad física, adherencia, intervención de ejercicio.

Introduction

Less than half of Europeans do not meet the minimum recommendations of weekly physical activity (PA), and approximately 30% of citizens do not exercise at all (1). In Spain, 33.6% of the population aged 18 and 69 years do not meet the weekly recommendations (31.3% men; 35.8% women (2).

According to the World Health Organization (WHO), physical inactivity is the fourth-leading risk factor for global mortality (1). Its high prevalence worldwide represents one of the main challenges for global public health. Physical exercise is commonly prescribed to prevent premature mortality in the elderly (2-4).

It reduces body fat, improves lipid and lipoprotein profiles, improves glycemic control, improves the immunological system and reduces oxidative stress (5,6). In contrast, the poor physical condition has been associated with fragility and functional dependence (5). For this reason, some determinants of physical fitness, such as aerobic capacity, mobility, muscular strength or stability, have become indicators of healthy ageing (6). As a result, the early detection of poor physical fitness, together with the implementation of adequate physical exercise programs, are key elements for policy-makers aiming to improve public health (2).

Simultaneously, the Mediterranean diet (MD) has been considered a healthy standard that ensures balanced nutritional and caloric intake (7). It contributes to the prevention of numerous diseases, such as acute myocardial infarction, arterial hypertension, type II diabetes or cancer, and increases life expectancy (8,9). In addition, recent studies have reported that populations that do not adhere to the MD have a higher risk of type II diabetes and obesity (3,10).

Active lifestyles and physical conditions have been associated with nutritional habits (6), and all three aspects seem to influence the ageing of human cells and organisms (11,12). Although public health campaigns might enhance citizens' daily physical activity and nutritional behavior for a period of time (10,13), the current main challenge is to generate adherence to those habits (13,14). Exercise prescriptions might include, in addition to a systematic exercise program (15), indicators of adherence in the mid-long term (12). Although some studies have demonstrated the effectiveness of an exercise program, knowledge of participants' adherence in the mid-term remains scarce (13, 16, 17).

For these reasons, the main objectives of this study were i) to assess the effectiveness of an exercise program in the short and mid-term and ii) to assess the impact of this program on physical condition (PC), adherence to Mediterranean diet (AMD), biochemical indicators of health, and anthropometrics.

Materials and methods

Design

We used a longitudinal design with a single group. Data were collected at the beginning of a 3-month program (Pre), at the end of the program (Post T1), and 9 months after the pro- gramme (Post T2) (Figure 1). The intervention last- ed 12 weeks and took place between September and November 2017.

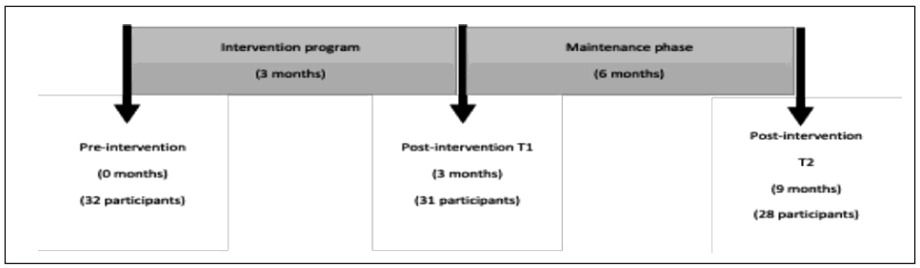

Figure 1. Action protocol.

Participants

Thirty-two women participated in this study (age 61.6±1.4 years). All participants taught at the University of Lleida and were married/in unions. The inclusion criteria were as follows: women, university professors, over 60 years of age, no cardiovascular or chronic disease that precluded them from participating in a physical exercise programme, and a low level of physical activity according to the International Physical Activity Questionnaire (IPAQ) (Table 1).

A minimum sample size of 32 participants was calculated using G-Power v3.1 for mixed ANOVA with interactions (1-β = 90%, α = 5%, r = 0.7). Recruitment was performed via the placement of leaflets in hospitals and faculty offices in university buildings. Participants were informed prior to the study and gave their signed consent.

Procedures of this study were ap- proved by the Ethical Committee of Clinical Research of the Sports Administration of Catalonia (02/2018/ CEICGC). They met the principles of the latest revision of the Declaration of Helsinki.

Measurements

Measurements and follow-up

Participants were assessed at the beginning of the study, after a 3-month programme and six months after the programme. Forms were answered individually, without the help of researchers.

Anthropometric variables

Anthropometric measurements were taken at each assessment (Pre, T1, T2). Participants were measured using a wall stadiometer (Seca-240, Hamburg, Germany) and weighed using an electronic scale (Tanita TBF300, Illinois, USA). Body mass index (BMI) was then calculated according to Quételet (kg/m2).

Physical activity

The Spanish version of the International Physical Activity Questionnaire (IPAQ) was used to determine the level of physical activity of participants (21). Physical activity was expressed in terms of MET- min/week (15). Participants were then classified as engaging in high-level (3 or more days/week of vigorous exercise, achieving 1500 MET-min/week or more), moderate-level (5 or more days of each combination of walking and moderate-vigorous physical activity, achieving 600 MET-min/week or more) or low-level (under 600 MET-min/week) physical activity (18).

Mediterranean diet adherence (MDA)

Mediterranean diet adherence (MDA) was assessed using the Spanish version of the Mediterranean Diet Adherence Questionnaire (MEDAS-14) (18). This questionnaire contains 12 food frequency items and two behavioral items; these items are specific to the Spanish Mediterranean diet. Each answer is scored 0 points or 1 point.

One point is added when olive oil is used as a main cooking fat, when white meat is preferred to red meat, or for consuming the following:

- 4 or more daily tablespoons of olive oil;
- 2 or more daily portions of vegetables;
- 3 or more daily pieces of fruit;
- Less than 1 daily portion of red meat or sausage;
- Less than 1 daily portion of animal fat;
- Less than 1 daily sugary drink;
- 7 or more weekly glasses of wine;
- 3 or more weekly portions of legumes;
- Less than 2 weekly portions of cake or pastry;
- 3 or more weekly portions of nuts;
- 2 or more weekly dishes containing traditional sauces of tomato, garlic and onion.

The total score ranges from 0 to 14 points and can be classified into three levels of MDA: low (0 - 6), medium (7 - 8), or high (≥ 9) (19).

Lipid profile

Biochemical analyses for total cholesterol, LDL cholesterol, HDL cholesterol, glucose, uric acid and triglycerides were performed at the nearest hospital (Hospital Universitari Arnau de Villanova de Lleida, Spain). Fasting blood samples were collected be- tween 8:00 and 9:00 AM from an antecubital vein and stored in tubes with EDTA. Blood samples were quickly centrifuged, and plasma was separated for posterior analysis. Plasma glucose, cholesterol and triglycerides were analysed using enzymatic colorimetric methods (Bio-Assay System, Hayward, CA, USA). Cholesterol (LDL and HDL) was analysed after precipitation using quantitative colorimetric methods (Crystal Chem, Downers Grove, IL, USA).

Physical condition

Assessments of physical condition (PC) were made using an adapted version (20) of the Senior Fitness Test Battery (21) and Eurofit Testing Battery (22), consisting of the following tests:

- Stability - Flamingo test: time that a participant was able to stand on a single leg, up to 60s.
- Lower extremity strength - Chair-stand test: maximum number of repetitions that a participant was able to complete standing up and sitting during a period of 30s.
- Upper extremity strength - Arm curl test: maximum number of repetitions that a participant was able to complete performing arm curls with a 2.5kg dumbbell during a period of 30s.
- Lower extremity flexibility - Chair sit and reach test: distance (cm) from fingers to toes during a trunk flexion in sitting position.
- Upper extremity flexibility - Back scratch test: distance (cm) between right and left fingers when crossing the arms backward in diagonal.
- Agility - Foot up-and-go test: time (s) that a participant takes to complete a circuit from sitting position.
- Velocity - Brisk walking test: time (s) that a participant needs to walk a distance of 30m.
- Endurance - 6-minute walk test: distance (m) that a participant is able to walk in 6min.

Intervention

Participants completed a 12-week exercise programme consisting of 24 sessions (duration: 1 hour; frequency: 2 sessions/week). This programme was supervised and individualized by two sports science graduates. Each session was organized in 3 parts: warmup (10min), workout (20min strength exercises +15min cardiorespiratory fitness), and cool down (5min of posture, motor coordination, flexibility, stability and reaction time exercises). At the end of each session, participants gave their rating of perceived exertion (RPE) on a 7-20 scale (29). Strength training was programmed in two phases: I) weeks 1 to 6: 2 series of 20 repetitions per exercise at 50% of

1-repetition maximum (1RM), with 2-3 min of rest between series; and II) weeks 7 to 12: 3 series of 15 repetitions at 65% of 1RM, with 2-3 min of rest between series. Strength exercises included the arm curl, French press, squat, bending over, military press and bench press. To determine 10RM, participants performed a standardized warmup and then performed repetitions with incremental resistance. Cardiorespiratory training was performed on a treadmill and consisted of 15 min (phase I) and 25 min (phase II) of walking/ running at a regular pace at an individualized intensity based on the 6-min walk test.

Statistical analysis

Data analysis was performed using SPSS v24.0 (SPSS Inc. Chicago, IL, USA). Data are presented as the mean ± standard deviation unless otherwise stated. The normality of the distributions of the variables was tested using the Shapiro-Wilk test. The normality of the distributions of the variables was tested by means of the Kolmogorov-Smirnov test. With normal distributions, Student's t-test was used, and when the sample did not meet the assumption of normality, the Wilcoxon test and chi-square test were used for categorical variables. Time differences were assessed using repeated-measures ANOVA. All confidence intervals were calculated at 95%. The level of significance for all analyses was set at $P<0.05$.

Results

Participant characteristics at each measurement can be found in Table 1. One participant dropped out of the study during the intervention for personal reasons and was excluded from the statistical analysis. All participants had normal Mass Corporal Index (IMC)values according to their age (30).

At the beginning of the study, all participants with a physical activity <600 MET-min/week were considered inactive. Regarding MDA, 28% of participants were classified as low, 68% as a medium, and 3% as high. Biochemical results can be found in Table 2.

Post-intervention (T1)

The mean attendance at the sessions was 95%. There was a statistically significant increase in PC in all participants ($p<0.019$). AMD improved at all levels, with an increase in the medium- and high-level proportions (table 1).

Table 1. Characteristics of study population.

Pre-intervention (0 months)		Group			p value		
		Post-intervention T1	Follow-up T2	(0 months) vs (T1)	(0 months) vs (T2)	(T1) vs (T2)	
Age (years)		61.6±1.4	61.5±1.4	61.5±1.4	(n.s)	(n.s)	(n.s)
Abody mass index BMI (kg/m^2)		27.0±4.1	26.9±4.1	26.9±4.1	(n.s)	(n.s)	(n.s)
Physical activity (MET-min week)		964.1±734.3	2089.5±2430.7	1788.0±1643.2	0.019*	0.008*	(n.s)
Differences between groups in adherence to the Mediterranean Diet	Target						
1. Do you use olive oil as main culinary fat?	Yes	31 (96.9%)	31 (96.9%)	31 (96.9%)	(n.s)	(n.s)	(n.s)
2. How much olive oil do you consume in a given day? (including frying, salads, etc.)	≥4 tablespoon/d (1 tablespoon: 13.5 g)	8 (25.0%)	9 (28.1%)	10 (31.3%)	(n.s)	(n.s)	(n.s)
3. How many vegetable servings do you consume per day? (consider side dishes as a half a serving	≥2 servings/d (1 serving: 200 g)	18 (56.3%)	21 (65.6%)	23 (71.9%)	(n.s)	0.043	(n.s)
4. How many fruit units do you consume per day? (including natural fruit juices)	≥3	9 (28.1%)	17 (53.1%)	17 (53.1%)	0.021*	0.008*	(n.s)
5. How many servings of red meat, hamburger or meat products do you consume per day?	<1	23 (71.9%)	28 (87.5%)	29 (90.6%)	(n.s)	0.048*	(n.s)
6. How many servings of butter, margarine, or cream do you consume per day?	<1	28 (87.5%)	28 (87.5%)	28 (87.5%)	(n.s)	(n.s)	0.000*
7. How many sweetened and/or carbonated beverages do you drink per day?	<1	26 (81.3%)	25 (78.1%)	26 (81.3%)	(n.s)	(n.s)	(n.s)
8. How much wine do you drink per week?	≥7glasses	2 (6.3%)	3 (9.4%)	2 (6.3%)	(n.s)	(n.s)	(n.s)
9. How many servings of legumes do you consume per week? (1 serving 150 g)	≥3	0 (0.0%	1 (3.1%)	1 (3.1%)	(n.s)	(n.s)	(n.s)
10. How many servings of fish or shellfish do you consume per week? (1 serving 100-150 g of fish or 4-5 units or 200 g of shellfish)	≥3	16 (50.0%)	17 (53.1%)	16 (50.0%)	(n.s)	(n.s)	0.000*
11. How many times per week do you consume commercial sweets or pastries	≥3	19 (59.4%)	23 (71.9%)	23 (71.9%)	(n.s)	(n.s)	(n.s)
12. How many servings of nuts do you consume per week? (1 servings 30 g)	<1	12 (37.5%)	12 (37.5%)	12 (37.5%)	(n.s)	(n.s)	(n.s)
13. Do you preferentially consume white meat over red meat?	Yes	28 (87.5%)	27 (84.4%)	28 (87.5%)	(n.s)	(n.s)	(n.s)
14. How many times per week do you consume vegetables, pasta, rice or other dished seasoned with sauce of tomato, onion, garlic, or leek with olive oil?	≥2	17 (53.1%)	11 (34.4%)	9 (28.1%)	(n.s)	0.050*	(n.s)
Mediterranean diet score		7.4±2.1	8.2±2.0	8.2±1.8	(n.s)	(n.s)	(n.s)

MEDAS, Mediterranean Diet Adherence Screener. Accordance of food consumption with Mediterranean diet is defined as achieving ≥ 9 targets of MEDAS (10).

Table 2 shows biochemical indicators at each sampling time point. In general, there were no improvements in the parameters except total cholesterol, which slightly decreased after the intervention. There was an improvement in strength ($p<0.001$), velocity ($p<0.001$), agility ($p<0.001$), and endurance ($p<0.001$) (Table 3).

Table 2. Biochemical characteristics.

	Group			p value		
	Pre-intervention (0 months)	Post-intervention T1	Follow-up T2	(0 months) vs (T1)	(0 months) vs (T2)	(T1) vs (T2)
Triglycerides, mg/dL	93.8±35.2	87.0±23.2	87.1±23.0	(n.s)	(n.s)	(n.s)
Total cholesterol	222.9±25.9	218.9±31.1	218.5±30.8	(n.s)	(n.s)	(n.s)
Glucose, mg/dL	90.8±10.5	95.0±10.2	95.7±10.4	0.013*	0.014*	(n.s)
HDL	64.8±12.9	65.9±14.1	65.5±13.9	(n.s)	(n.s)	(n.s)
LDL	142.4±32.6	135.7±25.7	135.4±25.8	(n.s)	(n.s)	(n.s)
Uric acid, mg/dL	4.762±0.951	4.568±0.807	4.559±0.806	(n.s)	(n.s)	(n.s)

Follow-up (T2)

Physical activity six months after the intervention was assessed in 28 of the participants, and the remaining 3 could not complete the interviews for personal reasons. Although PA decreased during the months following the programme, participants were moderately active, with a statistically significant in- crease from the beginning of the study ($p<0.008$) (Table 1). The results also confirmed an improvement in MDA (Table 1), especially in fruit, vegetable and nut consumption. In addition, the consumption of sugary drinks, pastries and red meat decreased ($p<0.04$). Biochemical parameters were still stable, except for total cholesterol, which did not show relevant changes. Improvements in PC were maintained until T2 (Table 3).

Table 3. Fitness tests.

	Group			p value		
	Pre-intervention (0 months)	Post-intervention T1	Follow-up T2	(0 months) vs (T1)	(0 months) vs (T2)	(T1) vs (T2)
Balance right leg (s)	47.8 ± 19.1	49.9 ± 18.1	57.9 ± 9.2	(n.s)	0.043*	(n.s)
Balance left leg (s)	44.1 ± 20.8	49.3 ± 17.6	50.4 ± 15.6	(n.s)	(n.s)	(n.s)
Leg strength (rep)	13.6 ± 2.0	20.7 ± 4.9	19.5 ± 3.8	0.000*	0.000*	(n.s)
Strength right arm (rep)	15.5 ± 2.6	20.8 ± 2.7	22.0 ± 2.9	0.000*	0.000*	0.029*
Strength left arm (rep)	15.8 ± 2.5	21.3 ± 22.9	21.2 ± 2.3	0.000*	0.000*	(n.s)
Lower extremity flexibility (cm)	-0.3 ± 7.4	1.9 ± 5.6	-0.4 ± 8.1	0.006*	(n.s)	0.038*
Upper extremity flexibility (cm)	0.6 ± 6.0	2.2 ± 6.2	1.4 ± 7.0	(n.s)	(n.s)	(n.s)
Agility (s)	5.2 ± 0.7	4.4 ± 0.5	4.8 ± 0.5	0.000*	0.019*	0.001*
Speed (s)	14.1 ± 2.0	12.5 ± 1.5	12.5 ± 1.2	0.000*	0.001*	(n.s)
Cardiovascular endurance (m)	567.9 ± 57.3	658.5 ± 82.7	600.7 ± 42.7	0.000*	0.010*	0.045*

Discussion

The aim of this study was to determine adherence to physical activity after a 3-month exercise programme. In addition, we aimed to assess whether this adherence was associated with MDA, improvements in biochemical markers, or improvements in PC. Our results confirmed that a 3-

month exercise programme can improve adherence to physical activity during the subsequent six months, as well as improve ADM and PC. Exercising regularly and maintaining a balanced diet are some of the recommendations for improving health and quality of life in older adults (2). Our results revealed relevant changes after the intervention as well as during the subsequent months. Indeed, previous studies have shown how exercise programmes contribute to improvements in several parameters related to PC in adults (23-25). However, studies, including a longitudinal follow-up, are still scarce (17).

We did not find statistically significant changes in BMI, in contrast to previous studies that reported slight declines (26). Notwithstanding this finding, we observed how dietary intake improved after the programme. Most of the participants had moderate or high AMD at both posterior measurements (T1 and T2). Nutritional care contributes to delayed ageing (27), increased life expectancy (28), control of excess body weight and a reduction impotently mobility impairment (29).

Our results suggest that improvements in PA might be associated with improvements in AMD. When analysing food intake, we found that improvements in PA were associated with more fruit and vegetable consumption and a decrease in red meat and pastry intake. Similar trends have been previously reported, with increases in fruit and vegetable intake associated with increases in PA (30, 31). We observed that after exercise, participants showed improved blood triglycerides but not glucose. Notably, participants showed reduced LDL cholesterol and slightly reduced HDL cholesterol after the pro- gramme. These findings might be relevant from a practical perspective, especially in the prevention of coronary diseases in adult women (3).

Our results regarding total cholesterol, which was elevated in all measurements, are consistent with those of previous studies that found similar trends (3,32).

Several studies have suggested that menopause might be associated with higher cardiovascular risk in women because of a deficiency in cardio protective hormones and do estrogens (33,34). In this regard, all participants were postmenopausal, which might have been related to the lack of change in total cholesterol after the programme.

Previous studies associated being female, being unmarried or divorced, having diabetes, having obesity, having low socioeconomic status and having a low educational level with lower adherence to exercise programmes (35-37).

All participants in our study were university professors, were married/in unions, had high socioeconomic status, had normal weight and were not diabetic. Hence, these characteristics might have contributed to the changes in adherence to physical activity that we observed. Guadalupe-Grauet al. (38), found that elders with less strength had a higher risk of death and/ or hospitalization of 45% of women and 30% of men and 25% of women and 16% of men. Since poorer PC is associated with several diseases and mortality, the implementation of specific

exercise programmes is fundamental for elderly adults (39, 40).

Although the association between health and exercise is widely known (41), adherence to exercise programmes is still scarcely investigated, especially in elderly adults (11). This study proved that a 12- week programme of 2 hours/week of physical activity might contribute to PA and PC improvements over a period of six months after the intervention. Gómez-Cabello et al. (2) suggested that an exercise duration of 2 hours/week or more is a key determinant in improving physical functioning in women.

Limitations and strengths

The authors assumed some limitations in the design of this study. First, we acknowledge the lack of objective measures to quantify weekly PA. He sample size was relatively small, greater number of participants are needed to accurately determine training. Finally, the results of the present study are representative of a sedentary postmenopausal women population aged between 60 and 63 years old, and therefore might not be extrapolated to active, younger, or older adults, including those with acute or chronic diseases. In addition, our research was conducted at a regional level, more national studies are necessary. Further research is needed to consider the impact of physical fitness program in postmenopausal women.

Conclusion

This study provides new evidence regarding adherence to physical activity over a 6-month term and its impact on AMD, biochemical indicators, anthropometrics, and PC. To further clarify how PA programmes might succeed or fail, more studies investigating behavior adherence in the long term are needed. The main findings of our study were as follows: i) a 3-month exercise programme of 2 hours/ week increases levels of PA in participants; ii) adherence to PA decreases after 6 months; iii) a 3-month exercise programme improves PC, especially strength, velocity, agility and endurance, and those indicators remain improved after 6 months; iv) our programme improved all of the studied biochemical variables except total cholesterol; and v) increases in PA were associated with improvements in AMD, and this association was maintained over time.

References

1) WHO/OMS. Recomendaciones mundiales sobre actividad física para la salud. Clasificación NLM: QT 255. Ginebra: WHO/OMS; 2010. Available online: https:// www.who.int/dietphysicalactivity/factsheet_recommendations/es/ (accessed on 06/07/2019r).
2) Gómez-Cabello A, Vila-Maldonado S, Pedrero-Cham- izo R, Villa-Vicente JG, Gusi N, Espino L, et al. La actividad física organizada en las personas mayores, una herramienta

para mejorar la condición física en la senectud. Rev Esp Salud Pública. 2018; 92, e1-e10.

3) Kheirat F, Merzouk H, Merzouk AS, Merzouk SA, Be- larbi B. One year changes in biochemical and redox markers in training menopausal women with adherence to Mediterranean diet. Sci. Sports. 2018; 33, e25-e32.

4) Soto-Rodríguez A, García-Soidán JL, Arias-Gómez MJ, Del Álamo Alonso A, Leirós Rodríguez R, Reyes Pérez Fernández M. Intervención educativa sobre parámetros cardiovasculares en mujeres perimenopáusicas con un factor de riesgo cardiovascular. Ensayo clínico aleatorizado." Med Clin. 2018; 150: 178-184. DOI: 10.1016/j. medcli.2017.06.020.

5) Greene NP, Martin SE, Crouse SF. Acute exercise and training alter blood lipid and lipoprotein profiles differently in over-weight and obese men and women. Obesity. 2012; 20: 1618-1627.

6) Nikolaidis MG, Paschalis V, Giakas G, Fatouros IG, Koutedakis Y, Kouretas D. et al. Decreased blood oxidative stress after repeated muscle-damaging exercise. Med Sci Sports Exerc. 2007; 39: 1080-1089.

7) Willet E, Sacks F, Trichopoulou A, Drescher G, Fer- ro-Luzz A, Helsing E. et al. Mediterranean diet pyramid: a cultural model for healthy eating. Am J Clin Nutr. 1995; 61 (Suppl. 1): 1402-1406.

8) Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health; an updated systematic review a meta-analysis. Am J Clin Nutr. 2010; 92: 1189-1196.

9) Schwingshackl L, Hoffmann G. Does a Mediterranean type diet reduce cancer risk? Curr Nutr Rep. 2016; 5: 9-17.

10) Arslan E, Can S, Demirkan E. Effect of short-term aerobic and combined training program on body composition, lipids profile and psychological health in premenopausal women. Sci. Sports. 2017; 32: 106-113.

11) Varo JJ, Martínez JA, Martínez-González MA. Beneficios de la actividad física y riesgos del sedentarismo. Med Clin. 2003; 121: 665-672.

12) Araya S, Padial P, Feriche B, Gálvez A, Pereira J, Mariscal-Arcas M. Incidencia de un programa de actividad física sobre los parámetros antropométricos y la condición física en mujeres mayores de 60 años. Nutr. Hosp. 2012; 27: 1472-1479. http://dx.doi.org/10.3305/ nh.2012.27.5.5899.

13) Orrow G, Kinmonth AL, Sanderson S, Sutton S. Effectiveness of physical activity promotion based in prima- ry care: systematic review and meta-analysis of randomised controlled trials. BMJ. 2012; 344: doi: https:// doi.org/10.1136/bmj.e1389

14) Crespo-Salgado JJ, Blanco-Moure A. Prescripción de ejercicio físico: ¿cómo mejorar la adherencia?. Med Clin. 2012; 139: 648-649.

15) Subirats E, Subirats G, Soteras I. Prescripción de ejercicio físico: indicaciones, posología y efectos adversos. Med Clin. 2012; 138: 18-24.

16) Harrison RA, Roberts C, Elton PJ. Does primary care referral to an exercise programme increase physical activity one year later? A randomized controlled trial. J Public Health. 2005; 27: 25-32.

17) Grandes G, Sanchez A, Montoya I, Ortega Sanchez-Pinilla R, Torcal J. Two-year longitudinal analysis of a cluster randomized trial of physical activity promotion by

general practitioners. PLoS ONE. 2011; 6: doi: 10.1371/journal.pone.0018363.

18) Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J. et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 2011; 141: 1140- 1145. doi: 10.3945/jn.110.135566.

19) León-Muñoz LM, Guallar-Castillón P, Graciani A, López-García E, Mesas AE, Aguilera MT, et al. Adherence to the Mediterranean diet pattern has declined in Spanish adults. J Nutr. 2012; 142: 1843-1850. DOI:10.3945/jn.112.164616

20) Morales S, Gómez-Cabello A, González-Agüero A, Casajús JA, Ara I, Vicente-Rodríguez G. Sedentarismo y condición física en mujeres postmenopáusicas. Nutr Hosp. 2013; 28: 1053-1059.

21) Rikli RE, Jones J. Senior fitness test manual. Champaign, IL : Human Kinetics, 2001.

22) EUROFIT. Test europeo de aptitud física. Ministerio de Educación y Ciencia, Madrid. 1992.

23) Bullo V, Bergamin M, Gobbo S, Sieverdes JC, Zaccaria M, Neunhaeuserer D, et al. The effects of Pilates exercise training on physical fitness and wellbeing in the elderly: A systematic review for future exercise prescription. Prev Med. 2015; 75: 1-11.

24) Lesinski M, Hortobagyi T, Muehlbauer T, Gollhofer A, Granacher U. Effects of Balance Training on Balance Performance in Healthy Older Adults: A Systematic Review and Meta-analysis. Sports Med. 2015; 45: 1721-1738.

25) Martins WR, de Oliveira RJ, Carvalho RS, de Oliveira Damasceno V, da Silva VZ, Silva MS. Elastic resistance training to increase muscle strength in elderly: a systematic review with meta-analysis. Arch Gerontol Geriatr. 2013; 57: 8-15.

26) Nelson ME, Fi Atarone MA, Morganti CM, Trice I, Greenberg RA, Evans WJ. Effects of high-intensity strength training on multiple risk factors for osteoporotic fractures. A randomized controlled trial. JAMA. 1994; 272: 1909-1194.

27) Scarmeas N, Gu Y, Schupf N, Lee JH, Luchsinger JA, Stern Y, et al. Mediterranean diet and leukocyte telomere length in a multi-ethnic elderly population. Alzheimers. Dement. 2014; 10: 755.

28) De la Montaña Miguélez J, Salve CA, Bernárdez MM. Evaluación del riesgo nutricional mediante el MNA en una población anciana no institucionalizada. Arch. Latinoam. Nutr. 2009; 59: 390.

29) Hergenroeder AL, Brach JS, Otto AD, Sparto PJ, Jakicic JM. The Influence of Body Mass Index on Self-report and Performance-based Measures of Physical Function in Adult Women. Card pulm phy therapy J. 2011; 22: 11-20.

30) Conklin AI, Forouhi NG, Suhrcke M, Surtees P, Ware- ham NJ, Monsivais P. Variety more than quantity of fruit and vegetable intake varies by socioeconomic status and financial hardship. Findings from older adults in the EPIC cohort. Appetite. 2014; 83: 248-255

31) Mäkinen TE, Sippola R, Borodulin K, Rahkonen O, Kunst A, Klumbiene J, et al. Explaining educational differences in leisure-time physical activity in Europe: the contribution of work-related factors. Scand. J. Med. Sci. Sports. 2012; 22(3): 439447.

32) Rodríguez AS, Soidán JLG, Gómez MJA, del Álamo Alonso A, Rodríguez RL, Fernández MRP. Intervención educativa sobre parámetros cardiovasculares en mujeres perimenopáusicas con un factor de riesgo cardiovascular. Ensayo clínico aleatorizado. Med Clin. 2018; 150: 178-184.

33) Lisabeth L, Bushnell C. Stroke risk in women: The role of menopause and hormone therapy. Lancet Neurol. 2012; 11: 82-91.

34) Libby P. Patogenia, prevención y tratamiento de la aterosclerosis. En: Fauci A, Braunwald E, Kasper D, Hauser S, Longo D, Jameson J, et al., editores. Harrison principios de medicina interna. 17.a ed México: McGraw- Hill; 2009. pp. 1501-1509.

35) Arthur H, Blanchard C, Gunn E, Kodis J, Walker S, Toner B. Exercise trajectories of women from entry to a 6-month cardiac rehabilitation program to one year after discharge. Biomed Res Int. 2013; 12: 121030.

36) Forhan M, Zagorski B, Marzonlini S, Oh P, Alter D. Predicting exercise adherence for patients with obesity and diabetes referred to a cardiac rehabilitation and secondary prevention program. Can J Diabetes. 2013; 37:, 189-194.

37) Assumpcao AM, Máximo LS, Sirineu D, Felício D, Sherrinton C. Adherence to exercise programs for older people is influenced by program characteristics and personal factors: A systematic review. J Physiother. 2014; 60: 151-156.

38) Guadalupe-Grau A, Carnicero JA, Gómez-Cabello A, Gutiérrez Ávila G, Humanes S, Alegre LM, et al. As- sociation of regional muscle strength with mortality and hospitalisation in older people. Age Ageing. 2015; 44(5): 790-795.

39) Taylor AH, Cable NT, Faulkner G, Hillsdon M, Narici M, Van Der Bij AK. Physical activity and older adults: a review of health benefits and the effectiveness of interventions. J Sports Sci. 2004; 22: 703-725. PubMed PMID: 15370483.

40) Paterson DH, Jones GR, Rice CL. Ageing and physical activity: evidence to develop exercise recommendations for older adults. Can J Public Health. 2007; 98: S69-108.

41) Muñoz-Arribas A, Vila-Maldonado S, Pedrero-Chamizo R, Espino L, Gusi N, Villa G, et al. Evolución de los niveles de condición física en población octogenaria y su relación con un estilo de vida sedentario. Nutr. Hosp. 2014; 29(4). http://scielo.isciii.es/scielo.php?script=sci_ arttext&pid=S0212-16112014000400024

ARTÍCULO 4

PHYSICAL ACTIVITY AND SLEEP QUALITY IN PRIMARY SCHOOL CHILDREN: MEDIATION OF SEX AND MATURATIONAL STAGE

Physical Activity and Sleep Quality in Primary School children: mediation of sex and maturational stage

Actividad Física y Calidad del Sueño en Niños de Educación Primaria: mediación del sexo y etapa madurativa

| Abstract |

Introduction: Sleep is a physiological process critical for physical and mental health in children. Childhood encompasses diverse developmental stages that may affect the impact of physical activity on sleep quality, which may also be influenced by sex.

Objective: The purpose of this study is to examine the mediation effect of sex and, maturational stage on the association between physical activity and sleep quality among primary school children

Methods: This is a cross-sectional study of 954 primary school students (437 early childhood and 517 middle childhood) with a mean age of 10.5 ± 1.2 years. Participants reported their sleep quality using the Pittsburgh Sleep Quality Index and their physical activity levels using the Physical Activity Questionnaire

Results: Our study found that physical activity is associated with improved sleep quality in children, particularly during middle childhood. Higher physical activity was linked to better sleep quality and reduced sleep latency (p=0.044). Sleep quality is generally better in males than in females (p=0.002) and is also better in early than middle childhood (p=0.00).

Conclusions: Especially in middle childhood, physical activity promotes children's sleep quality. Thus, educational institutions should promote or improve the implementation of physical activity in the school context in other to benefit children's sleep quality and, hence, improve their quality of life and well-being.

Keywords: Sleep quality; children; primary school; Physical Activity; Biological Maturation

| Resumen |

Introducción. El sueño es un proceso fisiológico crítico para la salud física y mental de los niños. La infancia abarca diversas etapas de desarrollo que pueden afectar el impacto de la actividad física en la calidad del sueño, que también puede verse influenciado por el sexo.

Objetivo. El propósito de este estudio es examinar el efecto de mediación del sexo y la etapa de maduración en la asociación entre la actividad física y la calidad del sueño entre los niños de la escuela primaria.

Materiales y métodos. Se trata de un estudio transversal de 954 alumnos de educación primaria (437 de primera infancia y 517 de infancia media) con una edad media de 10,5 ± 1,2 años. Los participantes informaron sobre la calidad del sueño mediante el Índice de calidad del sueño de Pittsburgh y sus niveles de actividad física mediante el Cuestionario de actividad física.

Resultados. Nuestro estudio encontró que la actividad física está asociada con una mejor calidad del sueño en los niños, particularmente durante la infancia media. Una mayor actividad física se relacionó con una mejor calidad del sueño y una menor latencia del sueño (p=0,044). La calidad del sueño es generalmente mejor en los hombres que en las mujeres (p=0,002) y también es mejor en la niñez temprana que en la mediana (p=0,00)

Conclusiones. Especialmente en la infancia media, la actividad física promueve la calidad del sueño de los niños. Por lo tanto, las instituciones educativas deben promover o mejorar la implementación de la actividad física en el contexto escolar en beneficio de la calidad del sueño de los niños y, por lo tanto, mejorar su calidad de vida y bienestar.

Palabras clave: Calidad de sueño; niños; escuela primaria; Actividad física; Maduración Biológica

Introduction

Sleep is a physiological process whose correct progress is essential for physical and mental human health. This statement acquires even more significance in children, due to the special role of sleep in their healthy development and well-being (1). Its functions are numerous: growth, development, learning, memory, synaptic efficiency, regulation of behavior, emotion, immune strengthening and cleaning time of neurotoxic sub-stances (2). Over the last decades, it has been constated a deterioration of childhood sleep, a fact that is generating certain concerns in public health institutions (3). According to the bibliography, this sleep deterioration is multifactorial and is based on different aspects such as artificial light, late-night screen time, caffeine use, and no bedtime rules in the household (4). The consequences of this sleep loss vary from inattentiveness, reduction in executive functioning and poor academic performance to in-creased risk of obesity and cardio-metabolic dysfunction (5).

The term "sleep quality" is frequently used in sleep medicine, but it's difficult to objectively define and measure since it represents a complex phenomenon. It may include various quantitative aspects of sleep such as Total Sleep Time, Sleep Onset Latency, sleep maintenance, Total Wake Time, Sleep Efficiency, and sometimes sleep disruptions like spontaneous arousal or apnea (6). The factors that determine sleep quality may differ among individuals. Surveys to analyze large-scale populations are commonly based on general questions about habitual sleep quality and types of sleep disturbances. In the case of childhood, it is important to comprehend the consequences of inadequate sleep quality in order to create effective public policies and develop strategies to reduce the harmful effects of sleep deficiency. The research on this topic plays a significant part in providing information for public policies, instructions, and schools. Then, advice and suggestions should be done through interventions to educate parents and children on how to maintain healthy sleep habits. Out of the many strategies recommended to im-prove children's sleep quality, physical activity is often highlighted since it can help establish healthy sleep patterns and habits. This can include going to bed earlier, sleeping for longer durations, and enhancing sleep efficiency, which is the proportion of total time spent sleeping relative to the time spent in bed (7). Physical activity has been linked to longer and better sleep quality for children and adolescents due to the discipline and social interaction that comes with participating in sports, as well as the significant energy expenditure and physical conditioning it provides (8). This positive impact can improve the quality of life for children and adolescents by enhancing their sleep patterns. Research has shown that adolescents who engage in more physical activity, both as reported by themselves (subjective) and as measured objectively, are more likely to experience better sleep quality both subjectively (perception of sleep quality) and objectively (measured by scientific means) (9).

An interesting question proposed in the bibliography over the last years is the possible sex difference in sleep decline. Apparently, due to biological and sociocultural factors that influence sleep patterns, there is more impaired sleep in females. This is a phenomenon generally observed from adolescence, when hormonal events underlying puberty may be involved (10). Nevertheless, there are conflicting results when it comes to understanding if sleep health differs between boys and girls in childhood. It's un-certain whether one gender is more or less likely to experience problems with children's sleep (11) and that causes the necessity of further investigation regarding this issue. It still reminds also unknown whether there are differences or variations in the way that sex affects the interaction between physical activity and sleep quality.

Childhood includes different developmental phases. Early childhood is considered chronologically from three to nine years old, and middle childhood is from ten to eleven years old (12). Each degree of maturational growth implies specific hormonal and skeletal characteristics (13) which could affect the relationship between physical activity and sleep quality. Nevertheless, it's currently uncertain whether the positive influence of physical activity on sleep quality is affected by the maturational growth stage. Also, the differences in biological growth maturation rhymes by sex could affect widely on this equation. Thus, this study aims to determine the mediation of sex and degree of maturation stage on the association between physical activity and sleep quality in primary school children.

Materials and methods

Design

This is a cross-sectional study based on self-report data conducted in accordance with the Declaration of Helsinki and approved by the Clinical Research Ethics Committee of the Sports Administration of Catalonia 02/2018/ CEICGC. The data of the present study belong to the initial evaluation of a crossover study project (Searching for the "normal" reference values of biomarkers of cardiac damage after sessions of physical activity) carried out between February and May 2019.

The project was made known by a group of voluntary independent evaluators formed in health sciences. In order to recruit participants, primary education centers were invited to participate in this study. All school principals received an information sheet on the nature and purpose of the study. The process included a brief and clear introduction to the study followed by an exhaustive explanation of the different items on the questionnaires. They had no time limit to complete the forms. The questionnaires took an average of 40 minutes to be completed. Subjects and parents or legal guardians were instructed about the anonymous and voluntary nature of participation and all of them signed the informed consent.

Participants

All participants were recruited following the general inclusion criteria (free of any chronic disease). A total of 954 children (429 boys and 525 girls, 10.5 ± 1.2 years) took part in this study. The sample was formed by 437 early childhood (students in the second cycle, 9,4 ± 0,6 years) and 517 middle childhood (students in the third cycle, 11,4 ± 0,6 years), belonging to 13 primary schools around the Spanish province of Lleida.

Measurements

Sleep Quality

The sleep quality was measured with the Spanish version of the Pittsburgh Sleep Quality Index (PSQI) (14). This questionnaire is a screening tool for sleep dysfunction in clinical and non-clinical samples with strong reliability and validity, and moderate structural validity in a variety of samples, suggesting the tool fulfills its intended utility (24). This tool was validated to assess adolescents' sleep quality in young people (25). It includes 19 questions on 7 components of sleep quality: subjective sleep quality, sleep duration, sleep latency, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. The 7 component scores are rated on a 3-point ascending scale, with 0 points indicating ideal sleep quality and 3 points indicating poor sleep quality. The global score of the PSQI is the sum of all component scores. The minimum possible score is 0, indicating ideal sleep quality, and the maximum possible score is 21, indicating poor sleep quality. The PSQI provides a sensitive measure to identify poor sleep quality if the total PSQI score is >5 (15), comparable to clinical and laboratory measures (such as polysomnography).

Level of Physical Activity

The level of physical activity was measured with the Spanish version of the Physical Activity Questionnaire for older children PAQ-C validated by Manchola-González (2017) (16). The questionnaire provides a summary activity score. The PAQ-C assesses general moderate to vigorous physical activity levels carried out in the last 7 days of a typical week, through 10 questions about the type and frequency of activities carried out. The questionnaire has 10 questions, the first 9 are used to calculate the final score and the remaining question is used to identify whether the child was ill or there was some circumstance that prevented him or her from routinely performing physical activity that week. A score from 1 to 5 is obtained from the responses, with a higher score indicating greater activity. Based on their final score, the children were classified into three terciles to then perform the analysis (17).

Statistical analysis

For statistical analysis, IBM Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, version 20.0; IBM Corp, Armonk, NY) software was used with a statistical significance level set at $\alpha = 0.050$. Descriptive statistics of the main variables were performed using mean, standard deviation, and 95% confidence interval according to sex. A one-way ANOVA was used to test the data on the relationship between the sleep quality variables according to the independent factors of sex, maturational stage or levels of physical activity. The three-way ANOVA was used to determine if there was an interaction effect between the three independent variables on sleep quality.

Results

Physical Activity levels and Sleep Quality

The descriptive values of the whole sample and the comparison of the sleep variables according to sex and maturational stage are presented in Table 1.

The results show significant differences according to sex in physical activity levels, being higher in males than females (p=0.004).

Analogously, results show significant sex differences in several of the components of sleep quality, including the global score. Sleep quality is generally better in males than in females (p=0.002), quality (p=0.004), latency (p=0.001) and disturbance (p=0.000).

Table 1. Comparative values of Physical Activity levels and Sleep Quality according to sex and maturational stage.

	Total (n = 954)	Males (n = 429)		Females (n = 525)		Early childhood (n = 437)		Middle childhood (n = 517)	
			IC 95%		*IC* 95%		*IC* 95%		*IC* 95%
Age (y)	10.5± 1.2	10.4±1.2	10.3-10.5	10.6±1.2	10.4-10.6	9.4±0.7	9.4-9.5	11.4±0.6*	11.3-11.4
Physical activity (1-5)	3.0±0.7	3.1±0.7	3.1-3.2	3.0±0.7*	2.9-3.0	3.1±0.7	3.0-3.1	3.0±0.7	3.0-3.1
Sleep Quality									
Quality (0-3)	0.7±0.7	0.6±0.7	0.6-0.7	0.8±0.7*	0.7-0.8	0.6±0.7	0.5-0.7	0.8±0.8*	0.8-0.9
Latency (0-3)	0.5±0.7	0.4±0.6	0.4-0.5	0.6±0.7*	0.5-0.6	0.4±0.6	0.4-0.5	0.6±0.7*	0.5-0.6
Duration (0-3)	0.0±0.2	0.1±0.3	0.0-0.1	0.0±0.2	0.0-0.0	0.0±0.2	0.0-0.1	0.0±0.3	0.0-0.1
Efficiency (0-3)	0.1±0.4	0.1±0.4	0.1-0.2	0.1±0.4	0.1-0.2	0.1±0.4	0.1-0.2	0.1±0.4	0.1-0.2
Disturbance (0-3)	1.3±0.6	1.2±0.6	1.1-1.2	1.4±0.6*	1.3-1.4	1.3±0.6	1.2-1.4	1.3±0.6	1.2-1.4
Daytime Dysfunction (0-3)	0.5±0.6	0.5±0.7	0.5-0.6	0.5±0.6	0.4-0.5	0.5±0.7	0.4-0.5	0.5±0.6	0.5-0.6
Global PSQI (0-21)	3.0±2.0	3.0±2.0	2.8-3.2	3.4±1.9*	3.2-3.5	3.0±1.9	2.8-3.1	3.4±2.0*	3.2-3.6

Interaction between physical activity, sex and maturational stage and their mediation on sleep quality

Results for PSQI score are shown in table 2 by sex, by level of physical activity and by cycle. Also, results are shown by sex*cycle, sex*physical activity and sex*cycle*physical activity. Three-way ANOVA analysis showed some interaction effects of physical activity level, maturational stage and sex in the sleep disturbances (Table 2). This mediation on sleep quality was also shown in the variables maturational stage and sex on their own. In males, higher levels of physical activity improve sleep disorders in mid-childhood but not in early childhood.

It is observed an interaction between the maturational stage and physical activity in global scores and latency. In general, higher physical activity levels improve sleep quality (0.044) and latency (0.017), with the difference being somewhat greater in middle childhood.

	Males						Females												
	PA Levels Early childhood 8-10 years			PA Levels Middle childhood 10-12 years			PA Levels Early childhood 8-10 years			PA Levels Middle childhood 10-12 years			P value						
	1st tertil	2nd tertil	3rd tertil	1st tertil	2nd tertil	3rd tertil	1st tertil	2nd tertil	3rd tertil	1st tertil	2nd tertil	3rd tertil	Sex	MS	PA	Sex*MS	Sex *PA	MS *PA	Sex*MS *PA
N	22	120	66	22	139	60	38	134	57	38	200	58							
PA	1.8 ± 0.4	2.9 ± 0.3	4.0 ± 0.3	1.9 ± 0.3	3.0 ± 0.4	4.0 ± 0.3	1.9 ± 0.3	2.9 ± 0.4	4.0 ± 0.3	1.9 ± 0.2	2.9 ± 0.3	3.8 ± 0.3							
Sleep Quality																			
Quality	0.5 ± 0.6	0.6 ± 0.6	0.4 ± 0.7	1.0 ± 0.7	0.7 ± 0.8	0.8 ± 0.7	0.7 ± 0.7	0.7 ± 0.7	0.6 ± 0.8	0.9 ± 0.7	0.9 ± 0.7	0.8 ± 0.8	0.072	**0.000**	0.469	0.317	0.807	0.235	0.629
Latency	0.3 ± 0.5	0.4 ± 0.6	0.3 ± 0.5	0.7 ± 0.7	0.5 ± 0.7	0.5 ± 0.6	0.5 ± 0.5	0.6 ± 0.7	0.4 ± 0.6	0.9 ± 0.8	0.6 ± 0.7	0.6 ± 0.7	**0.004**	**0.000**	0.131	0.742	0.827	**0.017**	0.982
Duration	0.0 ± 0.0	0.0 ± 0.2	0.1 ± 0.2	0.1 ± 0.3	0.1 ± 0.4	0.0 ± 0.3	0.0 ± 0.0	0.0 ± 0.3	0.0 ± 0.1	0.0 ± 0.2	0.0 ± 0.2	0.0 ± 0.3	0.221	0.242	0.719	0.492	0.964	0.515	0.347
Efficiency	0.0 ± 0.0	0.1 ± 0.4	0.2 ± 0.4	0.1 ± 0.5	0.2 ± 0.5	0.1 ± 0.2	0.2 ± 0.4	0.1 ± 0.4	0.1 ± 0.3	0.2 ± 0.4	0.1 ± 0.4	0.1 ± 0.3	0.384	0.549	0.272	0.962	0.151	0.201	0.231
Disturb.	0.9 ± 0.8	1.2 ± 0.6	1.3 ± 0.6*	1.3 ± 0.6	1.2 ± 0.6	1.1 ± 0.5	1.5 ± 0.7	1.3 ± 0.6	1.4 ± 0.6	1.5 ± 0.8	1.3 ± 0.6	1.6 ± 0.5**	**0.000**	0.262	0.353	0.846	**0.031**	0.151	**0.029**
DDysf.	0.3 ± 0.6	0.5 ± 0.7	0.4 ± 0.8	0.5 ± 0.7	0.6 ± 0.7	0.6 ± 0.7	0.5 ± 0.6	0.4 ± 0.5	0.5 ± 0.7	0.4 ± 0.5	0.5 ± 0.6	0.5 ± 0.6	0.643	0.186	0.678	0.116	0.360	0.836	0.673
Global PSQI	2.0 ± 2.0	2.9 ± 1.9	2.6 ± 1.9	3.8 ± 2.3	3.2 ± 2.0	3.0 ± 1.8	3.3 ± 1.8	3.2 ± 1.8	3.0 ± 1.8	4.0 ± 2.4	3.4 ± 1.8	3.6 ± 2.0	**0.001**	**0.000**	0.629	0.251	0.307	**0.044**	0.315

Mean ± DS. Level of significance p<0.05; * p <0.05 vs. 1er tercil of physical activity level. ** p <0.05 vs. 2nd tercil of physical activity level.

PA=Phisical Activity. PA levels: 1st tertil. low PA; 2nd tertil. medium PA; 3rd tertil. high PA. Disturb.=Disturbance; DDysf=Daytime dysfunction. Global PSQI=Total Pittsburgh Sleep Quality Index scores. MS=maturational stage.

Discussion

The current research examined how physical activity and sleep are connected among children. It also analyzed the mediation of sex and growth maturation on this connection. The main findings were that physical activity influences children's sleep in such a way that, mainly in middle childhood, the greater the physical activity, the better the quality of sleep and less latency. Physical activity and sports had been related to bringing benefits to the quality of sleep and life of children and adolescents (13). Nevertheless, is in adolescents where the promotion of sleep by physical activity has been wide more studied and evidenced since this line of research has been less developed in children. Our findings are in the same line as those of Afonso A. et al. (2022) (18) who recently found that children who accumulated at least 60 min of physical activity and sports per day went to bed earlier and had more sleep duration. The same study observed that children who participated in or competed in sports presented better sleep efficiency. The cause behind the clearer association between exercise and sleep quality in adolescents could be their greater growth maturation, which could let them carry out bigger amounts of exercise and consequently achieve bigger levels of fatigue than children (7–9). This maturation factor could be the reason why we found a stronger influence of physical activity on sleep in middle childhood than in early childhood.

The characteristics of discipline and social interaction promotion, in addition to high energy expenditure and physical conditioning could be factors triggering this positive association exercise-sleep in children, and this synergy seems to be highly beneficial for children's health by improving their body composition. This was constated by Stone et al. (2013), who observed that children who slept the least (<9h) were less active in terms of overall intensity than those attaining ≥ 10 h, and more were overweight/obese ($p<0.05$) (19). Other factors decisive in the healthy life of children such as screen time and sedentary behavior have been observed to play a transcendental role in this association between physical activity and sleep quality (20).

The observed improvement of sleep latency under the influence of regular physical activity in middle childhood is in line with those results found all around the bibliography according to the meta-analytic review of Kredlow et al. (2015) (21). The authors found that regular exercise had a small-to-medium beneficial effect on sleep onset latency indicating that individuals who participated in regular exercise training had significantly better sleep onset latency than individuals in control conditions. According to their results, this phenomenon happened specifically to younger individuals. The effect they found of regular exercise on sleep latency ($d = 0.75$), is comparable to the results of a meta-analysis of pharmacologic and behavioral therapy interventions for insomnia (Smith et al., 2002) (22): mean effect sizes derived from subjective

sleep diary data ranged from moderate to very large for sleep onset latency (pharmacotherapy d = 0.45, behavior therapy d = 1.05). The cause explaining this positive impact could be that the energy expenditure that physical activity implies could bring as a consequence higher levels of fatigue at the time to go to bed, which would accelerate the moment of sleep commencement.

Females showed worse sleep quality than males (p=0.001). Controversially with our results, some studies using self-reported methods observed that male children had worse sleep quality attending factors like shorter sleep duration (23–25) attributing those differences to social and nutritional factors. Nevertheless, other studies observed results along the same line as ours finding that female children were more likely to have poorer sleep quality (26), including shorter sleep duration (27), more difficulty waking up (28), higher daytime sleepiness (29), and more irregular sleep between a week and weekend nights (28). Causes of these sleep sex differences could be the higher internalization of problems that females experience during their youngness (30). The way females assumed the social role assigned to them and perhaps their greatest concern for being accepted by their peers (31) could affect their sleep more than it does in their counterparts. Anyway, the different results observed on how sleep health in childhood is affected by gender make the need for future studies to explore and understand the underlying factors that contribute to these gender differences. This could involve examining potential biological, social, and environmental influences that may affect sleep health in boys and girls differently, as well as investigating any potential cultural or societal factors that may contribute to these disparities. Additionally, future studies could aim to identify effective interventions or strategies for improving sleep health in both boys and girls, with a particular focus on addressing any gender-specific challenges or barriers that may be present. Ultimately, a better understanding of the gender-specific factors affecting sleep health in childhood could have important implications for promoting healthy sleep habits and overall well-being in children of all genders.

We observed better sleep quality in total punctuation in early childhood than in middle childhood. The explanation for these differences could be the hormonal com-ponent of growth maturation. Sex hormones, estrogen and progesterone primarily in females and testosterone mostly in males, have been detected to have a certain influence on sleep quality (11). Their levels change at different stages of life, with significant in-creases happening during puberty. Typically, males start puberty between the ages of 9 to 14 years, while females start between 8 to 12 years old. It takes around 3 to 4 years for both sexes to reach full maturity after puberty begins (32). As it can be noted, the ages of hormonal influence match in some way with the second maturational stage analyzed in this study. This coincidence could explain the maturational stage differences in children's sleep quality. Also, the earlier hormonal influence in females could be re cause behind the sex differences observed.

This study has remarkable strengths, such as (1) the considerable size of its sample, which is a guarantee of the validity of the results obtained, and (2) the recruitment of individuals from a big amount of different primary schools, which allows the knowledge of the sleep and physical habits from a big region's childhood. However, certain limitations can be taken into consideration. First, we did not consider other potential confounders in the analyses such as training schedules, nutrition, or screen time. Second, one might object that no objective activity or sleep data were collected. How-ever, there is evidence that subjective sleep data from sleep quality fit well with sleep-electroencephalography recordings (33) and the tools here used to assess sleep quality are validated and supported.

Conclusion

The analysis of the interaction between physical activity and sleep quality in a big sample of primary school children shows that physical activity has a positive effect. Specifically, during middle childhood, greater physical activity is associated with better sleep quality and less sleep latency. Additionally, this study found that sleep quality is generally better in males than in females and is also better in early than middle childhood. Parents should be aware of all the factors that can affect a child's ability to have a good night's sleep. Therefore, educational and health institutions need to establish evidence-based guidelines that are appropriate and up to date in promoting healthy sleep habits in children. Also, educational institutions should promote or improve the implementation of physical activity in the school context in other to benefit children's sleep quality and, hence, improve their quality of life and well-being.

References

1) Matricciani L, Paquet C, Galland B, Short M, Olds T. Children's sleep and health: A meta-review. Sleep Med Rev. 2019 Aug;46:136–50.
2) Rana M, Riffo Allende C, Mesa Latorre T, Rosso Astorga K, Torres AR. [Sleep in children: physiology and update of a literature review]. Medicina (B Aires). 2019;79 Suppl 3:25–8.
3) Matricciani L, Olds T, Petkov J. In search of lost sleep: Secular trends in the sleep time of school-aged children and adolescents. Sleep Medicine Reviews [Internet]. 2012 Jun [cited 2023 Feb 26];16(3):203–11. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1087079211000347
4) Gruber R, Carrey N, Weiss SK, Frappier JY, Rourke L, Brouillette RT, et al. Position statement on pediatric sleep for psychiatrists. J Can Acad Child Adolesc Psychiatry. 2014 Sep;23(3):174–95.
5) Owens JA, Weiss MR. Insufficient sleep in adolescents: causes and consequences.

Minerva Pediatr [Internet]. 2017 Jun [cited 2022 May 11];69(4). Available from: https://www.minervamedica.it/index2.php?show=R15Y2017N04A0326

6) Fabbri M, Beracci A, Martoni M, Meneo D, Tonetti L, Natale V. Measuring Subjective Sleep Quality: A Review. IJERPH [Internet]. 2021 Jan 26 [cited 2022 May 13];18(3):1082. Available from: https://www.mdpi.com/1660-4601/18/3/1082

7) Master L, Nye RT, Lee S, Nahmod NG, Mariani S, Hale L, et al. Bidirectional, Daily Temporal Associations between Sleep and Physical Activity in Adolescents. Sci Rep [Internet]. 2019 Dec [cited 2022 May 13];9(1):7732. Available from: http://www.nature.com/articles/s41598-019-44059-9

8) Rosa CC, Tebar WR, Oliveira CBS, Farah BQ, Casonatto J, Saraiva BTC, et al. Effect of Different Sports Practice on Sleep Quality and Quality of Life in Children and Adolescents: Randomized Clinical Trial. Sports Med - Open [Internet]. 2021 Dec [cited 2022 May 13];7(1):83. Available from: https://sportsmedicine-open.springeropen.com/articles/10.1186/s40798-021-00376-w

9) Lang C, Kalak N, Brand S, Holsboer-Trachsler E, Pühse U, Gerber M. The relationship between physical activity and sleep from mid adolescence to early adulthood. A systematic review of methodological approaches and meta-analysis. Sleep Medicine Reviews [Internet]. 2016 Aug [cited 2022 May 13];28:32–45. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1087079215000957

10) Mong JA, Cusmano DM. Sex differences in sleep: impact of biological sex and sex steroids. Phil Trans R Soc B [Internet]. 2016 Feb 19 [cited 2022 May 17];371(1688):20150110. Available from: https://royalsocietypublishing.org/doi/10.1098/rstb.2015.0110

11) Elkhatib Smidt SD, Hitt T, Zemel BS, Mitchell JA. Sex differences in childhood sleep and health implications. Annals of Human Biology [Internet]. 2021 Aug 18 [cited 2022 May 16];48(6):474–84. Available from: https://www.tandfonline.com/doi/full/10.1080/03014460.2021.1998624

12) Balasundaram P, Avulakunta ID. Human Growth and Development. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 [cited 2023 Feb 27]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK567767/

13) Beunen GP, Rogol AD, Malina RM. Indicators of Biological Maturation and Secular Changes in Biological Maturation. Food Nutr Bull [Internet]. 2006 Dec [cited 2023 Feb 27];27(4_suppl5):S244–56. Available from: http://journals.sagepub.com/doi/10.1177/15648265060274S508

14) Macías-Fernández, J.A., Royuela-Rico. La versión española del Índice de Calidad de Sueño de Pittsburgh. Inf Psiquiatr. 1996;146:465–72.

15) Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. Psychiatry Research [Internet]. 1989 May [cited 2022 May 11];28(2):193–213. Available from: https://linkinghub.elsevier.com/retrieve/pii/0165178189900474

16) Manchola-González J, Bagur-Calafat C, Girabent-Farrés M. Fiabilidad de la versión española del Cuestionario de actividad física PAQ-C / Reliability of the Spanish Version of Questionnaire of Physical Activity PAQ-C. rimcafd [Internet]. 2017 [cited 2023 Feb 28];65(2017). Available from: https://revistas.uam.es/rimcafd/article/view/7364

17) Ramirez Pastore L, Gotz S, Riera J, Pastore B, Vera N, Castaño L, et al. Nivel de

actividad física y estado nutricional en una población pediátrica de un consultorio ambulatorio Asunción. Pediatr (Asunción) [Internet]. 2020 Mar 3 [cited 2023 Mar 11];47(1):11–6. Available from: https://revistaspp.org/index.php/pediatria/article/view/527

18) Afonso A, Jacinto G, Infante P, Engana T. Primary School Children's Sleep Habits: Association with Socioeconomic Factors and Physical Activity Habits. Children [Internet]. 2022 Jun 28 [cited 2023 Mar 2];9(7):965. Available from: https://www.mdpi.com/2227-9067/9/7/965

19) Stone MR, Stevens D, Faulkner GEJ. Maintaining recommended sleep throughout the week is associated with increased physical activity in children. Preventive Medicine [Internet]. 2013 Feb [cited 2023 Mar 2];56(2):112–7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0091743512005920

20) Saunders TJ, Gray CE, Poitras VJ, Chaput JP, Janssen I, Katzmarzyk PT, et al. Combinations of physical activity, sedentary behaviour and sleep: relationships with health indicators in school-aged children and youth. Appl Physiol Nutr Metab [Internet]. 2016 Jun [cited 2022 May 13];41(6 (Suppl. 3)):S283–93. Available from: http://www.nrcresearchpress.com/doi/10.1139/apnm-2015-0626

21) Kredlow MA, Capozzoli MC, Hearon BA, Calkins AW, Otto MW. The effects of physical activity on sleep: a meta-analytic review. J Behav Med [Internet]. 2015 Jun [cited 2023 Mar 3];38(3):427–49. Available from: http://link.springer.com/10.1007/s10865-015-9617-6

22) Smith MT, Perlis ML, Park A, Smith MS, Pennington J, Giles DE, et al. Comparative Meta-Analysis of Pharmacotherapy and Behavior Therapy for Persistent Insomnia. AJP [Internet]. 2002 Jan [cited 2023 Mar 3];159(1):5–11. Available from: http://psychiatryonline.org/doi/abs/10.1176/appi.ajp.159.1.5

23) Bagley EJ, Kelly RJ, Buckhalt JA, El-Sheikh M. What keeps low-SES children from sleeping well: the role of presleep worries and sleep environment. Sleep Medicine [Internet]. 2015 Apr [cited 2023 Mar 1];16(4):496–502. Available from: https://linkinghub.elsevier.com/retrieve/pii/S138994571400481X

24) Magriplis E, Farajian P, Panagiotakos DB, Risvas G, Zampelas A. The relationship between behavioral factors, weight status and a dietary pattern in primary school aged children: The GRECO study. Clinical Nutrition [Internet]. 2019 Feb [cited 2023 Mar 1];38(1):310–6. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0261561418300165

25) Biggs SN, Lushington K, James Martin A, van den Heuvel C, Declan Kennedy J. Gender, socioeconomic, and ethnic differences in sleep patterns in school-aged children. Sleep Medicine [Internet]. 2013 Dec [cited 2023 Mar 1];14(12):1304–9. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1389945713010897

26) 26. Pano-Rodríguez A, Beltrán-Garrido JV, Hernández-González V, Bueno-Antequera J, Oviedo-Caro MA, Mayolas-Pi C, et al. Sleep quality is mediated by physical activity level in adolescents. J Sports Med Phys Fitness [Internet]. 2023 Feb [cited 2023 Mar 11]; Available from: https://www.minervamedica.it/index2.php?show=R40Y9999N00A23022003

27) Nuutinen T, Ray C, Roos E. Do computer use, TV viewing, and the presence of the media in the bedroom predict school-aged children's sleep habits in a longitudinal study? BMC Public Health [Internet]. 2013 Dec [cited 2023 Mar 1];13(1):684.

Available from: http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-13-684

28) Garmy P, Clausson EK, Nyberg P, Jakobsson U. Insufficient Sleep Is Associated with Obesity and Excessive Screen Time Amongst Ten-Year-Old Children in Sweden. Journal of Pediatric Nursing [Internet]. 2018 Mar [cited 2023 Mar 1];39:e1–5. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0882596317302919

29) Gaina A, Sekine M, Hamanishi S, Chen X, Wang H, Yamagami T, et al. Daytime Sleepiness and Associated Factors in Japanese School Children. The Journal of Pediatrics [Internet]. 2007 Nov [cited 2023 Mar 1];151(5):518-522.e4. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0022347607003824

30) Bor W, Dean AJ, Najman J, Hayatbakhsh R. Are child and adolescent mental health problems increasing in the 21st century? A systematic review. Aust N Z J Psychiatry [Internet]. 2014 Jul [cited 2022 May 17];48(7):606–16. Available from: http://journals.sagepub.com/doi/10.1177/0004867414533834

31) Guyer AE, Caouette JD, Lee CC, Ruiz SK. Will they like me? Adolescents' emotional responses to peer evaluation. International Journal of Behavioral Development [Internet]. 2014 Mar [cited 2022 May 17];38(2):155–63. Available from: http://journals.sagepub.com/doi/10.1177/0165025413515627

32) Abreu AP, Kaiser UB. Pubertal development and regulation. The Lancet Diabetes & Endocrinology [Internet]. 2016 Mar [cited 2022 May 17];4(3):254–64. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2213858715004180

33) de la Vega R, Tomé-Pires C, Solé E, Racine M, Castarlenas E, Jensen MP, et al. The Pittsburgh Sleep Quality Index: Validity and factor structure in young people. Psychological Assessment [Internet]. 2015 Dec [cited 2022 May 13];27(4):e22–7. Available from: http://doi.apa.org/getdoi.cfm?doi=10.1037/pas0000128

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PARTE IV- DISCUSIÓN GENERAL Y CONCLUSIONES

4 DISCUSIÓN

La presente tesis de Doctoral proporcionó información sobre las relaciones de hábitos saludables en diferentes grupos de población, por lo tanto, se pretende generar nuevos conocimientos sobre las relaciones que se establecen entre diferentes hábitos saludables y aporta nuevas evidencias que ponen de manifiesto su importancia a lo largo de todo el ciclo de la vida.

Artículo 1. Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university.

A la luz de los datos obtenidos y de los diferentes estudios publicados tanto en el ámbito nacional como internacional, la Universidad, en muchas ocasiones, no tiene el papel significativo en cuanto a potenciar y promover estilos de vida sanos y abandono de estilos nocivos para la salud (Brotons & Ribera, 2000; Martínez-Pastor et al., 2009). Uno de los principales problemas de los estudiantes universitarios es el consumo excesivo de alcohol, que ha sido descrito por varios autores. (El Ansari et al., 2013; Mc Camridge et al., 2013). En nuestro estudio, la mayoría de los estudiantes consumían alcohol, no existiendo diferencias significativas entre hombres y mujeres. Los resultados encontrados muestran una tendencia ya estudiada por otros autores (Martínez-Pastor et al., 2009; Mantilla-Toloza et al., 2011; Castañeda-Vázques et al., 2014).

De igual modo, los resultados mostraron como el consumo de tabaco era una conducta habitual entre un porcentaje significativo de estudiantes. A pesar de que la prevalencia de consumo de tabaco ha disminuido en los países desarrollados, continúa siendo el factor de riesgo susceptible de ser prevenido y que más enfermedad y muerte causa en el mundo (Global Burden, 2018). Los resultados reportados por diferentes investigaciones muestran que las campañas de prevención en este tipo de población son difíciles e insuficientes, por lo que es importante seguir investigando sobre líneas de actuación y su eficacia para el control del tabaquismo a la edad más temprana posible (Chen et al., 2004; Morrel et al., 2005; Abellán, 1995).

Otra de las variables estudiadas fue la práctica regular de actividad física. Las guías actuales sobre actividad física recomiendan que los adultos de entre 18 y 64 años deberían acumular un mínimo de 150 minutos semanales de AF aeróbica moderada o 75 minutos semanales de AF aeróbica vigorosa (o la combinación equivalente de ambas) (OMS, 2020). El presente estudio mostro que los estudiantes universitarios fueron regularmente activos y que, de estos, un gran porcentaje tenía un alto nivel de AF. Resultados similares a los encontrados en otras investigaciones (Pavón-Lores et al., 2008; Castañeda-Vásquez et al., 2022).

La práctica de AF tuvo diferencias estadísticamente significativas entre sexos. Este es un patrón constante, ya que la actividad física es uno de los pocos comportamientos relacionados con la salud que suele ser más frecuente en los hombres que en las mujeres (Rodríguez et al., 2013; Romaguera et al., 2011). En este sentido, se deben promover actividades que motiven a los universitarios a adherirse a la práctica de AF, y en esta línea, cada vez es más habitual hablar de transporte activo como una opción que se puede utilizar regularmente durante la semana (Solland, Egset & Nordfjaern, 2019), lo que puede ser una oportunidad útil para garantizar que los estudiantes realicen una actividad física adecuada durante el día (Özil et al., 2020; Solland, Egset & Nordfjaern, 2019). El transporte no motorizado, como caminar y desplazarse en bicicleta, y otros modos activos, como los scooters no eléctricos, son ejemplos del transporte activo (Özil et al., 2021; Solland, Egset & Nordfjaern, 2019; Molina-García et al., 2014; Parras-Saldías et al., 2019). En nuestro estudio, la mayoría de los estudiantes se mueven de forma activa, ya sea a pie, en bicicleta o en cualquier otro medio de transporte, siendo las mujeres las que lo hacen con mayor frecuencia. Existe evidencia de que el desplazamiento activo al centro educativo (escuela, instituto, universidad, etc.) es una oportunidad para aumentar los niveles de AF en los jóvenes y prevenir o mitigar el aumento de peso corporal. (Segura-Díaz et al., 2015; Villa-González et al., 2012; Chillón et al., 2016; Molina-García et al, 2014; Solland Egset & Nordfjaern, 2019; Molina-García et al., 2014; Parras-Saldías et al., 2019). Una de las principales razones encontradas en este estudio para la alta movilidad en bicicleta son las características orográficas de Lleida, que es una ciudad pequeña y sin desniveles importantes, por lo que no es necesario recorrer grandes distancias para llegar a ningún sitio. En consecuencia, algunos autores se han planteado desarrollar estrategias basadas en modelos socioecológicos (Sallis et al., 2009; Chen & Hsu, 2020: Teuber & Sudeck, 2021), actuaciones en relación con el diseño urbano, los sistemas de transporte o los recursos para la recreación y los espacios verdes.

Otra variable estudiada fue la ingesta de frutas y verduras. Los resultados mostraron un bajo consumo de estos alimentos. Siguiendo las recomendaciones de las guías alimentarias para la población española (Montagnese et al., 2015; NAOS, 2015), que sugieren el consumo diario de frutas y verduras, los alumnos de la UDL siguen estando muy por debajo de las cifras establecidas. (NAOS, 2015).

Estos resultados muestran una progresiva pérdida de adherencia a la dieta mediterránea, caracterizada por un alto consumo de verduras y un abundante consumo de frutas frescas, ya que ningún alumno consumía.

Los estudiantes universitarios son una población clave para realizar actividades de promoción

y prevención de la salud, por lo que es necesario crear planes estratégicos de educación que mejoren la calidad de vida y promuevan la adquisición de buenos hábitos alimentarios y la realización de AF.

Artículo 2. Physical activity from cycling and effects on the Mediterranean Diet. Project: ASISA

En el presente estudio, evaluamos la relación entre los desplazamientos en bicicleta y la adherencia a la Dieta Mediterránea (DM) entre la población adulta que trabaja o estudia en un entorno urbano denso del Mediterráneo. Los resultados del presente estudio con sujetos inactivos y ciclistas proporcionaron datos confirmatorios y novedosos: la mayoría de los sujetos presentaban una adherencia a la dieta mediterránea deficiente, mientras que el desplazamiento en bicicleta se asoció con una mejor adherencia a la dieta mediterránea.

Muchos estudios sobre los desplazamientos activos combinan caminar y andar en bicicleta (por ejemplo, Abu-Omar & Rutten, 2008; Bassett et al., 2008; Lindström, 2008; Gordon-Larsen et al., 2009). Estos estudios han demostrado que los desplazamientos activos reducen el riesgo de eventos cardiovasculares, diabetes tipo 2, hipertensión y adiposidad, y mejora la condición física. Sin embargo, dado que los desplazamientos en bicicleta suelen ser de mayor intensidad fisiológica que caminar (Oja et al., 1991), es probable que este tipo de beneficios para la salud puedan ser mucho mayores**.**

Los resultados obtenidos refuerzan enérgicamente los datos de estudios recientes que sugieren que existe una deficiente adherencia a la dieta mediterránea en la población española, asociada al escaso consumo de aceite de oliva, verduras, frutas y pescado (Mayolas-Pi et al., 2017; Vila-Martí et al., 2020). La disminución de la adherencia a la DM implica una gran inquietud, puesto que abandono de la DM conduce a un mayor consumo de lípidos saturados (en su mayoría derivados de la carne y los productos lácteos) y azúcar, y a una disminución del consumo de carbohidratos complejos (p. ej., cereales y legumbres), que aumentan el riesgo de enfermedades (CIHEAM/FAO, 2015; Cavaliere et al., 2023).

Complementariamente, el uso de la bicicleta para los desplazamientos urbanos ofrece múltiples beneficios para la salud, especialmente como alternativa al sedentarismo (Crane et al., 2014; Javadpoor et al., 2023). Investigar la asociación entre los factores de riesgo conductuales podría ayudar en el desarrollo de campañas preventivas más efectivas en salud pública (Crane et al., 2014). En particular, es importante comprender cómo se relacionan la dieta y la actividad física, especialmente en los países mediterráneos como España, donde existe una baja actividad diaria moderada.

Mejorar los estilos de vida de la población podría ser una forma efectiva de promover campañas integrales de salud pública que fomenten comportamientos activos y nutricionales. Estas mejoras

incluyen una mayor claridad en la descripción de los beneficios para la salud del uso de la bicicleta (Oja et al., 2011). El ciclismo puede contribuir al desarrollo físico y salud mental y bienestar entre la población adulta. Proporciona una forma de participar con el ambiente exterior y actividades cotidianas (Black & Street, 2014). Programas de promoción de la bicicleta: como mejoras en los carriles bici, y eventos promocionales, junto con el crecimiento en la disponibilidad de asistencia tecnologías como bicicletas eléctricas podría ayudar a fomentar el uso diario de la bicicleta (Black & Street, 2014).

Se debería fomentar cada vez más la adopción de un patrón dietético de tipo mediterráneo, combinado con desplazamientos activos.

Artículo 3. Effectiveness of a Physical Activity intervention Programme on the Integral Health of University Professors

En las mujeres con los años se produce una disminución de la producción de hormonas reproductivas, especialmente estrógeno. Durante este período, las mujeres experimentan cambios hormonales significativos que pueden tener un impacto en su salud y bienestar. La salud de las mujeres está influenciada por una variedad de factores, entre los cuales la actividad física, la condición física y la dieta desempeñan un papel crucial. La falta de actividad física y la disminución de la condición física, en adultos mayores, son comunes en esta etapa de la vida y están asociadas con un mayor riesgo de desarrollar enfermedades crónicas, como enfermedades cardiovasculares, osteoporosis y obesidad (Soares & Zitek, 2008)

El objetivo de este estudio fue evaluar la efectividad a corto y medio plazo de un programa de ejercicio de 3 meses, así como investigar si la adherencia al programa se relaciona con la adherencia a la dieta mediterránea (ADM), mejoras en los marcadores bioquímicos y mejoras en la condición física. Nuestros resultados demuestran que el programa de ejercicio de 3 meses mejoró la adherencia a la actividad física y a la dieta mediterránea, así como la condición física, tanto en el período posterior a la intervención como durante los meses siguientes.

Es sabido que la práctica regular de ejercicio y una dieta equilibrada son recomendaciones importantes para mejorar la salud y la calidad de vida de los adultos mayores (Gómez-Cabello et al., 2018).

Estudios previos han demostrado que los programas de ejercicio en adultos pueden mejorar varios parámetros relacionados con la condición física (Bullo et al., 2015; Lesinski et al., 2015; Martins et al., 2013). Sin embargo, son escasos los estudios longitudinales que investigan los efectos a largo plazo de estos programas (Grandes et al., 2011). Nuestros hallazgos revelan cambios significativos en la adherencia al programa, la adherencia a la dieta mediterránea y la condición física, lo que sugiere que los programas de ejercicio pueden ser efectivos en la promoción de hábitos saludables a largo plazo en adultos mayores.

El IMC normal de los ancianos está asociado con mejoras significativas en la calidad de vida, la función física y la salud (Page et al., 2019). En nuestro análisis, no encontramos cambios estadísticamente significativos en el IMC. Nuestros resultados estarían en la línea de los encontrados por Grosso et al., (2014), y difieren de otros estudios previos que reportaron ligeros descensos (Nelson et al., 1994; Barrea et al., 2019; Shimizu et al., 2022; Kim et al., 2022). A pesar

de este hallazgo, observamos cómo mejoraba la ingesta dietética después del programa. La mayoría de los participantes tenían una adherencia a la dieta mediterránea moderada o alta en ambas mediciones posteriores (T1 y T2). La dieta mediterránea es un patrón de alimentación que se basa en cocina tradicional y hábitos alimentarios de los países mediterráneos, como España, Grecia e Italia. Se ha demostrado que esta dieta puede tener numerosos beneficios para la salud, incluyendo la prevención de enfermedades cardiovasculares, la reducción del riesgo de diabetes tipo 2 y la mejora de la salud cognitiva (Dussaillant et al., 2016; Vinaccia Alpi et al., 2019).

Al combinar la dieta mediterránea con la actividad física regular, se puede lograr una intervención a largo plazo aún más efectiva que realizándola sobre un solo elemento. Combinar esta intervención puede tener beneficios significativos para la salud, como la mejora de la condición cardiovascular, la reducción del riesgo de enfermedades crónicas y el mantenimiento de un peso saludable. (Dussaillant et al., 2016).

No cabe duda de que el cuidado general de nuestra salud contribuye al retraso del envejecimiento (Scarmeas et al., 2014), al aumento de la esperanza de vida (De la Montaña Miguelez et al., 2009), pero estos resultados son significativamente mejores siembre que utilizamos un programa sistematizado de actividad física y una buena dieta mediterránea.

Nuestros resultados sugieren que las mejoras en la condición física podrían estar asociadas con mejoras en la adherencia a la dieta mediterránea. Al analizar la ingesta de alimentos, encontramos que las mejoras en la AF se asociaron con un mayor consumo de frutas y verduras y una disminución de la ingesta de carnes rojas y bollería. Estos resultados son consistentes con estudios previos que han demostrado una relación positiva entre la actividad física y el aumento en la ingesta de frutas y verduras (Conklin et al., 2014; Mäkinen et al., 2012).

Observamos que después del ejercicio, los participantes mostraron una mejora en los triglicéridos en sangre. Los participantes mostraron un colesterol LDL reducido y un colesterol HDL ligeramente reducido después del programa. El metaanálisis de Rees et al., (2019) observo poco o ningún efecto sobre el colesterol LDL y HDL así como los triglicéridos. Estos hallazgos pueden ser relevantes desde una perspectiva práctica, especialmente en la prevención de enfermedades coronarias en mujeres adultas (Kheirat et al., 2018).

Nuestros resultados con respecto al colesterol total, que fue elevado en todas las mediciones, son consistentes con estudios previos que encontraron tendencias similares (Kheirat et al., 2018; Rodríguez et al., 2018).

Varios trabajos han sugerido que la menopausia podría estar asociada con un mayor riesgo cardiovascular en las mujeres como consecuencia de una deficiencia de hormonas cardioprotectoras y estrógenos (Lisabeth et al., 2012; Libby, 2009). En este sentido, todas las participantes eran posmenopáusicas, lo que podría estar relacionado con la falta de cambio en el colesterol total después del programa.

En resumen, la actividad física, la condición física y la dieta desempeñan un papel fundamental en la salud de las mujeres adultas. Mantenerse activas, mantener una buena condición física y seguir una dieta equilibrada y saludable puede ayudar a prevenir enfermedades crónicas y mejorar la calidad de vida durante esta etapa de la vida. Es importante fomentar la conciencia y la adopción de hábitos saludables en las mujeres, especialmente posmenopáusicas, así como proporcionarles recursos y apoyo para lograr una vida saludable y activa.

Artículo 4. Physical Activity and Sleep Quality in Primary School children: mediation of sex and maturational stage.

El presente estudio tuvo como objetivo determinar la mediación del sexo y el grado de madurez en la asociación entre la actividad física y la calidad del sueño en niños de educación primaria. Los principales hallazgos fueron que la actividad física se relaciona con en el sueño de los niños de tal manera que, principalmente en la infancia media, a mayor actividad física, mejor calidad del sueño y menor latencia. Números trabajos han relacionado positivamente la práctica de actividad física con la calidad del sueño, así como con una mejora de la calidad de vida de niños y adolescentes (Lang et al., 2016; Beunen et al., 2006; Brand et al., 2010; Lian et al., 2018). Nuestros hallazgos están en la misma línea que los de Afonso et al., (2022) quienes recientemente encontraron que los niños que acumulaban al menos 60 min de actividad física y deportes por día se acostaban más temprano y tenían más duración del sueño. En esta misma línea, los estudios de Philbrook & El-Sheikh, (2016) y Lian et al., (2018) demostraron una asociación positiva entre aquellos jóvenes que practicaban actividad física y la calidad del sueño, concretamente dormían más tiempo.

La causa detrás de la asociación más clara entre el ejercicio y la calidad del sueño en los adolescentes podría ser su mayor madurez de crecimiento, lo que podría permitirles realizar una mayor cantidad de ejercicio y, en consecuencia, alcanzar mayores niveles de fatiga que los niños (Master et al., 2019; Rosa et al., 2021; Lang et al., 2016). Este factor de maduración podría ser la razón por la que encontramos una mayor influencia de la actividad física sobre el sueño en la niñez intermedia que en la niñez temprana.

Las características de disciplina y promoción de la interacción social, además del alto gasto energético y el acondicionamiento físico podrían ser factores desencadenantes de esta asociación positiva ejercicio-sueño en los niños, y esta sinergia parece ser altamente beneficiosa para la salud de los niños al mejorar su composición corporal. Esto fue confirmado por Stone et al. (2013), quienes observaron que los niños que menos dormían (< 9h) eran menos activos en intensidad global que los que dormían ≥ 10 h, y más sobrepeso/obesidad ($p<0,05$). Se ha observado que otros factores determinantes en la vida saludable de los niños como el tiempo de pantalla y el sedentarismo juegan un papel trascendental en esta asociación entre la actividad física y la calidad del sueño (Saunders et al., 2016).

La mejora observada de la latencia del sueño bajo la influencia de la actividad física regular en la infancia media está en línea con los resultados encontrados en toda la bibliografía según la revisión metaanalítica de Kredlow et al. (2015). La causa que explica este impacto positivo podría ser que el

gasto energético que implica la actividad física podría traer como consecuencia mayores niveles de fatiga a la hora de acostarse, lo que aceleraría el momento del inicio del sueño.

Las niñas y niños mostraron peor calidad de sueño que los hombres. De manera controvertida con nuestros resultados, algunos estudios que utilizaron métodos autoinformados observaron que los niños varones tenían una peor calidad del sueño debido a factores como una menor duración del sueño (Bagley et al., 2015; Magriplis et al., 2019; Biggs et al., 2013), atribuyendo esas diferencias a factores sociales y nutricionales. Sin embargo, otros estudios observaron resultados en la misma línea que el nuestro y encontraron que las niñas tenían más probabilidades de tener una peor calidad del sueño (Pano-Rodríguez et al., 2023), incluida una menor duración del sueño (Nuutinen et al., 2013), más dificultad para despertarse (Garmy et al., 2018), mayor somnolencia diurna (Gaina et al., 2007), y sueño más irregular entre una semana y noches de fin de semana (Garmy et al., 2018). Las causas de estas diferencias de sexo en el sueño podrían ser la mayor internalización de los problemas que experimentan las mujeres durante su juventud (Bor et al., 2014). La forma en que las mujeres asumían el rol social que se les asignaba y quizás su mayor preocupación por ser aceptadas por sus pares (Guyer et al., 2014) podría afectar su sueño más que en sus contrapartes.

De todos modos, los diferentes resultados observados sobre cómo la salud del sueño en la infancia se ve afectada por el género hacen necesario que futuros estudios exploren y comprendan los factores subyacentes que contribuyen a estas diferencias de género.

Limitaciones y fortalezas

Artículo 1 Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university.

Una de las principales limitaciones de este estudio es que los datos relacionados con el consumo de alcohol fueron autoinformados y esto significa que, aunque los datos son fiables, podrían estar sesgados a pesar de haber contestado el cuestionario de forma anónima. Tampoco se recogieron datos socioeconómicos que pudieran sesgar los resultados. Otro aspecto limitador fue que este estudio recogió datos de una sola universidad, por lo que la generalización de los resultados es limitada a nivel geográfico. Sin embargo, es fundamental poder detectar precozmente el consumo de riesgo para modificar los patrones de consumo en una población tan vulnerable a sus efectos. Intervenir a la población universitaria en riesgo puede aportar importantes beneficios, no solo en términos académicos sino en futuras patologías derivadas del consumo de alcohol y tabaco. Entre las fortalezas del estudio, encontramos (1) la representatividad de la muestra, todas las facultades de la Universidad de Lleida participaron del estudio, (2) el tamaño de la muestra, que es una garantía de validez de los resultados.

Artículo 2. Physical activity from cycling and effects on the Mediterranean Diet. Project: ASISA

Algunas limitaciones en nuestro estudio deben ser consideradas. En primer lugar, este estudio se realizó en una sola ciudad. Por lo tanto, la generalización de nuestros hallazgos está geográficamente limitada. En segundo lugar, utilizamos un diseño transversal, que excluye cualquier suposición sobre la causalidad. Finalmente, los datos se obtuvieron mediante entrevistas y cuestionarios, los cuales son susceptibles de sesgo de información. Este estudio también tiene varios puntos fuertes. El estudio tiene una alta validez interna, con una buena representación de los desplazamientos en bicicleta. Además, la muestra de ciclistas era grande y completa, lo que mejora la representatividad de la población de Lleida, España. Finalmente, nuestro estudio en una ciudad del sur de Europa ha añadido evidencia a un tema novedoso, relevante para la sostenibilidad de las ciudades mediterráneas y la calidad de vida de los habitantes.

Artículo 3. Effectiveness of a Physical Activity intervention Programme on the Integral Health of University Professors

Los autores asumieron algunas limitaciones en el diseño de este estudio. El tamaño de la muestra fue relativamente pequeño, se necesitan más estudios y con más muestra. Los resultados del presente

estudio son representativos de una población de mujeres sedentarias de entre 60 y 63 años, por lo que no podrían extrapolarse a adultos activos, jóvenes o adultos mayores, incluidos aquellos con enfermedades agudas o crónicas. Como fortaleza es un trabajo experimental con una duración considerable, además de realizar un seguimiento de la adherencia meses más tarde, lo que le da una consistencia importante al trabajo.

Artículo 4. Physical Activity and Sleep Quality in Primary School children: mediation of sex and maturational stage.

Este estudio tiene fortalezas destacables, como (1) el considerable tamaño de su muestra, que es garantía de la validez de los resultados obtenidos, y (2) el reclutamiento de individuos de una gran cantidad de escuelas primarias diferentes, lo que permite el conocimiento de los hábitos físicos y de sueño de la infancia de una gran región. Sin embargo, se pueden tener en cuenta ciertas limitaciones. Primero, no consideramos otros posibles factores de confusión en los análisis, como los horarios de entrenamiento, la nutrición o el tiempo frente a la pantalla. En segundo lugar, se podría objetar que no se recopilaron datos objetivos de actividad o sueño. Sin embargo, el tamaño de la muestra y el ámbito territorial examinado hacen que el trabajo tenga una gran transcendencia para aplicar estrategias concretas en la población examinada.

5 CONCLUSIONES

Artículo 1 Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university.

- Un alto porcentaje de estudiantes consume alcohol con regularidad. No hay diferencias entre sexos. En cambio, el consumo de tabaco es mucho más moderado, siendo superior en las mujeres con respecto a los hombres.
- La gran mayoría de los estudiantes se mueven activamente, siendo ligeramente superior en mujeres con respecto a los hombres.
- Los jóvenes universitarios mostraron comportamientos alimentarios muy por debajo en cuanto al consumo de frutas y verduras de los recomendados por los diferentes organismos oficiales.

Artículo 2. Physical activity from cycling and effects on the Mediterranean Diet. Project: ASISA

- Nuestros resultados sugieren que, para ambos sexos, el ciclismo practicado de forma regular se relaciona positivamente con los niveles de adherencia a la dieta mediterránea.
- Las principales carencias, con el cumplimiento de las recomendaciones alimentarias para la población española, estaban asociadas al bajo consumo de frutos secos, frutas, pescado y legumbres.
- La mayoría de los ciclistas urbanos cumplen con las recomendaciones de practica de actividad física semanal según la Organización Mundial de la Salud.

Artículo 3. Effectiveness of a Physical Activity intervention Programme on the Integral Health of University Professors

- Un programa de ejercicio de 3 meses de 2 horas por semana aumenta los niveles de Actividad Física y condición física de los participantes.
- La adherencia a la Actividad Física disminuye a partir de los 6 meses después de realizar un programa de ejercicio físico.
- Un programa de ejercicio de 3 meses mejora la condición física, especialmente la fuerza, la velocidad, la agilidad y la resistencia, y esos indicadores se mantienen mejorados después de 6 meses.

- Un programa de actividad física desarrollado, mejoró todas las variables bioquímicas estudiadas excepto el colesterol total.
- Los aumentos en Actividad Física se asociaron con mejoras en la Adherencia a la dieta Mediterránea, y esta asociación se mantuvo en el tiempo.

Artículo 4. Physical Activity and Sleep Quality in Primary School children: mediation of sex and maturational stage.

- La interacción entre la actividad física y la calidad del sueño, en una amplia muestra de escolares de primaria, muestra que la actividad física tiene una asociación positiva.
- La calidad del sueño es generalmente mejor en los niños en edad escolar que en las niñas y también es mejor en la niñez temprana que en la intermedia.
- En la población de niños en edad escolar estudiada, durante la infancia media, una mayor actividad física se asocia con una mejor calidad del sueño y una menor latencia del sueño.

6 REFERENCIAS

Abellán AF. Hábitos asociados a enfermedades vasculares y variables de personalidad en la población universitaria de Murcia y Oviedo [tesis doctoral]. Departamento de Medicina. Universidad deMurcia;1995.

Abu-Omar, K. & Rutten, A. (2008). Relation of leisure time, occupational, domestic, and commuting physical activity to health indicators in Europe. Prev Med. 47: 319–323.

Afonso, A., Jacinto, G., Infante, P. & Engana, T. (2022). Primary School Children's Sleep Habits: Association with Socioeconomic Factors and Physical Activity Habits. Children, 9(7):965. https://www.mdpi.com/2227-9067/9/7/965

Agencia Española de Consumo, Seguridad Alimentaria y Nutrición. Evalua- ción y seguimiento de la estrategia NAOS: conjunto mínimo de indicadores. Madrid: Ministerio de Sanidad, Servicios Sociales e Igualdad; 2015.

Alvarez, G.G. & Ayas, N.T. (2004). The impact of daily sleep duration on health: a review of the literature. Prog Cariovasc Nurs. 19(2):56-9

Ariza, C., Nebot, M., Villalbí, J.R., Díez, E., Tomás, Z. & Valmayor, S. (2003). Tendencias en el consumo de tabaco, alcohol y cannabis en los escolares de Barcelona (1987–1999). GacSanit. 17:190–5.

Arslan, E., Can, S. & Demirkan, E. (2017). Effect of short-term aerobic and combined training program on body composition, lipids profile and psychological health in premenopausal women. Sci. Sports. 32: 106-113.

Bach-Faig, A., Berry, E.M., Lairon, D., Reguant, J., Trichopoulou, A., Dernini, S., Medina, F.X., Battino, M., Belahsen, R., Miranda, G.; et al. (2011). Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr. 14, 2274–2284.

Bagley, E.J., Kelly, R.J., Buckhalt, J.A. & El-Sheikh, M. (2015). What keeps low-SES children from sleeping well: the role of presleep worries and sleep environment. Sleep Medicine. 16(4):496–502. https://linkinghub.elsevier.com/retrieve/pii/S138994571400481X 359

Barber, L. (2014). Conceptualizations of sleep in stress theory: exciting new directions. Stress Health 30, 431–432. doi: 10.1002/smi.2598

Barrea, L., Muscogiuri, G., Di Somma, C., Tramontano, G., De Luca, V., Illario, M., Colao, A. & Savastano, S. (2019). Association between Mediterranean diet and hand grip strength in older adult women. Clin. Nutr. 38, 721–729.

Bassett, J., David, R., Pucher, J., Buehler, R., Thompson, D.L. & Crouter, S.E. (2008). Walking, cycling, and obesity rates in Europe, North America, and Australia. J Phys Act Health. 5: 795–814

Becerra-Tomas, N., Blanco Mejıa, S., Viguiliouk, E., Khan, T., Kendall, C.W.C., Kahleova, H, et al. (2020). Mediterranean diet, cardiovascular disease and mortality in diabetes: A systematic review and meta-analysis of prospective cohort studies and randomized clinical trials. Crit Rev Food Sci Nutr. 60:1207–27.

Beunen, G.P., Rogol, A.D. & Malina, R.M. (2006). Indicators of Biological Maturation and Secular Changes in Biological Maturation. Food Nutr Bull. 27(4):244–56.

Biggs, S.N., Lushington, K., James Martin, A., van den Heuvel, C., Kennedy, D.J. (2013). Gender, socioeconomic, and ethnic differences 363 in sleep patterns in school-aged children. Sleep Medicine. 14(12): 1304–9. https://linkinghub.elsevier.com/retrieve/pii/S1389945713010897 365

Black, P. & Street, E. (2014). The Power of Perceptions: Exploring the Role of Urban Design in Cycling Behaviours and Healthy Ageing. Transportation Research Procedia, 4; 68-79. https://doi.org/10.1016/j.trpro.2014.11.006

Bor, W., Dean, A.J., Najman, J. & Hayatbakhsh, R. (2014). Are child and adolescent mental health problems increasing in the 21st century? A systematic review. Aust N Z J Psychiatry. 48(7): 606–16. http://journals.sagepub.com/doi/10.1177/0004867414533834

Brand, S., Gerber, M., Beck, J., Hatzinger, M., Pühse, U. & Holsboer-Trachsler, E. (2010). High exercise levels are related to favorable sleep patterns and psychological functioning in adolescents: a comparison of athletes and controls. J Adolesc Health. 46:133e41.

Brotons Cuixart, C. & Ribera Solé, A. (2000). Factores de riesgo cardio- vascular en niños y adolescentes españoles. En: Plaza Pérez I, editor. Libro de la Sección de Cardiología Preventiva y Rehabilitación. Barcelona: Doyma; p.29–38.

Canto, E.G., Guillamon, A.R. & López, L.N. (2021). Nivel de actividad física, consumo habitual de tabaco y alcohol, y su relación con la calidad de vida en adolescentes españoles. *Retos: nuevas tendencias en educación física, deporte y recreación*, (39), 112-119.

Casajús J. A., & Vicente-Rodríguez, G. (2011). Ejercicio físico y salud en poblaciones especiales. Exernet. *Colección ICD*, 2172-2161

Caspersen, C.J., Powell, K.E. & Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 100:126e31.

Castañeda-Vázquez, C. & Romero-Granados, S. (2014). Alimentación y Consumo de Sustancias (alcohol, tabaco y drogas) del alumnado universitario. Análisis en función del género y la práctica de actividad físico-deportiva. *CCD.* 9:95-105. http://doi.org/bdt7.

Castelló, J.V. & Tubianosa, C. (2020). Linking Mediterranean Diet and Lifestyle with Cardio Metabolic Disease and Depressive Symptoms: A Study on the Elderly in Europe. Int. J. Environ. Res. Public Health 2020, 17, 7053.

Cavaliere, A., De Marchi, E., Nadia Frola, E., Benfenati, A., Aletti, G., Bacenetti, J., Banterle, A.. (2023). Exploring the environmental impact associated with the abandonment of the Mediterranean Diet, and how to reduce it with alternative sustainable diets. Ecological economics, 209, 107818. https://doi.org/10.1016/j.ecolecon.2023.107818

Chaput, J. P., & Dutil, C. (2016). Lack of sleep as a contributor to obesity in adolescents: impacts on eating and activity behaviors. Int. J. Behav. Nutr. Phys. Act. 13:103. doi: 10.1186/s12966-016-0428-0

Chen, X., Li, X., Stanton, B., Mao, R., Sun, Z., Zhang, H., et al. (2004). Patterns of cigarette smoking among students from 19 colleges and universities in Jiang-su Province, China: alatent class analysis. Drug Alcohol Depend. 76:153–63.

Chen, L.T. & Hsu, Y.W. (2020). Socio-ecological Predictors of frequent bike shar trips: Do purposes Matter?. International Journal of Environmental Research and Public Health, 17(20).

Chillón, P., Molina-García, J., Castillo, I. & Queralt, A. (2016). What distance do university students walk and bike dayly to class in Spain. *Journal of Transport & Health.* 3(3):315-20. http://doi.org/f88brh.

CIHEAM/FAO. (2015). Mediterranean Food Consumption Patterns: Diet, Environment, Society, Economy and Health. A White Paper Priority 5. Expo Milan 2015 Feeding Knowledge Programme. Rome: CIHEAM-Bari/FAO

Conklin, A.I., Forouhi, N.G., Suhrcke, M., Surtees, P., Wareham, N.J &, Monsivais, P. (2014). Variety more than quantity of fruit and vegetable intake varies by socioeconomic status and financial hardship. Findings from older adults in the EPIC cohort. Appetite. 83: 248-255

Crane, M., Rissel, C., Standen, C. & Greaves, S. (2014). Associations between the frequency of cycling and domains of quality of life. Health Promotion J Austr. 25(3): 182-185.

CSD. Plan Integral para la Actividad Física y el Deporte. 2010.

D'Amico, E.J., Rodríguez, A., Tucker, J. S., Dunbar, M.S., Pedersen, E. R., Shih, R. A. ... Seelam, R. (2020). Early and Late Adolescent Factors that Predict Co-use of Cannabis with Alcohol and Tobacco in Young Adulthood. Prevention Science.

De la Montaña Miguélez, J., Salve, C.A. & Bernárdez, M.M. (2009). Evaluación del riesgo nutricional mediante el MNA en una población anciana no institucionalizada. Arch. Latinoam. Nutr. 59: 390.

Dinu, M., Pagliai, G., Casini, A. & Sofi, F. (2018). Mediterranean diet and multiple health outcomes: An umbrella review of metaanalyses of observational studies and randomised trials. Eur J Clin Nutr. 72:30–43.

Dussaillant, C., Echeverría, G., Urquiaga, I., Velasco, N., & Rigotti, A. (2016). Evidencia actual sobre los beneficios de la dieta mediterránea en salud. Revista médica de Chile, 144(8), 1044-1052.

Eek, F., Karlson, B., Garde, A. H., Hansen, A. M., & Orbæk, P. (2012). Cortisol, sleep, and recovery – Some gender differences but no straight associations. Psychoneuroendocrinology 37, 56–64. doi: 10.1016/j.psyneuen.2011.05.003

El Ansari, W., Stock, C. & Mills, C. (2013). Is Alcohol Consumption Associated with Poor Academic Achievement in University Students? *Int J Prev Med.* 4(10):1175-88.

Esposito, K., Kastorini, C. M., Panagiotakos, D. B., & Giugliano, D. (2011). Mediterranean diet and weight loss: metaanalysis of randomized controlled trials. Metab Syndr Relat Disord, 9(1), 1

Estrada, P. R., Vázquez, E. I. A., Gáleas, Á. M. V., Ortega, I. M. J., Serrano, M. D. L. P., & Acosta, J. J. M. (2016). Beneficios psicológicos de la actividad física en el trabajo de un centro educativo. *Retos: nuevas tendencias en educación física, deporte y recreación*, (30), 203-206.

Ferranti, R., Marventano, S., Castellano, S., Giogianni, G., Nolfo, F., Rametta, S., et al. (2016). Sleep quality and duration is related with diet and obesity in young adolescent living in Sicily, Southern Italy. Sleep Sci. 9, 117–122. doi: 10.1016/j.slsci.2016.04.003

Frank, S., Gonzalez, K., Lee-Ang, L., Young, M. C., Tamez, M., andMattei, J. (2017). Diet and sleep

physiology: public health and clinical implications. Front. Neurol. 8:393. doi: 10.3389/fneur.2017.00393

Gaina, A., Sekine, M., Hamanishi, S., Chen, X., Wang, H., Yamagami, T., et al. (2007). Daytime Sleepiness and Associated Factors in Japanese School Children. The J Pediatr. 151(5):518-522.e4. https://linkinghub.elsevier.com/retrieve/pii/S0022347607003824 377

Garmy, P., Clausson, E.K., Nyberg, P. & Jakobsson, U. (2018). Insufficient Sleep Is Associated with Obesity and Excessive Screen Time Amongst Ten-Year-Old Children in Sweden. J Pediatr Nurs. 29; 1-5.

Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burdenof Disease Study 2017. Lancet. 2018;392(10159):1923-94.4

Gómez Candela, C., Loria Kohen, V., & Dassen, C. (2009). Elementos relevantes de la dieta en la prevención de la enfermedad cardiovascular. Form Med Contin Aten Prim., 16(1), 5-13.

Gómez-Cabello, A., Vila-Maldonado, S., Pedrero-Chamizo, R., Villa-Vicente, J.G., Gusi, N., Espino, L., et al. (2018). La actividad física organizada en las personas mayores, una herramienta para mejorar la condición física en la senectud. Rev Esp Salud Pública. 92, e1-e10.

Gordon-Larsen, P., Boone-Heinonen, J., Sidney, S., Sternfeld, B., Jacobs, D.R. & Lewis, C.E. (2009). Active commuting and cardiovascular disease risk the CARDIA study. Arch Intern Med. 169: 1216–1223.

Grandes, G., Sanchez, A., Montoya, I., Ortega Sanchez-Pinilla, R. & Torcal, J. (2011). Two-year longitudinal analysis of a cluster randomized trial of physical activity promotion by general practitioners. PLoS ONE. 6: doi:10.1371/journal.pone.0018363

Grandner, M. A., Jackson, N. J., Izci-Balserak, B., Gallagher, R. A., Murray- Bachmann, R.,Williams, N. J., et al. (2015). Social and behavioral determinants of perceived insufficient sleep. Front. Neurol. 6:112. doi: 10.3389/fneur.2015.00112

Greene, N.P., Martin, S.E. & Crouse, S.F. (2012). Acute exercise and training alter blood lipid and lipoprotein profiles differently in over-weight and obese men and women. Obesity. 20: 1618-1627.

Grosso, G., Marventano, S., Giorgianni, G., Raciti, T., Galvano, F. & Mistretta, A. (2014). Mediterranean diet adherence rates in Sicily, southern Italy. Public Health Nutr. 17, 2001–2009.

Guyer, A.E., Caouette, J.D., Lee, C.C. & Ruiz, S.K. (2014). Will they like me? Adolescents' emotional responses to peer evaluation. International Journal of Behavioral Development. 38(2): 155–63.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Katz, E. S., Kheirandish-Gozal, L., Neubauer, D. N., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., Ware, J. C., & Adams Hillard, P. J. (2015). National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep health, 1(1), 40–43. https://doi.org/10.1016/j.sleh.2014.12.010

Irala-Estevez, J.D., Groth, M., Johansson, L., Oltersdorf, U., Prattala, R. & Martinez-Gonzalez, M.A. (2000). A systematic review of socio-economic differences in food habits in Europe: Consumption of fruit and vegetables. Eur. J. Clin. Nutr. 54, 706–714.

Javadpoor, M., Soltani, A., Fatehnia, L. & Soltani, N. (2023). How the Built Environment Moderates Gender Gap in Active Commuting to Schools. Int J Environ Res Public Health. 9;20(2):1131. doi: 10.3390/ijerph20021131.

Kalak, N., Gerber, M., Kirov, R., Mikoteit, T., Yordanova, J., Pühse, U., et al. (2012). Daily morning running for 3 weeks improved sleep and psychological functioning in healthy adolescents compared with controls. J Adolesc Health. 51: 615e22.

Kheirat, F., Merzouk, H., Merzouk, A.S., Merzouk, S.A. & Belarbi, B. (2018). One year changes in biochemical and redox markers in training menopausal women with adherence to Mediterranean diet. Sci. Sports. 33, e25-e32.

Kim, I.; Son, K.; Jeong, S.J. & Lim, H. (2022). Sex and Diet-Related Disparities in Low Handgrip Strength among Young and Middle Aged Koreans: Findings Based on the Korea National Health and Nutrition Examination Survey (KNHANES) from 2014 to 2017. Nutrients, 14, 3816.

Kittle, K., Lee, C., Waldron, D., Evans, M., Li, Y., and Dugan, E. (2016). Restful sleep and driving limitations and cessation: findings from the health and retirement study. Gerontologist 56, 571–571. doi: 10.1093/geront/gnw162.2293

Kredlow, M.A., Capozzoli, M.C., Hearon, B.A., Calkins, A.W. & Otto, M.W. (2015). The effects of physical activity on sleep: a meta-analytic review. J Behav Med. 38(3):427–49. http://link.springer.com/10.1007/s10865-015-352 9617-6

Kwon, S. C., Wyatt, L. C., Kranick, J. A., Islam, N. S., Devia, C., Horowitz, C., et al. (2015). Physical

activity, fruit and vegetables intake, and health-related quality of life among older Chinese, Hispanics, and Blacks in New York City. Am. J. Public Health 105, S544–S552. doi: 10.2105/AJPH.2015.30265

Lachat, C., Otchere, S., Roberfroid, D., Abdulai, A., Seret, F., Milesevic, J., et al. (2013). Diet and physical activity for the prevention of noncommunicable diseases in low- and middle-income countries: a systematic policy review. PLoS Medicine 10:e1001465. doi: 10.1371/journal.pmed.1001465

Lang, C., Kalak, N., Brand, S., Holsboer-Trachsler, E., Pühse, U. & Gerber, M. (2016). The relationship between physical activity and sleep form mid adolescence to early adulthood. A systematic review of methodological approaches and meta-analysis. Sleep Medicine Reviews, 28; 32-45.

Lenfant, C. (2006). The interdependence of sleep and health--a commentary. Metabolism, 55(10 Suppl 2), S50-53 ure. Prog Cardiovasc Nurs, 19(2), 56-59

Lesinski, M., Hortobagyi, T., Muehlbauer, T., Gollhofer, A. & Granacher, U. (2015). Effects of Balance Training on Balance Performance in Healthy Older Adults: A Systematic Review and Meta-analysis. Sports Med. 45: 1721-1738.

Libby P. Patogenia, prevención y tratamiento del aterosclerosis. En: Fauci A, Braunwald E, Kasper D, Hauser S, Longo D, Jameson J, et al., editores. Harri-son principios de medicina interna. 17.a ed México: McGraw-Hill; 2009. pp. 1501-1509.

Lindström, M. (2008). Means of transportation to work and overweight and obesity: a population-based study in southern Sweden. Prev Med. 46: 22–28

Lisabeth, L. & Bushnell, C. (2012). Stroke risk in women: The role of menopause and hormone therapy. Lancet Neurol. 11: 82-91.

Liu, K., Daviglus, M. L., Loria, C. M., Colangelo, L. A., Spring, B., Moller, A. C., et al. (2012). Healthy lifestyle through young adulthood and the presence of low cardiovascular disease risk profile in middle age: the Coronary Artery Risk Development in (Young) Adults (CARDIA) study. Circulation 125, 996–1004. doi: 10.1161/CIRCULATIONAHA.111.060681

Magriplis, E., Farajian, P., Panagiotakos, D.B., Risvas, G. & Zampelas, A. (2019). The relationship between behavioral factors, weight status and a dietary pattern in primary school aged children: The GRECO study. Clinical Nutrition. 38(1): 310–6. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0261561418300165

Mäkinen, T.E., Sippola, R., Borodulin, K., Rahkonen, O., Kunst, A., Klumbiene, J., et al. (2912).

Explaining educational differences in leisure-time physical activity in Europe: the contribution of work-related factors. Scand. J. Med. Sci. Sports. 22(3): 439447.

Mantilla-Toloza, S.C., Gómez-Conesa, A. & Hidalgo-Montesinos, M.D. (2011). Actividad física, tabaquismo y consumo de alcohol, en un grupo de estudiantes universitarios. *Rev. salud pública.* 13(5):748-58. http://doi.org/cm8s.

Martínez-González, M.A., Salas-Salvadó, J., Estruch, R., Corella, D.D., Fitó, M. & Ros, E. (2015). Benefits of the mediterranean diet: insights from the PREDIMED study. Prog Cardiovasc Dis. 2015;58:50–60.

Martínez Pastor, A., Balanza Galindo, S., Leal Hernández, M., Martínez Navarro, A., Conesa Bernal, C., & Abellán Alemán, J. (2009). Relacióm entre el consumo de tabaco y alcohol y el ejercicio físico con el paso por la universidad. Gaceta Sanitaria, 41(10), 558- 563.

Martinez-Gonzalez, M. A., Bes-Rastrollo, M., Serra-Majem, L., Lairon, D., Estruch, R., & Trichopoulou, A. (2009). Mediterranean food pattern and the primary prevention of chronic disease: recent developments. Nutr Rev, 67 Suppl 1, S111-116

Martins, W.R., de Oliveira, R.J., Carvalho, R.S., de Oliveira Damasceno, V., da Silva, V.Z. & Silva, M.S. (2013). Elastic resistance training to increase muscle strength in elderly: a systematic review with meta-analysis. Arch Gerontol Geriatr. 2013; 57: 8-15.

Master, L., Nye, R.T., Lee, S., Nahmod, N.G., Mariani, S., Hale, L, et al. (2019). Bidirectional, Daily Temporal Associations between Sleep and Physical Activity in Adolescents. Sci Rep. 9(1):7732. http://www.nature.com/articles/s41598-019-44059-9 312

Mastrantonio, M.P. & Coduras, O. (2020). Actividad Física y Calidad de Vida Percibida en usuarios de Centros Deportivos Públicos de Terrassa. Retos, 37, 427-433.ç

Mayolas-Pi, C., Munguia-Izquierdo, D., Peñarrubia-Lozano, C., Reverter-Masia, J., Bueno-Antequera, J., López-Laval, I., et al. (2017). Adherencia a la dieta mediterránea en adultos inactivos, practicantes de ciclo indoory ciclistas aficionados. Nutri hospital. 35(1): 131-139.

McCambridge, J., Bendtsen, M., Karlsson, N., White, I.R., Nilsen, P. & Bendtsen, P. (2013). Alcohol assessment and feedback by email for university students: main findings form a randomized controlled trial. *Br J Psychiatry.* 203(5):334-40. http://doi.org/f224fs.

Méndez, I., & Ruiz-Esteban, C. (2020). Actividad física, consumo de drogas y conductas riesgo en

adolescentes. *JUMP*, (1), 45-51.

Mindell, J. A., & Williamson, A. A. (2018). Benefits of a bedtime routine in young children: Sleep, development, and beyond. Sleep medicine reviews, 40, 93–108. https://doi.org/10.1016/j.smrv.2017.10.007

Molina-García, J., Sallis, J.F. & Castillo, I. (2014). Active commuting and sociodemographic factors among university students in Spain. *J Phys Act Health.* 11(2):259-63. http://doi.org/f5v6pk.

Montagnese, C., Santarpia, L., Buonifacio, M., Nardelli, A., Caldara, A.R., Silvestri E, *et al. (2015).* European food-based diatary guidelines: a comparison and update. *Nutrition.* 2015;31(7-8):908-15. http://doi.org/f7hzxv.

Morentin, B., Callado, L.F., García-Hernández, S., Bodegas, A., Lucena, J. (2018). The role of toxic substances in sudden cardiac death. Revista Española de Medicina Legal. 44(1), 13-21.

Morrel, H.E., Cohen, L.M., Bacchi, D. & West, J. (2005). Predictors of smoking and smokeless tobacco use in college students: a preliminary study using web-based survey methodology. J Am Coll Health. 54:108–15. 22.

Muñoz-Arribas, A., Vila-Maldonado, S., Pedrero-Chamizo, R., Espino, L., Gusi, N., Villa, G., et al. (2014). Evolución de los niveles de condición física en población octogenaria y su relación con un estilo de vida sedentario. Nutr. Hosp. 29(4). http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S0212-16112014000400024

Nelson, M.E., Fi Atarone, M.A., Morganti, C.M., Trice, I., Greenberg, R.A. & Evans, W.J. (1994). Effects of high-intensity strength training on multiple risk factors for osteoporotic fractures. A randomized controlled trial. JAMA. 272: 1909-1194.

Nikolaidis, M.G., Paschalis, V., Giakas, G., Fatouros, I.G., Koutedakis, Y., Kouretas, D. et al. (2007). Decreased blood oxidative stress after repeated muscle-damaging exercise. Med Sci Sports Exerc. 39: 1080-1089.

Nuutinen, T., Ray, C. & Roos, E. (2013). Do computer use, TV viewing, and the presence of the media in the bedroom predict school-aged 369 children's sleep habits in a longitudinal study? BMC Public Health. 13(1): 684. Available from: http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-13-684 371

Ohayon, M., Wickwire, E. M., Hirshkowitz, M., Albert, S. M., Avidan, A., Daly, F. J., Dauvilliers,

Y., Ferri, R., Fung, C., Gozal, D., Hazen, N., Krystal, A., Lichstein, K., Mallampalli, M., Plazzi, G., Rawding, R., Scheer, F. A., Somers, V., & Vitiello, M. V. (2017). National Sleep Foundation's sleep quality recommendations: first report. Sleep health, 3(1), 6–19.

Oja, P., Titze, S., Bauman, A., De Geus, B., Krenn, P., Reger-Nash, B & Kohlberger, T. (2011). Health benefits of cycling: a systematic review. Scand J Med Sci Sports. 21(4):496-509. doi: 10.1111/j.1600-0838.2011.01299.x. Epub 2011 Apr 18

Ortega, F. B., Ruiz, J., & Castillo, M. J. (2013). Actividad física, condición física y sobrepeso en niños y adolescentes: evidencia procedente de estudios epidemiológicos. Endocrinol Nutr, 60(8), 458-469

Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. (2019). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. PLoS Med. **2019**, 18, e1003583.

Palmer, C. A. & Alfano, C. A. (2017). Sleep and emotion regulation: an organizing, integrative review. Sleep Med. Rev. 31, 6–16. doi: 10.1016/j.smrv.2015.12.006

Pano-Rodriguez A, Beltran-Garrido JV, Hernadez-Gonzalez V, Bueno-Antequera J, Oviedo-Caro MA, Mayolas-Pi C, et al. Sleep quality is mediated by physical activity level in adolescents. J Sports Med Phys Fitness. 2023; 367 Available from: https://www.minervamedica.it/index2.php?show=R40Y9999N00A23022003 368

Parra-Saldías, M., Castro-Piñero, J., Castillo-Parede, A., Palma Leal, X., Díaz Martínez, X., Rodríguz-Rodríguez, F. (2019). Active Commuting Behaviours from High School to University in Chile: A Retrospective Study. International Journal of Environmental Research and Public Health, 16(1).

Pavón-Lores, A.I. & Moreno-Murcia, J.A. (2008). Actitud de los universitarios ante la práctica físico-deportiva: diferencias por géneros. *Revista de Psicología del Deporte.* 17(1):7-23.

Perry, G. S., Patil, S. P., and Presley-Cantrell, L. R. (2013). Raising awareness of sleep as a healthy behavior. Prev. Chronic Dis. 10:130081. doi: 10.5888/pcd10.130081

Polo-Gallardo Cobos, R. R., Mendinueta-Martinez, M., & Acosta, K. R. (2017). Consumo de drogas y la práctica de actividad física en adolescentes: revisión narrativa. *Revista de la Facultad de Ciencias de la Salud Universidad del Cauca*, *19*(2), 29-37.

Ramos-Valverde, M. P. (2009). Estilos de vida y salud en la adolescencia. Universidad de Sevilla,

Sevilla

Rees, K., Takeda, A., Martin, N., Ellis, L., Wijesekara, D., Vepa, A., et al. (2019). Mediterranean-style diet for the primary and secondary prevention of cardiovascular disease. Cochrane Database Syst Rev. 3(3):CD009825.

Riemann, D., Baglioni, C., Bassetti, C., Bjorvatn, B., Dolenc Groselj, L., Ellis, J. G., Espie, C. A., Garcia-Borreguero, D., Gjerstad, M., Gonçalves, M., Hertenstein, E., JanssonFröjmark, M., Jennum, P. J., Leger, D., Nissen, C., Parrino, L., Paunio, T., Pevernagie, D., Verbraecken, J., Weeß, H. G., … Spiegelhalder, K. (2017). European guideline for the diagnosis and treatment of insomnia. Journal of sleep research, 26(6), 675–700. https://doi.org/10.1111/jsr.12594

Rizzuto D, Fratiglioni L. Lifestyle factors related to mortality and survival: a mini- review. Gerontology. 2014;60(4):327-35.

Rodríguez, A.S., Soidán, J.L.G., Gómez, M.J.A., del Álamo Alonso, A., Rodríguez. R,L. & Fernández, M.R.P. (2018). Intervención educativa sobre parámetros cardiovasculares en mujeres perimenopáusicas con un factor de riesgo cardiovascular. Ensayo clínico aleatorizado. Med Clin. 150: 178-184.

Rodríguez, F., Palma, X., Romo, Á., Escobar, D., Aragú, B., Espinoza, L., *et al. (2013).* Hábitos alimentarios, actividad física y nivel socioeconómico en estudiantes universitarios de Chile. *Nutr Hosp.* 28(2):447-55. http://doi.org/b5dq.

Romaguera, D., Tauler, P., Bennasar, M., Pericas, J., Moreno, C., Martinez, S., *et al. (2011).* Determinants and patterns of physical activity practice among Spanish university students. *J Sport Sci.* 29(9):989-97. http://doi.org/bsg4mr.

Rosa, C.C., Tebar, W.R., Oliveira, C.B.S., Farah, B.Q., Casonatto, J., Saraiva, B.T.C., et al. (2021). Effect of Different Sports Practice on Sleep Quality and Quality of Life in Children and Adolescents: Randomized Clinical Trial. Sports Med. 7(1):83. https://sportsmedicine-open.springeropen.com/articles/10.1186/s40798-021-00376-w 315

Ross, R., Chaput, J. P., Giangregorio, L. M., Janssen, I., Saunders, T. J., Kho, M. E., Poitras, V. J., Tomasone, J. R., El-Kotob, R., McLaughlin, E. C., Duggan, M., Carrier, J., Carson, V., Chastin, S. F., Latimer-Cheung, A. E., Chulak-Bozzer, T., Faulkner, G., Flood, S. M., Gazendam, M. K., Healy, G. N., … Tremblay, M. S. (2020). Canadian 24-Hour Movement Guidelines for Adults aged 18-64 years and Adults aged 65 years or older: an integration of physical activity, sedentary behaviour, and sleep. Applied

physiology, nutrition, and metabolism, 45(10); 57–102. https://doi.org/10.1139/apnm-2020-0467

Roth T. (2007). Insomnia: definition, prevalence, etiology, and consequences. Journal of clinical sleep medicine, 3(5); 7–S10.

Ryff, C. D., Singer, B. H., & Love, D. G. (2004). Positive health: connecting well-being with biology. Philos Trans R Soc Lond B Biol Sci, 359(1449), 1383-1394

Sallis, J.F., Bowles, H.R., Bauman, A., Ainsworth, B.E., Bull, F.C., Craig, C.L., *et al. (2009).* Neighborhood environments and physical activity among adults in 11 countries. *Am J Prev Med.* 36(6):484-90. http://doi.org/cz3ztx.

Sanabria, P., González, L. & Urrego, D. (2007). Estilos de vida saludable en profesionales de la salud colimbianos. Estudio exploratorio. Revista Med. 15 (2):207-17.

Sanchez-Sanchez, M.L., Garcıa-Vigara, A., Hidalgo-Mora, J.J., Garcıa-Perez, M.A., Tarın, J. & Cano, A. (2020). Mediterranean diet and health: A systematic review of epidemiological studies and intervention trials. Maturitas. 136:25–37.

Saunders, T.J., Gray, C.E., Poitras, V.J., Chaput, J.P., Janssen, I., Katzmarzyk, P.T., et al. (2016). Combinations of physical activity, sedentary behaviour and sleep: relationships with health indicators in school-aged children and youth. Appl Physiol Nutr Metab, 41:283–93. http://www.nrcresearchpress.com/doi/10.1139/apnm-349 2015-0626

Scarmeas, N., Gu, Y., Schupf, N., Lee, J.H., Luchsinger, J.A., Stern, Y., et al. (2014). Mediterranean diet and leukocyte telomere length in a multi-ethnic elderly population. Alzheimers. Dement. 10: 755.

Schlessman, A.M., Martin, K., Ritzline, P.D., Petrosino, C.L. (2011). The role of physical therapist in pediatric health promotion and obesity prevention: comparison of attitudes. *Pediatr Phys Ther.* 23(1):79-86. http://doi.org/bxp454

Schröder, H., Fitó, M., Estruch, R., Martínez-González, M.A., Corella, D., Salas-Salvadó, J., et al. (2011). A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 141(6): 1140-5.

Schwingshackl, L. & Hoffmann, G. (2016). Does a Mediterranean type diet reduce cancer risk? Curr Nutr Rep. 5: 9-17.

Segarra-Romero, L. (2020). Factores condicionantes de la composición corporal y la condición física

en la población mayor española. Tesis Doctoral. Universidad de Zaragoza.

Segura-Díaz JM, Herrador-Colmenero M, Martínez-Téllez B, Chillón P. Efecto de la precipitación y el periodo estacional sobre los patrones de desplazamiento al centro educativo en niños y adolescentes de Granada. *Nutr Hosp.* 2015;31(3):1264-72. http://doi.org/cm8t.

Serra-Majem L, Roman-Vi~nas B, Sanchez-Villegas A, Guasch- Ferre M, Corella D, La Vecchia C. Benefits of the Mediterranean diet: Epidemiological and molecular aspects. Mol Aspects Med. 2019;67:1–55.

Shimizu, A.; Okada, K.; Tomata, Y.; Uno, C.; Kawase, F.; Momosaki, R. Association of Japanese and Mediterranean Dietary Patterns with Muscle Weakness in Japanese Community-Dwelling Middle-Aged and Older Adults: Post Hoc Cross-Sectional Analysis. Int. J. Environ. Res. Public Health **2022**, 19, 12636.

Soares, C.N. & Zitek, B. Reproductive hormone sensitivity and risk for depression across the female life cycle: A continuum of vulnerability?. J Psychiatry Neurosci. 2008; 33(4): 331–343

Södergren, M., McNaughton, S. A., Salmon, J., Ball, K., and Crawford, D. A. (2012). Associations between fruit and vegetable intake, leisure-time physical activity, sitting time and self-rated health among older adults: cross-sectional data from the WELL study. BMC Public Health 12:551. doi: 10.1186/1471-2458-12-551

Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health; an updated systematic review a meta-analysis. Am J Clin Nutr. 2010; 92: 1189-1196.

Solland Egset, K. & Nordfjaern, T. (2019). The role of transport priorities, transport attitudes and situational factors for sustainable transport mode use in wintertime. Transportation Research part F. 62; 473-482.

Stone, M.R., Stevens, D. & Faulkner, G.E.J. (2013). Maintaining recommended sleep throughout the week is associated with increased physical activity in children. Preventive Medicine. 56(2):112–7. https://linkinghub.elsevier.com/retrieve/pii/S0091743512005920

Tambalis, K. D., Panagiotakos, D. B., Psarra, G., & Sidossis, L. S. (2018). Insufficient Sleep Duration Is Associated With Dietary Habits, Screen Time, and Obesity in Children. Journal of clinical sleep medicine, 14(10), 1689–1696. https://doi.org/10.5664/jcsm.7374.

Tambalis, K. D., Panagiotakos, D. B., Psarra, G., & Sidossis, L. S. (2018). Insufficient Sleep Duration Is Associated With Dietary Habits, Screen Time, and Obesity in Children. Journal of clinical sleep medicine, 14(10), 1689–1696. https://doi.org/10.5664/jcsm.7374

Tan, S.L., Storm, V., Reinwand, D.A., Wienert, J., de Vries, H. & Lippke S (2018) Understanding the Positive Associations of Sleep, Physical Activity, Fruit and Vegetable Intake as Predictors of Quality of Life and Subjective Health Across Age Groups: A Theory Based, Cross-Sectional Web-Based Study. Front. Psychol. 9:977.doi: 10.3389/fpsyg.2018.00977

Teuber, M. & Sudeck, G. (2021). Why Do Students Walk or Cycle for Transportation? Perceived Study Environment and Psychological Determinants as Predictors of Active Transportation by University Students. International Journal of Environmental Research and Public Health, 18(4).

Tian, X., Du, H., Li, L., Bennett, D., Gao, R., Li, S., et al. (2017). China Kadoorie Biobank Study: fruit consumption and physical activity in relation to allcause and cardiovascular mortality among 70,000 Chinese adults with preexisting vascular disease. PLoS One 12:e0173054. doi: 10.1371/journal.pone.0173054

Titze, S.; Stronegger, W.J.; Janschitz, S. & Oja, P. (2008). Association of built-environment, social environment and personal factors with bicycling as a mode of transportation among Austrian city dwellers. Prev. Med. 47, 252–259.

Tourlouki, E., Polychronopoulos, E., Zeimbekis, A., Tsakountakis, N., Bountziouka, V., Lioliou, E., et al. (2010). The ‘secrets’ of the long livers in Mediterranean islands: the MEDIS study. Eur J Public Health, 20(6), 659-664.

Tremblay, M. S., Carson, V., Chaput, J. P., Connor Gorber, S., Dinh, T., Duggan, M., et al. (2016). Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep. Applied physiology, nutrition, and metabolism, 41(6), 311–327. https://doi.org/10.1139/ apnm-2016-0151

Varo, J.J., Martínez, J.A. & Martínez-González, M.A. (2003). Beneficios de la actividad física y riesgos del sedentarismo. Med Clin. 121: 665-672.

Vila-Marti, A., Ramírez-Contreras, C., Apolinar-Jiménez, E., Rojas-Cárdenas, P., Valera-Gran, D., Almendra-Pegueros, R., & Navarrete-Muñoz, E. M. (2022). Factors Associated with Dietary Restriction and Emotional and Uncontrolled Eating in Adults from Spanish-Speaking Countries during the COVID-19 Confinement: Results of the CoV-Eat Project. Nutrients, 14(22), 4866.

Villa-González, E., Rodríguez-López, C., Huertas Delgado, F.J., Tercedor, P., Ruiz, J.R. & Chillón, P. (2021). Factores personales y ambientales asociados con el desplazamiento activo al colegio de los escolares españoles. *Rev Psicol Dep.* 21(2):343-9.

Villasana, M. V., Pires, I. M., Sá, J., Garcia, N. M., Zdravevski, E., Chorbev, I. ... Flórez-Revuelta, F. (2020). Promotion of Healthy Nutrition and Physical Activity Lifestyles for Teenagers: A Systematic Literature Review of The Current Methodologies. J. Pers. Med., 10(12), 1-17.

Vinaccia Alpi, S., Serra Majem, L., Ruano Rodriguez, C., Quintero, M. F., Quiceno, J., Ortega, A., ... & Pacheco, A. C. (2019). Adherencia a la dieta mediterránea en población universitaria colombiana. Nutrición clínica y dietética hospitalaria.

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: the evidence. CMAJ,

WHO guidelines on physical activity and sedentary behaviour: at a glance; 2020. Available online: https://apps.who.int/iris/bitstream/handle/10665/337004/9789240014817-spa.pdf

Willet E, Sacks F, Trichopoulou A, Drescher G, Ferro- Luzz A, Helsing E. et al. Mediterranean diet pyra
mid: a cultural model for healthy eating. Am J Clin Nutr. 1995; 61 (Suppl. 1): 1402-1406.

World Health Organization (2020). WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization. Retrieved from https://www.who.int/publications/i/item/9789240015128.

World Health Organization (2019). WHO global report ontrends in prevalence of tobacco use 2000-2025. Disponible en: https://www.who.int/publications/i/item/who-global-report-on-trends-in-prevalence-of-tobacco-use-2000-2025-third-edition

World Health Organization [WHO] (2014). Global Status Report on Noncommunicable Diseases 2014. Switzerland: World Health Organization.

Zhang, Z., He, Z. & Chen,W. (2022). The relationship between physical activity intensity and subjective well-being in college students. J. Am. Coll. Health. 70, 1241–1246.

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- "Curso on-line sobre Sistemas Personalizados de Dosificación (SPD)" (4h). ICOF de Castellón. 1 - 2 junio de 2021.
- XXII Congreso Nacional Farmacéutico. Sevilla. 20 – 22 septiembre de 2022.
- Congreso INFARMA. "Modelos retributivos en la dispensación de nuevos fármacos y servicios" (0,20 créditos). Barcelona, 14-16 marzo 2023.
- 4º Simpodader Internacional (15 horas). Granada. 21-22 de abril de 2023.
- X Congreso de la Sociedad Valenciana de Farmacia Hospitalaria (SVFH) (20 horas). Castellón. 11, 12 y 13 de mayo de 2023.
- "Programa de Desarrollo de Consejeros" (72 horas). ESADE Madrid. 7 febrero – 23 mayo 2023.

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- Conferencia "Alimentación y actividad física". Centro Penitenciario de Castellón II. 24 de mayo de 2017.
- Conferencia "Consejo farmacéutico en la suplementación deportiva". I Jornada de Alimentación. MICOF Valencia. 8 de noviembre de 2017.
- Conferencia "Cuida tu salud. Conceptos básicos para todos". Centro Penitenciario de Castellón II. 15 de febrero de 2018.
- Conferencia "Consejo farmacéutico en la suplementación deportiva". I Jornada de Alimentación. ICOF de León. 7 de abril de 2018.
- Ponencia en la actividad: Mesa Redonda 2. "Sostenibilidad de la atención primaria y posibles soluciones: punto de vista de las instituciones profesionales". 4º Simpodader Internacional. Granada. 21-22 de abril de 2023.

Publicaciones:

- "Informe de obesidad infantil. Desayunos saludables". Araceli Álvarez Martín, Rosa Arnau Salvador, Natividad Folch Monfort, Encarnación Gandía Arándiga, Mª Teresa Pedrosa Roca, Fernando Puzo Ardanuy, Lydia Roca Blasco, Mª Blanca Talavera Talavera, Carolina Vilches Peña. Viure en Salut. Julio 2008.
- Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university (Actividad física, hábitos alimenticios y consumo de tabaco y alcohol en estudiantes de una universidad catalana). Vicenç Hernández-González, Rosa Arnau-Salvador, Carme Jové-Deltell, Carme Mayolas-Pi, Joaquín Reverter-Masià. Rev. Fac. Med., Volumen 66, Número 4, p. 537-541, 2018. ISSN electrónico 2357-3848. ISSN impreso 0120-0011.

- Physical activity from cycling and effects on the mediterranean diet. Project: ASISA. Rosa Arnau-Salvador, Vicenç Hernández González, Rafel Cirer-Sastre, Francisco Corbi-Soler, Joaquin Reverter-Masià. February 2019. Acta Médica Mediterránea. DOI: 10.19193/0393-6384_2019_4_295
- Effectiveness of a physical activity intervention programme on the integral health of university professors. Rosa Arnau Salvador, Vicenç Hernández González, Rafel Cirer Satre, Francisco Corbi, Álvaro Pano Rodríguez, Joaquín Reverter Masià. May 2020. Acta Médica Mediterránea. DOI: 10.19193/0393-6384_2020_3_300
- Pano-Rodriguez, A.; Arnau-Salvador, R.; Mayolas-Pi, C.; Hernandez-Gonzalez, V.; Legaz-Arrese, A.; Reverter-Masia, J. Physical Activity and Sleep Quality in Spanish Primary School Children: Mediation of Sex and Maturational Stage. *Children* 2023, *10*, 622. https://doi.org/10.3390/children10040622

Posters:

- "Desayuna sano, coge fuerzas y aprueba". L. Roca Blasco, R. Arnau Salvador, N. Folch Monfort, A. Álvarez Martín, T. Pedrosa Roca, C. Vilches Peña. XVI Congreso Nacional Farmacéutico. Octubre 2008.
- "Plenufar V en Castellón y provincia". R. Arnau Salvador, L. Roca Blasco, H. Roca Blasco, A.C. Salvador Bayarri, R. Arnau Salvador. XIX Congreso Nacional Farmacéutico. Octubre de 2014.
- "Caracterización cualitativa del aceite de oliva en la comarca del Baix Maestrat". R. Arnau Salvador, S. López-Miranda González, L. Roca Blasco, H. Roca Blasco, A.C. Salvador Bayarri, R. Arnau Salvador. XIX Congreso Nacional Farmacéutico. Octubre 2014.
- "Influencia de la recolección en la calidad del aceite de oliva en la comarca del Baix Maestrat". R. Arnau Salvador, S. López-Miranda González, L. Roca Blasco, H. Roca Blasco, A.C. Salvador Bayarri, R. Arnau Salvador. XIX Congreso Nacional Farmacéutico. Octubre 2014.
- "Hábitos de alimentación y de salud en estudiantes de una Universidad catalana". R. Arnau Salvador, J. Reverter Masià, V. Hernández González, C. Jové Deltell, C. Mayolas, A. Legaz Arese. XX Congreso Nacional Farmacéutico. Octubre 2016.
- "Valoración del asesoramiento nutricional ofrecido desde la farmacia comunitaria. Provincia de Castellón". R. Arnau Salvador, F.J. Mejías Vicente, E. Forés Lluch, R. Arnau Salvador, J.M. González Arbelo, J. Reverter Masià. XX Congreso Nacional Farmacéutico. Octubre 2016.
- "Valoración del asesoramiento nutricional ofrecido desde la farmacia comunitaria". A. García; R. Arnau; A.M. Ruiz; J. Castillo; P. León; R. Pastor; L. Serrano; J. Tur. XX Congreso Nacional Farmacéutico. Octubre 2016.
- "Virus Zika: evaluación del riesgo de establecimiento y transmisión en España y Canarias". J.M. González Arbelo; R. Arnau Salvador; J.A. Castellano Del Toro; I. Alarcón Torres. XX Congreso Nacional Farmacéutico. Octubre 2016.
- "Plenufar 6: práctica de actividad física en la provincia de Castellón". R. Arnau Salvador, E. Forés Lluch, M. Latasa Barros, S. Marco Peiró, A. Baltanás Latasa, F. Baltanás Latasa, J. Reverter Masià. XXI Congreso Nacional Farmacéutico. Octubre 2018.
- "Plenufar 6: calidad de la dieta de las personas deportistas en la provincia de Castellón". R. Arnau Salvador, E. Forés Lluch, M. Latasa Barros, S. Marco Peiró, A. Baltanás Latasa, F. Baltanás Latasa, J. Reverter Masià. XXI Congreso Nacional Farmacéutico. Octubre 2018.
- "Evaluación de parámetros de salud y niveles de actividad física en escuela primaria y secundaria". R. Arnau Salvador, F. Corbi Soler, E. Conesa Milián, V. Hernández González, I. López Lavall, A. De Pano Rodríguez, J. Reverter Masià. XXII Congreso Nacional

Farmacéutico. Septiembre 2022.

- "Actividad física y calidad del sueño en niñas/os españoles". R. Arnau Salvador, A. De Pano Rodríguez, V. Hernández González, J. Reverter Masià. XXII Congreso Nacional Farmacéutico. Septiembre 2022.

Comunicaciones orales:

- "Repercusión de la actividad física en bicicleta sobre algunos hábitos de estilos de vida saludables". J. Reverter Masià; R. Arnau Salvador; V. Hernández González. I Congreso Internacional de Ciencias de la Actividad Física y el Deporte. Torrent, 24, 25 y 26 de enero de 2019.

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Anexos

Artículo 1

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ORIGINAL RESEARCH

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Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university

Actividad física, hábitos alimenticios y consumo de tabaco y alcohol en estudiantes de una universidad catalana

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| Abstract |

Introduction: University populations are considered as vulnerable groups when it comes to acquiring health habits.

Objective: The aim of this study is to know the levels of physical activity and health habits of the students of the University of Lleida.

Methods: Healthy habits and the practice of physical activity in university students were evaluated through the Global Physical Activity Questionnaire (GPAQ).

Results: 600 students from the University of Lleida participated during the period 2014-2015. 30.7% of them smoked, while 96.7% reported alcohol consupmtion, and 75.5% practiced physical activity. More than 62% of male students practiced physical activity between 3 and 7 days a week compared to 33.5% of women (p=0.000). More than 30% of the students ingested fruit every day and 65% did so at least 4 days a week. 19.4% of women and 7.9% of men consumed fruit daily, finding significant differences (p=0.001).

Conclusions: 30% of the participant did not meet the minimum recommendations of physical activity. A high percentage of participants have a low fruits and vegetables consumption and a high prevalence of risk of alcohol consumption. An educational intervention by universities is suggested to encourage the practice of healthy habits in students.

Keywords: Physical Activity; Tobacco; Feeding Behavior; Students; Alcoholism (MeSH).

Hernández-González V, Arnau-Salvador R, Jové-Deltell C, Mayolas-Pi C, Reverter-Masia J. Physical activity, eating habits and tobacco and alcohol use in students of a Catalan university. Rev. Fac. Med. 2018;66(4):537-41. English. doi: http://dx.doi.org/10.15446/revfacmed.v66n4.61896.

| Resumen |

Introducción. La población universitaria se considera un colectivo vulnerable a la hora de adquirir hábitos de salud.

Objetivo. Conocer los niveles de actividad física y los hábitos de salud de los estudiantes de la Universidad de Lleida.

Materiales y métodos. Se valoraron los hábitos saludables y la práctica de actividad física en estudiantes universitarios mediante el cuestionario Global Physical Activity Questionnarie.

Resultados. Participaron 600 estudiantes de la Universidad de Lleida durante el periodo 2014-2015; 30.7% fumaba, 96.7% consumía alcohol y 75.5% practicaba actividad física. Más del 62% de los hombres practicaban actividad física entre 3 y 7 días a la semana frente al 33.5% de las mujeres (p=0.000). Más del 30% de estudiantes ingirió fruta cada día y 65% lo hizo al menos 4 días a la semana; en específico, 19.4% de las mujeres y 7.9% de hombres consumía fruta a diario, encontrándose diferencias significativas (p=0.001).

Conclusiones. El 30% de los estudiantes no cumple con las recomendaciones mínimas de actividad física. Un alto porcentaje de los participantes tiene escaso consumo de frutas y verduras y presenta elevada prevalencia de consumo de riesgo de alcohol. Se sugiere una intervención educativa en estudiantes y por parte de las universidades respecto a la práctica de hábitos saludables.

Palabras clave: Actividad física; Tabaquismo; Conducta alimentaria; Estudiantes; Alcoholismo (DeCS).

Hernández-González V, Arnau-Salvador R, Jové-Deltell C, Mayolas-Pi C, Reverter-Masia J. [Actividad física, hábitos alimenticios y consumo de tabaco y alcohol en estudiantes de una universidad catalana]. Rev. Fac. Med. 2018;66(4):537-41. English. doi: http://dx.doi.org/10.15446/revfacmed.v66n4.61896.

Introducción

The promotion of healthy habits, particularly those related to physical activity (PA) and eating, is one of the primary work functions of health and education professionals. (1)

University students are a vulnerable group in terms of the influence of current lifestyles according to trends, usually characterized by health-risk behaviors. These behaviors include diets saturated in fat that lead to high cholesterol levels, low consumption of fruits and vegetables (2) and high levels of tobacco and (3) alcohol use (4) and sedentary lifestyle. (5) Therefore, universities are a strategic place to promote, on the one hand, patterns of behavior that favor health and, on the other, effective ways that lead to increased participation in healthy habits. (6)

It is of great interest for public health to know the evolution and trends of the university population, especially regarding sedentary lifestyles and healthy habits. (7) This allows establishing strategies to prevent and promote health, particularly among social groups that are consolidating their lifestyles and whose future behavior should be a model to imitate. (5) In Catalonia, Spain, the Secretaria General de l'Esport (General Secretary of Sports) promotes the University Sports of Catalonia Strategic Plan 2013-2020 (PEUC), which shows the need to analyze the current situation in the different Catalan universities to establish specific action plans in each institution to promote physical activity.

Several studies have attempted to determine proper levels of physical activity and health in university students to establish prevention and health promotion strategies. (8-11) With the aim of developing education and intervention actions aimed at introducing possible modifications in the behavior of university students, it is essential to determine which habits are predominant. To obtain this type of information, questionnaires are usually used (12), including the Global Physical Activity Questionnaire (GPAQ) — recommended by the World Health Organization —, which was elaborated to study PA and eating habits, and has acceptable levels of reliability and validity. (13,14)

The objectives of this study were to know the levels of physical activity and health habits — feeding and consumption of tobacco and alcohol— of the students of the University of Lleida (UDL) and to identify inappropriate behaviors related to healthy habits.

Materials and methods

This is a cross-sectional, observational and descriptive study on eating habits and behaviors related to physical activity in students of the UDL enrolled during the period 2014-2015.

Participants

A non-probabilistic sample was taken for convenience, stratified by sex and studies completed, and representative of the UDL students, which implies a confidence level of 95% and a maximum sampling error of ±5%. The population consisted of 290 men (48.3%) and 310 women (51.7%), with an average age of 21.69 years [standard deviation (SD): 4.61]. Trained surveyors applied 600 questionnaires using a face to face modality and convenience with respect to the places, days and times of greatest transit of students within the university.

Measurements

To estimate PA, the Spanish version of the GPAQ was used (15), which consists of a series of questions grouped into domains: work, transport, recreation, tobacco consumption, alcohol consumption and diet. The questions about work and recreation inquired about the frequency and duration of different types of PA according to their intensity. Regarding diet, questions sought to find about the intake of fruits and vegetables, frequency of consumption, etc.

Participants provided their informed consent in writing and the study was evaluated and approved by the Ethics and Good Practices Committee of the UDL on April 10, 2014.

Statistical analysis

The statistical program SPSS Statistics version 20.0 was used for analysis. The exact chi-square test was applied to evaluate the differences in PA according to sex and alcohol and tobacco use, while the Student's t-test was used to evaluate the differences in the time of practice of PA according to sex and free time.

Results

The research involved 600 subjects, 290 (48.3%) men and 310 (51.7%) women, with an average age of 21.6 years (SD: 4.61).

When examining the variables tobacco use, alcohol consumption and PA (Figure 1), it was found that 30.7% of students smoked and 96.7% reported alcohol consumption. When distributing the sample by sex, tobacco use was higher in women than in men (34.8% vs. 26.2%, p=0.027). Regarding alcohol consumption, a very similar percentage was found in men and women (96.9% vs. 96.5%, p=0.623). The question about whether students travel by foot or bicycle for at least consecutive 10 minutes showed that 73.8% of the sample did so, with a higher percentage observed in women (78% vs. 69.3%; p=0.019).

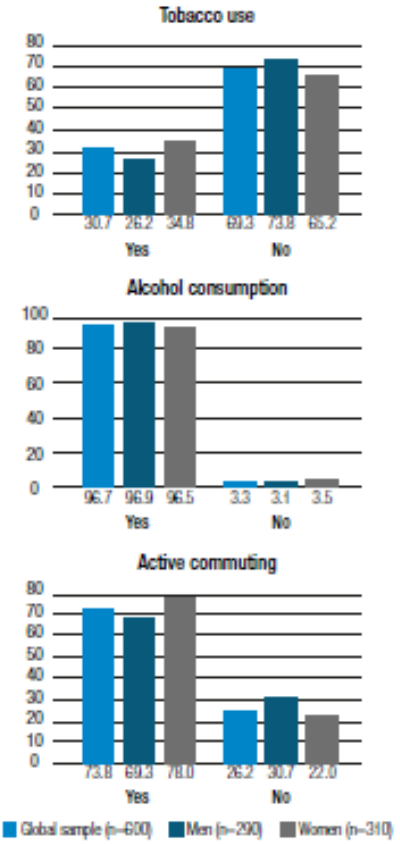

Figure 1. Descriptions of health habits.
Source: Own elaboration.

Table 1 shows that most university students practiced vigorous (66.2%) or moderate (63.5%) PA. With respect to the number of days they practiced vigorous PA, 62% of men and 33.5% of women did it between 3 and 7 days a week. For moderate PA, 54% of men and 33% of women practiced it between 3 and 7 days per week. In both cases, significant differences were found (p=0.000).

Table 2 shows the time, expressed in minutes, that students spent on PA; for the most part, the practices were over 60 minutes.

Table 3 shows that more than 30% of respondents ingested fruit every day and more than 65% did so at least 4 days a week. When analyzing daily vegetable consumption, it was found that women ingested more than men (19.4% vs. 7.9%; p=0.001).

Table 1. Descriptive index of physical activity practices.

Frequency	Vigorous						Moderate					
	Global sample		Men		Women		Global sample		Men		Women	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Every day	22	3.7	11	3.8	11	3.5	36	6.0	16	5.5	20	6.5
5-6 days per week	78	13.0	54	18.6	24	7.7	81	13.5	55	19.0	26	8.4
3-4 days per week	184	30.7	115	39.7	69	22.3	143	23.8	87	30.0	56	18.1
1-2 days per week	113	18.8	41	14.1	72	23.2	121	20.2	45	15.5	76	24.5
No	203	33.8	69	23.8	134	43.2	219	36.5	87	30.0	132	42.6
Total	600	100	290	100	310	100	600	100	290	100	310	100

f: frequency.
Source: Own elaboration.

Table 2. Time spent doing physical activity.

Duration	Vigorous						Moderate					
	Global sample		Men		Women		Global sample		Men		Women	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
<60 min	148	24.7	74	25.5	74	23.8	160	26.6	73	25.2	87	28.1
61-100 min	108	18.0	66	22.8	42	13.5	55	9.2	38	13.1	17	5.5
>100 min	139	23.2	81	27.9	58	18.7	140	23.3	75	25.9	65	21.0
0 min	205	34.2	69	23.8	136	43.9	245	40.8	104	35.9	141	45.5
Total	600	100	290	100	310	100	600	100	290	100	310	100

f: frequency.
Source: Own elaboration.

Table 3. Description of eating habits.

Variable		Fruits						Vegetables					
		Global sample		Men		Women		Global sample		Men		Women	
		f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Daily consumption	0 days	24	4.0	11	3.8	13	4.2	17	2.8	10	3.4	7	2.3
	1 day	27	4.5	12	4.1	15	4.8	51	8.5	29	10.0	22	7.1
	2 days	52	8.7	22	7.6	30	9.7	125	20.8	72	24.8	53	17.1
	3 days	77	12.8	42	14.5	35	11.3	121	20.2	59	20.3	62	20.0
	4 days	76	12.7	33	11.4	43	13.9	94	15.7	50	17.2	44	14.2
	5 days	88	14.7	47	16.2	41	13.2	66	11.0	26	9.0	40	12.9
	6 days	50	8.3	23	7.9	27	8.7	34	5.7	15	5.2	19	6.1
	7 days	197	32.8	93	32.1	104	33.5	83	13.8	23	7.9	60	19.4
	DK/DA	9	1.5	7	2.4	2	0.6	9	1.5	6	2.1	3	1.0
	Total	600	100	290	100	310	100	600	100	290	100	310	100
Number of servings per day	0 servings	20	3.3	9	3.1	11	3.5	13	2.2	9	3.1	4	1.3
	1 serving	261	43.5	130	44.8	131	42.3	399	66.5	204	70.3	195	62.9
	2 servings	226	37.7	106	36.6	120	38.7	122	20.3	55	19.0	67	21.6
	3 servings	55	9.2	22	7.6	33	10.6	27	4.5	8	2.8	19	6.1
	4 servings	13	2.2	7	2.4	6	1.9	12	2.0	2	0.7	10	3.2
	> 4 servings	8	1.3	5	1.7	3	1.0	4	0.7	0	0.0	4	1.3
	DK/DA	17	2.8	11	3.8	6	1.9	23	3.8	12	4.1	11	3.5
	Total	600	100	290	100	310	100	600	100	290	100	310	100

f: frequency; DK/DA: do not know/do not answer.
Source: Own elaboration.

Discussion

Most students drink alcohol at least once a month, without significant differences between men and women. While it is true that few students do it between 1 and 2 days per week, this figure is higher than that found by other authors (16), who also reported higher alcohol consumption in men than in women. The results of this research are above those found by Castañeda-Vázquez & Romero-Granados (17), since more than one third of the population studied use alcohol on weekends and more than 40% do so occasionally. One of the main problems of university students is binge drinking, which has been described by several authors. (18,19)

In turn, tobacco is also used by one third of the students, a figure similar to that reported by Castillo-Viera & Sáenz-López (20) in students of the University of Huelva, although tobacco consumption in this age group is studied in a very superficial way. (3) In addition, prevention campaigns in this type of population are difficult and insufficient, so it is important to continue conducting research on lines of action and their effectiveness for controlling smoking at the youngest possible age.

Regarding transport, most of the students in this study move actively, whether by walking or cycling or any other means of transport. Comparing sexes, women show higher rates of active commuting than men, and they do it more frequently. There is evidence that active commuting to the educational center (school, institute, university, etc.) is an opportunity to increase PA levels in young people and prevent or mitigate the increase of body weight. (21-24) One of the main reasons found in this study for high mobility in bicycles is the orographic characteristics of Lleida, which is a small city without significant slopes, so it is not necessary to travel long distances to get anywhere. In consequence, some authors have considered developing strategies based on socio-ecological models (25), actions in relation to urban design, transport systems or resources for recreation and green spaces.

According to different studies, adults aged between 18 and 64 years should accumulate a minimum of 150 minutes per week of moderate aerobic PA or 75 minutes per week of vigorous aerobic PA (or the equivalent combination of both). The present study shows that 75% of university students are regularly active and that, of these, a large percentage have a high level of PA, so the majority are regularly active; this coincides with other studies conducted in university populations. (9,11) It was also found that most students who practice PA, do so two or more days a week, so the promotion and awareness campaigns towards the practice of PA should be directed towards a smaller group of students who do not carry out any PA at all.

PA practice had statistically significant differences between sexes. This is a constant pattern, since PA is one of the few health-related behaviors typically more prevalent in men than in women. (6,16,26) In this sense, activities that motivate university students to adhere to the practice of PA should be promoted.

Another variable studied was fruits and vegetables intake in students, but data were not encouraging, since only a third of the students consume fruits on a daily basis and only half do it between 3 and 6 days per week. The consumption of vegetables is much lower, since only 1 in 10 students interviewed here do it daily, being more frequent in women. Following the recommendations of the dietary guidelines for the Spanish population (27,28), which suggest the daily consumption of fruits and vegetables, the students of the UDL are still far below the established figures. (27,28)

These results show a progressive loss of adherence to the Mediterranean diet, characterized by a high consumption of vegetables and a abundant consumption of fresh fruits, as no student consumed these products. (29) The lack of consumption of fruits and vegetables could predict an increase in pathologies derived from poor diet, such as obesity or diabetes. (30,31)

University students are a key population to carry out health promotion and prevention activities, so it is necessary to create strategic education plans that improve the quality of life and promote the acquisition of good eating habits and the performance of PA. Based on the results, the UDL will propose specific strategies for the promotion of healthier lifestyles.

One of the main limitations of this study is that data related to alcohol consumption was self-reported and this means that, although data are reliable, could be biased despite having answered the test anonymously. Socio-economic data that could bias the results were not collected either. However, it is essential to be able to detect risk consumption early in order to modify consumption patterns in a population so vulnerable to its effects. Intervening the university population at risk may provide important benefits, not only in academic terms but in future pathologies derived from the consumption of alcohol and tobacco.

Conclusions

A high percentage of students use alcohol and tobacco regularly. The vast majority of students move actively, especially women. This study shows that a significant amount of university students are regularly active and that, of these, a high percentage has a high level of PA practice. According to the recommendations of different dietary guidelines, students of the UDL are far below in terms of consumption of fruits and vegetables.

Conflicts of interest

None stated by the authors.

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References

1. **Schlessman AM, Martin K, Ritzline PD, Petrosino CL.** The role of physical therapist in pediatric health promotion and obesity prevention: comparison of attitudes. *Pediatr Phys Ther.* 2011;23(1):79-86. http://doi.org/bxp454.
2. **Troncoso C, Amaya JP.** Factores sociales en las conductas alimentarias de estudiantes universitarios. *Rev. Chil. Nutr.* 2009;36(4):1090-7. http://doi.org/ct36zs.
3. **Chelet-Martí M, Escriche-Saura A, García-Hernández J, Moreno-Bas P.** Consumo de tabaco en población universitaria de Valencia. *Trastor Adict.* 2011;13(1):5-10.

4. **Miquel L, Rodamilans M, Giménez R, Cambras T, Canudas AM, Gual A.** Evaluación del consumo de riesgo de alcohol en estudiantes universitarios de la Facultad de Farmacia. *Adicciones.* 2016;27(3):190-7. http://doi.org/cm8p.
5. **Cancela-Carral JM, Ayán-Pérez C.** Prevalencia y relación entre el nivel de actividad física y las actitudes alimenticias anómalas en estudiantes universitarias españolas de ciencias de la salud y la educación. *Rev Esp Salud Pública.* 2011;85(5):499-505.
6. **Rodríguez F, Palma X, Romo A, Escobar D, Aragú B, Espinoza L, *et al.*** Hábitos alimentarios, actividad física y nivel socioeconómico en estudiantes universitarios de Chile. *Nutr Hosp.* 2013;28(2):447-55. http://doi.org/b5dq.
7. **Escalante Y.** Physical activity, exercise, and fitness in the public health field. *Rev Esp Salud Pública.* 2011;85(4):325-8. http://doi.org/bh7s6d.
8. **Blasco T, Capdevila L, Pintanel M, Valiente L, Cruz J.** Evolución de los patrones de actividad física en estudiantes universitarios. *Revista de Psicología del Deporte.* 1996;5(2):51-63.
9. **Pavón-Lores AI, Moreno-Murcia JA.** Actitud de los universitarios ante la práctica físico-deportiva: diferencias por géneros. *Revista de Psicología del Deporte.* 2008;17(1):7-23.
10. **Moreno-Murcia JA, Pavón-Lores AI, Gutiérrez-Sanmartín M, Sicilia-Camacho A.** Motivaciones de los universitarios hacia la práctica físico-deportiva. *Rev. int. med. cienc. acti. fis. Deporte.* 2005;5(19):154-65.
11. **Castañeda-Vázquez C, Campos-Mesa MC, Del Castillo-Andrés O.** Actividad física y percepción de salud de los estudiantes universitarios. *Rev. Fac. Med.* 2016;64(2):277-84. http://doi.org/cm8q.
12. **Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, *et al.*** International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc.* 2003;35(8):1381-95. http://doi.org/bk5h6s.
13. **Armstrong T, Bull F.** Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). *J Public Health.* 2006;14(2):66-70. http://doi.org/dhq9nh.
14. **Bull FC, Maslin TS, Armstrong T.** Global Physical Activity Questionnaire (GPAQ): Nine country reliability and validity study. *J Phys Act Health.* 2009;6(6):790-804.
15. Organización Mundial de la Salud. Cuestionario Mundial sobre Actividad Física (GPAQ). Ginebra: OMS.
16. **Mantilla-Toloza SC, Gómez-Conesa A, Hidalgo-Montesinos MD.** Actividad física, tabaquismo y consumo de alcohol, en un grupo de estudiantes universitarios. *Rev. salud pública.* 2011;13(5):748-58. http://doi.org/cm8s.
17. **Castañeda-Vazquez C, Romero-Granados S.** Alimentación y Consumo de Sustancias (alcohol, tabaco y drogas) del alumnado universitario. Análisis en función del género y la práctica de actividad físico-deportiva. *CCD.* 2014;9:95-105. http://doi.org/bdt7.
18. **El Ansari W, Stock C, Mills C.** Is Alcohol Consumption Associated with Poor Academic Achievement in University Students? *Int J Prev Med.* 2013;4(10):1175-88.
19. **McCambridge J, Bendtsen M, Karlsson N, White IR, Nilsen P, Bendtsen P.** Alcohol assessment and feedback by email for university students: main findings from a randomized controlled trial. *Br J Psychiatry.* 2013;203(5):334-40. http://doi.org/f224fs.
20. **Castillo-Viera E, Sáenz-López P.** Práctica de actividad física y estilo de vida del alumnado de la Universidad de Huelva. Huelva: Servicio de publicaciones de la Universidad de Huelva; 2008.
21. **Segura-Díaz JM, Herrador-Colmenero M, Martínez-Téllez B, Chillón P.** Efecto de la precipitación y el periodo estacional sobre los patrones de desplazamiento al centro educativo en niños y adolescentes de Granada. *Nutr Hosp.* 2015;31(3):1264-72. http://doi.org/cm8t.
22. **Villa-González E, Rodríguez-López C, Huertas Delgado FJ, Tercedor P, Ruiz JR, Chillón P.** Factores personales y ambientales asociados con el desplazamiento activo al colegio de los escolares españoles. *Revista de Psicología del Deporte.* 2012;21(2):343-9.
23. **Chillón P, Molina-García J, Castillo I, Queralt A.** What distance do university students walk and bike dayly to class in Spain. *Journal of Transport & Health.* 2016;3(3):315-20. http://doi.org/f88brh.
24. **Molina-García J, Sallis JF, Castillo I.** Active commuting and sociodemographic factors among university students in Spain. *J Phys Act Health.* 2014;11(2):259-63. http://doi.org/f5v6pk.
25. **Sallis JF, Bowles HR, Bauman A, Ainsworth BE, Bull FC, Craig CL, *et al.*** Neighborhood environments and physical activity among adults in 11 countries. *Am J Prev Med.* 2009;36(6):484-90. http://doi.org/cz3rtx.
26. **Romaguera D, Tauler P, Bennasar M, Pericas J, Moreno C, Martinez S, *et al.*** Determinants and patterns of physical activity practice among Spanish university students. *J Sport Sci.* 2011;29(9):989-97. http://doi.org/bsg4mr.
27. **Montagnese C, Santarpia L, Buonifacio M, Nardelli A, Caldara AR, Silvestri E, *et al.*** European food-based dietary guidelines: a comparison and update. *Nutrition.* 2015;31(7-8):908-15. http://doi.org/f7hxxv.
28. Agencia Española de Consumo, Seguridad Alimentaria y Nutrición. Evaluación y seguimiento de la estrategia NAOS: conjunto mínimo de indicadores. Madrid: Ministerio de Sanidad, Servicios Sociales e Igualdad; 2015.
29. **Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S, *et al.*** Mediterranean diet pyramid today. Science and cultural updates. *Public Health Nutr.* 2011;14(12A):2274-84. http://doi.org/dvhf2f.
30. **He K, Hu FB, Colditz GA, Manson JE, Willett WC, Liu S.** Changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women. *Int J Obes Relat Metab Disord.* 2004;28(12):1569-74. http://doi.org/dg98df.
31. **Palou A, Bonet ML.** Challenges in obesity research. *Nutr Hosp.* 2013;28(Suppl 5):144-53. http://doi.org/cm8v.

Artículo 2

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PHYSICAL ACTIVITY FROM CYCLING AND EFFECTS ON THE MEDITERRANEAN DIET. PROJECT: ASISA

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ABSTRACT

Cycling can facilitate daily physical activity. Several studies have investigated the relationship between active displacement and healthy lifestyles. However, very few studies examine the relationship just between cycling and adherence to the Mediterranean diet. The objective of this study was to evaluate the relationship between bicycle displacements of the adult population that work or study in an urban environment and the adherence to the Mediterranean diet (AMD). Methodology: a cross-sectional study was carried out with 1,492 adults in the city of Lleida, Spain. Participants responded to a survey about physical activity and adherence to the Mediterranean Diet from June 2016 to May 2017. Results of this study with inactive subjects and cyclists provided confirmatory and novel data. Most of the subjects evidence a poor AMD, and cycling was associated with greater AMD. These findings indicate that competent authorities might promote cycling as a daily routine to reduce sedentary lifestyles, as well as improving public health and well-being in general. In conclusion, more campaigns promoting healthy lifestyles are necessary.

Keywords: Healthy Diet, Health Promotion, Health Public Policy, Motor Activity, Urban Health.

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Introduction

Physical inactivity is an important risk factor for many noncommunicable diseases and also shortens life expectancy[1,2]. In this regard, active commuting, by walking and/or cycling, is increasingly promoted because of their potential to increase physical activity (PA) levels in the general population[1,3]. Active commuting has multiple health benefits: reduces cardiovascular risk, reduces body weight, improves general fitness condition, and increases physical and mental well-being(1). Specifically, cycling has been inversely associated with mortality, for both men and women[2]. Cycling as an active displacement provides similar or greater health enhancements than walking, since cycling intensity is greater than by walking[4].

According to the World Health Organization, to obtain these benefits and consider that a subject is active, adults should practice at least 150 minutes of moderate intensity aerobic activity or 75 minutes of vigorous intensity per week or an equivalent combination of both physical intensities.

Diet is one of the most influential factors for health[5]. The traditional Mediterranean Diet (MD) is considered one of the healthiest ones. Recent reviews highlighted the protective factor of MD on numerous chronic and degenerative diseases such as metabolic syndrome, cardiovascular risk, atherosclerosis, cancer, diabetes, obesity…[5,6].

Although health benefits of cycling and MD have been widely demonstrated, population adherence to MD (ADM) or to bycicle commuting are low. Moreover, AMD has decreased worldwide in recent decades, especially among the inhabitants of the Mediterranean basin, together with the proportion of active adult subjects[1]. Determining how behavioral risk factors are grouped might contribute

to the development of future preventive and comprehensive health interventions. Although several studies have examined the relationship between active displacement and the Mediterranean diet[3,5], none of them studied the relationship between cycling and AMD in adults who use this means of transportation daily. The objective of this study was to evaluate the relationship between bicycle travel and AMD among the adult population that works or studies in a dense, Mediterranean/southern European urban environment.

Methods

Participants

This cross-sectional study was based on participants from the physical activity and and health survey ASISA/BICI. It is a relatively large study aimed at investigating the risks and benefits of physical activity. Participants were residents in Lleida, Spain. Recruitment was carried out by trained interviewers on the streets of the city between June 2016 and May 2017. A total of 30 random points in the city were selected in order to guarantee the representativeness of the sample. Adults who traveled by bicycle and those who did not were asked to answer some screening questions, and those who met the inclusion criteria were invited to answer an electronic survey. 1,492 cyclists (777 men, 715 women) were included in the study. A control group of inactive subjects was recruited by asking, cyclists to invite subjects of similar sociodemographic status who did not practice physical activity on a regular basis to participate in the study. Out of a total of 1,492 subjects enrolled, 738 were classified as inactive according to the short version of the International Physical Activity Questionnaire (IPAQ)[7] and were consequently included in the control group.

Adherence to the Mediterranean Diet

The AMD was evaluated using the Spanish version of the validated questionnaire "Mediterranean Diet Adherence Screener" (MEDAS)(6). The MEDAS consists of 12 questions about the frequency of food consumption and 2 questions about eating habits considered as characteristic of the Spanish MD. Each question is punctuated with 0 or 1.

The total score ranges from 0 to 14 and allows to differentiate three levels of AMD: low (0-6), medium[7-8] and high (≥9).

Physical activity and training

The level of physical activity was established by the Spanish version 7 of the short questionnaire of the "International Physical Activity Questionnaire" (IPAQ), which shows acceptable psychometric properties. The questionnaire values allow categorizing subjects with low, medium or high levels of physical activity. Subjects with low levels of physical activity were considered inactive. A questionnaire was designed to evaluate the training level of cycling practitioners by recording the volume (h/wk in the last month), frequency (days/wk in the last month) and training experience (years of practice).

Statistical analysis

Statistical analysis was performed using the IBM Statistical Package for Social Sciences (IBM SPSS Statistics, v. 24.0 WINDOWS). Cohort data are presented as mean ± standard deviation or percentage. To measure the differences in the variables of interest, a 2-way ANOVA analysis was performed with two factors between subjects (GROUP: cyclists and inactive, and SEX: male and female). To establish the differences in the qualitative variables, the Chi-square test was applied. Pearson's correlations were used to establish relationships of interest. Differences were considered statisticaly significant when $p < 0.05$.

The study protocol was approved by the "Research Ethics Committee of the Spatial Didactics Department of the University of Lleida ". n° 02/2016/DEUDL.

Results

Differences between groups in healthy habits

No age differences were observed between groups ($p = 0.383$) (Table 1). In both sexes, cyclists showed lower values of BMI and higher levels of physical activity (all $p < 0.05$) compared with the control group. Volume and frequency of cycling were comparable between the sexes, with no differences in the years of sports practice ($p = 0.394$).

	MEN		WOMEN		p value	
	Cyclists (400)	Inactive (167)	Cyclists (344)	Inactive (171)	Group	Sex
Age	39.2 ± 9.9	38.9 ± 8.0	37.8 ± 10.1	36.3 ± 11.2	0.383	0.001
BMI (kg/m²)	25.3 ± 3.1	26.9 ± 4.5*	22.6 ± 3.3	24.1 ± 4.2*	0.000	0.000
Physical activity (MET-min/week)	3489 ± 1964	1015 ± 760*	3011 ± 1591	899 ± 865*	0.000	0.031
Training						
Current sports experience (years)	3.9 ± 2.9	_	3.1 ± 2.7	_	0.304	0.000
Frecuency last month (days/week)	2.7 ± 1.3	_	2.4 ± 1.2	_	0.000	0.582
Volume last month (hours/weeks)	2.6 ± 1.2	_	2.4 ± 1.3	_	0.000	0.175
Adherence to Mediterranean Diet						
1. Use olive oil as the main fat for cooking	98	96	95	93	0.144	0.171
2. ≥ 4 tablespoons of olive oil a day	46	45	39	42	0.099	0.630
3. ≥ 2 vegetable servings a day	56	43*	71	68	0.011	0.000
4. ≥ 3 pieces of fruit per day	39	24*	42	24*	0.000	0.001
5. < 1 serving of red meat or sausage a day	53	61*	72	71	0.019	0.000
6. < 1 serving of animal fat a day	93	93	91	92	0.000	0.411
7. < 1 sugary drink a day	81	73*	89	85	0.001	0.001
8. ≥ 7 glasses of red wine a week	14	13	9	8	0.056	0.011
9. ≥ 3 servings of legumes a week	31	33	22	20	0.001	0.000
10. ≥ 3 fish servings a week	37	26*	44	33*	0.009	0.007
11. < 2 commercial cakes or pastries a week	68	51*	77	63*	0.004	0.002
12. ≥ 3 or more portions of nuts a week	43	28*	37	36	0.000	0.000
13. Preferably consume white meat than red meat	79	62*	87	82	0.000	0.000
14. ≥ 2 sometimes a week dish with a traditional sauce of tomatoes, garlic and onions	68	70	51	66*	0.000	0.000
Total score	7.8 ± 1.7	7.0 ± 2.0*	8.2 ± 1.0	7.7± 1.5*	0.000	0.000
Score <7 (%)	23.9	41.6*	22.1	27.3*	0.000	0.033
Score 7-8 (%)	41.3	34.3	32.8	39.3	0.019	0.301
Score >9 (%)	37.1	23.2*	48.3	36.4*	0.000	0.169
* p < 0.05 Inactives vs. cyclists						

TABLE 1. Basic characteristics of the subjects and differences between groups

Differences between groups in the AMD

The majority of subjects showed low or medium levels of AMD (Table 1). Main deficiencies, with less than 50% compliance, were associated with the consumption of nuts, olive oil, fruit, fish, vegetables and wine. Women showed higher AMD than men ($p = 0.000$). In both sexes, cyclists showed higher AMD than inactive people ($p = 0.000$).

Discussion

The results of the present study with inactive subjects and cyclists provided confirmatory and novel data: the majority of subjects evidenced a deficient AMD, while bicycle displacement was associated with a higher AMD.

The results obtained strongly reinforce data from recent studies suggesting a deficient AMD in the Spanish population, associated with the scarce consumption of olive oil, vegetables, fruit and fish[5,6]. It is also confirmed that a very high percentage of people meet the objectives of using olive oil as the main fat for cooking, as well as the low consumption of red meat, animal fat and carbonated/sugary drinks. Even under these conditions, it was evident that the majority of the participants were classified in the lowest category of AMD while only less than a half of the cyclists showed a high AMD, which indicates that a high percentage of the population is not adhering to a healthy diet. These results reinforce the need for interventions to promote a healthy diet for both sexes.

Using bycicle for urban commuting presents variate health benefits that are more evidents when presented as a alternative to sedentary lifestyles.8 Determining how behavioral risk factors are associated might contribute to the development of better preventive and comprehensive public health campaings[8].

Moreover, a better knowledge regarding how diet and physical activity relate is of special interest since in Mediterranean countries, such as Spain, an increase of physical lifestyles among the population might reverse the currently low ADM. Moreover, this would contribute to promote comprehensive public health campaings aimed to enhance simultaneously active and nutritional behaviours.

We performed a specific analysis to determine the possible association between active commuting and AMD. Previous results established that cycling could be a mediating factor in a satisfactory state

of health[1,3,4,5]. Our results contribute to the current knowledge suggesting that for both sexes, cycling on a regular basis might increase AMD levels. It was also observed that most urban cyclists comply with the international recommendations of the World Health Organization. Our findings indicate that competent authorities might promote bicycling as a daily routine to reduce sedentary, as well as improve public health and well-being in general. Finally, more campaigns to promote healthy lifestyles are needed, in order to improve adherence to the Mediterranean diet. The current strategies are insufficient so that most of the population evidenced high AMD.

Limitations and strengths

Some limitations in our study should be considered. First, this study was conducted in only one city. Hence, generalization of our findings is geographically limited. Second, we used a cross-sectional design, which precludes any assumptions about causality. Finally, data was obtained by interviews and questionnaires, which are susceptible to information bias. This study has several strengths, too. The study has high internal validity, with a good representation of bicycle commutings. Moreover, the sample of cyclists was large and complete, which enhances the population representativity for Lleida, Spain. Finally, our study in a southern European city has added evidence to a novel topic, relevant for the sostenibility of Mediterranean cities and inhabitants quality of life.

Future research

Our findings underscored the need for future research. There is a need to obtain a clear understanding about the relationship between bicycle commuting and ADM in longitudinal studies. It is probable that other factors might influence this relationship, specially those related with environmental and cultural determinants. Our results present a wide view on the nutritional behavior and active commuting in a city, which is information frequently lacking in scientific literature. This results might direct future researchers and governos to promote more active and healthier lifestyles

Founding

Projec: Chair ASISA-University of Lleida. Title: Activity practice

Physical cycling: effects on health and quality of life ..

University of Lleida. Concession reference: ASISA Chair

References

1) Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Physical Activity Series Working Group. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012; 21(380): 247-57.
2) De Geus B, Van Hoof E, Aerts I, Meeusen R. Cycling to work: influence on indexes of health in untrained men and women in Flanders. Coronary heart disease and quality of life. Scand J Med Sci Sports. 2008; 18: 498-510
3) Riiser A, Solbraa A, Jenum AK, Birkeland KI, Andersen LB. Cycling and walking for transport and their associations with diabetes and risk factors for cardiovascular disease. J Transp Health. 2018. https://doi.org/10.1016/j.jth.2018.09.002
4) Oja P, Manttari A, Heinonen A, Kukkonen-Harjula K, Laukkanen R, Pasanen M, et al. Physiological effects of walking and cycling to work. Scand. J Med Sci. Sport. 1991; 1(3): 151-157. https://doi.org/10.1111/j.1600-0838.1991.tb00288.x.
5) Mayolas-Pi C, Munguia-Izquierdo D, Peñarrubia-Lozano C, Reverter-Masia J, Bueno-Antequera J, López-Laval I, et al. Adherencia a la dieta mediterránea en adultos inactivos, practicantes de ciclo indoory ciclistas aficionados. Nutri hospital. 2017; 35(1): 131-139.
6) Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 2011; 141(6): 1140-5.
7) Toloza SM, Gómez-Conesa A. El Cuestionario Internacional de Actividad Física. Un instrumento adecuado en el seguimiento de la actividad física poblacional. ReviIBERiaFisoKinesi. 2007; 10(1): 48-52.
8) Crane M, Rissel C, Standen C, Greaves S. Associations between the frequency of cycling and domains of quality of life. Health Promotion J Austr. 2014; 25(3): 182-185.
9) Noble N, Paul C, Turon H, Oldmeadow C. Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. Prev Med. 2015; 81: 16-41.

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Artículo 3

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EFFECTIVENESS OF A PHYSICAL ACTIVITY INTERVENTION PROGRAMME ON THE INTEGRAL HEALTH OF UNIVERSITY PROFESSORS

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ABSTRACT

Introduction: *Physical exercise programmes (PA) are common in the scientific literature. However, few studies have evaluated adherence to physical activity after PA interventions. This study aimed to test the effectiveness of a long-term physical exercise programme in postmenopausal women.*

Methods: *Longitudinal design. Thirty-two women participated in this study (age 61.6 years). At the beginning of the study, an evaluation of participants' physical condition, adherence to the Mediterranean diet (AMD) and different biochemical parameters were performed. When the initial results were obtained, a PA intervention programme was conducted. Three months after the start of the intervention, all the previous parameters were reassessed, and 6 months after the end of the intervention, the parameters were revaluated.*

Results: *In total, 90% of the women completed the programme. The intervention increases the level of PA and improves biochemical parameters. At 6 months after the end of the intervention, the positive effects of the PA programme were maintained, especially in agility ($p<0.01$) and resistance ($p<0.000$).*

Conclusions: *Adherence to PA was observed after a physical exercise programme. For the entire study population, the exercise programme improved physical condition, and those indicators remained improved after 6 months. Additionally, increases in PA were associated with improvements in AMD.*

Keywords: *Postmenopausal women, physical activity, adherence, exercise intervention.*

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Introduction

Less than half of Europeans do not meet the minimum recommendations of weekly physical activity (PA), and approximately 30% of citizens do not exercise at all[1]. In Spain, 33.6% of the population aged 18 and 69 years do not meet the weekly recommendations (31.3% men; 35.8% women[2].

According to the World Health Organization (WHO), physical inactivity is the fourth-leading risk factor for global mortality[1]. Its high prevalence worldwide represents one of the main challenges for global public health. Physical exercise is commonly prescribed to prevent premature mortality in the elderly[2-4].

It reduces body fat, improves lipid and lipoprotein profiles, improves glycaemic control, improves the immunological system and reduces oxidative stress[5, 6]. In contrast, the poor physical condition has been associated with fragility and functional dependence[5]. For this reason, some determinants of physical fitness, such as aerobic capacity, mobility, muscular strength or stability, have become indicators of healthy ageing[6]. As a result, the early detection of poor physical fitness, together with the implementation of adequate physical exercise programmes, are key elements for policy-makers aiming to improve public health[2].

Simultaneously, the Mediterranean diet (MD) has been considered a healthy standard that

ensures balanced nutritional and caloric intake[7]. It contributes to the prevention of numerous diseases, such as acute myocardial infarction, arterial hypertension, type II diabetes or cancer, and increases life expectancy[8, 9]. In addition, recent studies have reported that populations that do not adhere to the MD have a higher risk of type II diabetes and obesity[3, 10].

Active lifestyles and physical conditions have been associated with nutritional habits[6], and all three aspects seem to influence the ageing of human cells and organisms[11, 12]. Although public health campaigns might enhance citizens' daily physical activity and nutritional behaviour for a period of time[10, 13], the current main challenge is to generate adherence to those habits[13, 14]. Exercise prescriptions might include, in addition to a systematic exercise programme[15], indicators of adherence in the mid-long term[12]. Although some studies have demonstrated the effectiveness of an exercise programme, knowledge of participants' adherence in the mid-term remains scarce[13, 16, 17].

For these reasons, the main objectives of this study were i) to assess the effectiveness of an exercise programme in the short and mid-term and ii) to assess the impact of this programme on physical condition (PC), adherence to Mediterranean diet (AMD), biochemical indicators of health, and anthropometrics.

Materials and methods

Design

We used a longitudinal design with a single group. Data were collected at the beginning of a 3-month programme (Pre), at the end of the programme (Post T1), and 9 months after the programme (Post T2) (Figure 1). The intervention lasted 12 weeks and took place between September and November 2017.

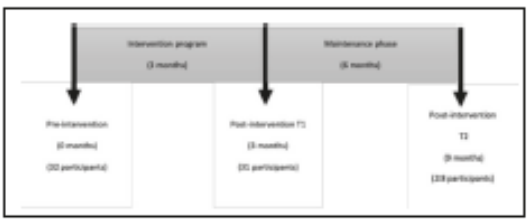

Figure 1: Action protocol.

Participants

Thirty-two women participated in this study (age 61.6±1.4 years). All participants taught at the University of Lleida and were married/in unions. The inclusion criteria were as follows: women, university professors, over 60 years of age, no cardiovascular or chronic disease that precluded them from participating in a physical exercise programme, and a low level of physical activity according to the International Physical Activity Questionnaire (IPAQ) (Table 1).

A minimum sample size of 32 participants was calculated using G-Power v3.1 for mixed ANOVA with interactions ($1\text{-}\beta = 90\%$, $\alpha = 5\%$, $r = 0.7$). Recruitment was performed via the placement of leaflets in hospitals and faculty offices in university buildings. Participants were informed prior to the study and gave their signed consent. Procedures of this study were approved by the Ethical Committee of Clinical Research of the Sports Administration of Catalonia (02/2018/CEICGC). They met the principles of the latest revision of the Declaration of Helsinki.

Measurements and follow-up

Participants were assessed at the beginning of the study, after a 3-month programme and six months after the programme. Forms were answered individually, without the help of researchers.

Anthropometric variables

Anthropometric measurements were taken at each assessment (Pre, T1, T2). Participants were measured using a wall stadiometer (Seca-240, Hamburg, Germany) and weighed using an electronic scale (Tanita TBF300, Illinois, USA). Body mass index (BMI) was then calculated according to Quételet (kg/m^2).

Physical activity

The Spanish version of the International Physical Activity Questionnaire (IPAQ) was used to determine the level of physical activity of participants[21]. Physical activity was expressed in terms of MET-min/week[15]. Participants were then classified as engaging in high-level (3 or more days/week of vigorous exercise, achieving 1500 MET-min/week or more), moderate-level (5 or more days of each combination of walking and moderate-vigorous physical activity, achieving 600 MET-min/week or more) or low-level (under 600 MET-min/week) physical activity[18].

Mediterranean diet adherence (MDA)

Mediterranean diet adherence (MDA) was assessed using the Spanish version of the Mediterranean Diet Adherence Questionnaire (MEDAS-14)[18]. This questionnaire contains 12 food frequency items and two behavioural items; these items are specific

to the Spanish Mediterranean diet. Each answer is scored 0 points or 1 point.

One point is added when olive oil is used as a main cooking fat, when white meat is preferred to red meat, or for consuming the following:

- 4 or more daily tablespoons of olive oil;
- 2 or more daily portions of vegetables;
- 3 or more daily pieces of fruit;
- Less than 1 daily portion of red meat or sausage;
- Less than 1 daily portion of animal fat;
- Less than 1 daily sugary drink;
- 7 or more weekly glasses of wine;
- 3 or more weekly portions of legumes;
- Less than 2 weekly portions of cake or pastry;
- 3 or more weekly portions of nuts;
- 2 or more weekly dishes containing traditional sauces of tomato, garlic and onion.

The total score ranges from 0 to 14 points and can be classified into three levels of MDA: low (0 - 6), medium (7 - 8), or high (≥ 9)[19].

Lipid profile

Biochemical analyses for total cholesterol, LDLcholesterol, HDLcholesterol, glucose, uric acid and triglycerides were performed at the nearest hospital (Hospital UniversitariArnau de Villanova de Lleida, Spain). Fasting blood samples were collected between 8:00 and 9:00 AM from an antecubital vein and stored in tubes with EDTA. Blood samples were quickly centrifuged, and plasma was separated for posterior analysis. Plasma glucose, cholesterol and triglycerides were analysed using enzymatic colorimetric methods (Bio-Assay System, Hayward, CA, USA). Cholesterol (LDL and HDL) was analysed after precipitation using quantitative colorimetric methods (Crystal Chem, Downers Grove, IL, USA).

Physical condition

Assessments of physical condition (PC) were made using an adapted version(20) of the Senior Fitness Test Battery[21] and Eurofit Testing Battery[22], consisting of the following tests:

- *Stability - Flamingo test:* time that a participant was able to stand on a single leg, up to 60 s.
- *Lower extremity strength - Chair-stand test:* maximum number of repetitions that a participant was able to complete standing up and sitting during a period of 30 s.
- *Upper extremity strength - Arm curl test:* maximum number of repetitions that a participant was able to complete performing arm curls with a 2.5 kg dumbbell during a period of 30 s.
- *Lower extremity flexibility - Chair sit and reach test:* distance (cm) from fingers to toes during a trunk flexion in sitting position.
- *Upper extremity flexibility - Back scratch test:* distance (cm) between right and left fingers when crossing the arms backward in diagonal.
- *Agility - Foot up-and-go test:* time (s) that a participant takes to complete a circuit from sitting position.
- *Velocity - Brisk walking test:* time (s) that a participant needs to walk a distance of 30 m.
- *Endurance - 6-minute walk test:* distance (m) that a participant is able to walk in 6 min.

Intervention

Participants completed a 12-week exercise programme consisting of 24 sessions (duration: 1 hour; frequency: 2 sessions/week). This programme was supervised and individualized by two sports science graduates. Each session was organized in 3 parts: warmup (10 min), workout (20 min strength exercises + 15 min cardiorespiratory fitness), and cool down (5 min of posture, motor coordination, flexibility, stability and reaction time exercises). At the end of each session, participants gave their rating of perceived exertion (RPE) on a 7-20 scale[23]. Strength training was programmed in two phases: I) weeks 1 to 6: 2 series of 20 repetitions per exercise at 50% of 1-repetition maximum (1RM), with 2 - 3 min of rest between series; and II) weeks 7 to 12: 3 series of 15 repetitions at 65% of 1RM, with 2 - 3 min of rest between series. Strength exercises included the arm curl, French press, squat, bending over, military press and bench press. To determine 10RM, participants performed a standardized warmup and then performed repetitions with incremental resistance. Cardiorespiratory training was performed on a treadmill and consisted of 15 min (phase I) and 25 min (phase II) of walking/running at a regular pace at an individualized intensity based on the 6-min walk test.

Statistical analysis

Data analysis was performed using SPSS v24.0 (SPSS Inc. Chicago, IL, USA). Data are presented as the mean ± standard deviation unless otherwise stated. The normality of the distributions of the variables was tested using the Shapiro-Wilk test. The normality of the distributions of the variables was tested by means of the Kolmogorov-Smirnov test. With normal distributions, Student's t-test was used, and when the sample did not meet the assumption of normality, the Wilcoxon test and chi-square test were

used for categorical variables. Time differences were assessed using repeated-measures ANOVA. All confidence intervals were calculated at 95%. The level of significance for all analyses was set at P<0.05.

Results

Participant characteristics at each measurement can be found in Table 1. One participant dropped out of the study during the intervention for personal reasons and was excluded from the statistical analysis. All participants had normal Mass Corporal Index (IMC)values according to their age[30].

At the beginning of the study, all participants with a physical activity <600 MET-min/week were considered inactive. Regarding MDA, 28% of participants were classified as low, 68% as a medium, and 3% as high. Biochemical results can be found in Table 2.

Post-intervention (T1)

The mean attendance at the sessions was 95%. There was a statistically significant increase in PC in all participants (p<0.019). AMD improved at all levels, with an increase in the medium- and high-level proportions.

Pre-intervention (0 months)		Group			p value		
		Post-intervention T1	Follow-up T2	(0 months) vs (T1)	(0 months) vs (T2)	(T1) vs (T2)	
Age (years)		61.6±1.4	61.5±1.4	61.5±1.4	(n.s)	(n.s)	(n.s)
Abody mass index BMI (kg/m²)		27.0±4.1	26.9±4.1	26.9±4.1	(n.s)	(n.s)	(n.s)
Physical activity (MET-min semana)		966.1±734.3	2089.5±2430.7	1788.0±1643.2	0.019*	0.008*	(n.s)
Differences between groups in adherence to the Mediterranean Diet	Target						
1. Do you use olive oil as main culinary fat?	Yes	31 (96.9%)	31 (96.9%)	31 (96.9%)	(n.s)	(n.s)	(n.s)
2. How much olive oil do you consume in a given day? (including frying, salads, etc.)	≥4 tablespoons/d (1 tablespoon: 13.5 g)	8 (25.0%)	9 (28.1%)	10 (31.3%)	(n.s)	(n.s)	(n.s)
3. How many vegetable servings do you consume per day? (consider side dishes as a half a serving	≥2 servings/d (1 serving: 200 g)	18 (56.3%)	21 (65.6%)	23 (71.9%)	(n.s)	0.043	(n.s)
4. How many fruit units do youconsume per day? (including natural fruit juices)	≥3	9 (28.1%)	17 (53.1%)	17 (53.1%)	0.021*	0.008*	(n.s)
5. How many servings of red meat, hamburger or meat products do you consume per day?	<1	23 (71.9%)	28 (87.5%)	29 (90.6%)	(n.s)	0.048*	(n.s)
6. How many servings of butter, margarine, or cream do you consume per day?	<1	28 (87.5%)	28 (87.5%)	28 (87.5%)	(n.s)	(n.s)	0.030*
7. How many sweetened and/or carbonated beverages do you drink per day?	<1	26 (81.3%)	25 (78.1%)	26 (81.3%)	(n.s)	(n.s)	(n.s)
8. How much wine do you drink per week?	≥7glasses	2 (6.3%)	3 (9.4%)	2 (6.3%)	(n.s)	(n.s)	(n.s)
9. How many servings of legumes do you consume per week? (1 serving 150 g)	≥3	0 (0.0%	1 (3.1%)	1 (3.1%)	(n.s)	(n.s)	(n.s)
10. How many servings of fish or shellfish do you consume per week? (1 serving 100-150 g of fish or 4-5 units or 200 g of shellfish)	≥3	16 (50.0%)	17 (53.1%)	16 (50.0%)	(n.s)	(n.s)	0.030*
11. How many times per week do you consume commercial sweets or pastries	≥3	19 (59.4%)	23 (71.9%)	23 (71.9%)	(n.s)	(n.s)	(n.s)
12. How many servings of nuts do you consume per week? (1 servings 30 g)	<1	12 (37.5%)	12 (37.5%)	12 (37.5%)	(n.s)	(n.s)	(n.s)
13. Do you preferentially consume white meat over red meat?	Yes	28 (87.5%)	27 (84.4%)	28 (87.5%)	(n.s)	(n.s)	(n.s)
14. How many times per week do you consume vegetables, pasta, rice or other dished seasoned with sauce of tomato, onion, garlic, or leek with olive oil?	≥2	17 (53.1%)	11 (34.4%)	9 (28.1%)	(n.s)	0.050*	(n.s)
Mediterranean diet score		7.4±2.1	8.2±2.0	8.2±1.8	(n.s)	(n.s)	(n.s)

Table 1: Characteristics of study population.
aMEDAS, Mediterranean Diet Adherence Screener. bAccordance of food consumption with Mediterranean diet is defined as achieving ≥ 9 targets of MEDAS(10).

	Group			p value		
	Pre-intervention (0 months)	Post-intervention T1	Follow-up T2	(0 months) vs (T1)	(0 months) vs (T2)	(T1) vs (T2)
Triglycerides, mg/dL	93.8±35.2	87.6±23.2	87.1±23.0	(n.s)	(n.s)	(n.s)
Total cholesterol	222.9±25.9	218.9±31.1	218.5±30.8	(n.s)	(n.s)	(n.s)
Glucose, mg/dL	90.8±10.5	95.6±10.2	95.7±10.4	0.013*	0.014*	(n.s)
HDL	64.8±12.9	65.9±14.1	65.5±13.9	(n.s)	(n.s)	(n.s)
LDL	142.4±32.6	135.7±25.7	135.4±25.8	(n.s)	(n.s)	(n.s)
Uric acid, mg/dL	4.762±0.951	4.568±0.807	4.559±0.806	(n.s)	(n.s)	(n.s)

Table 2: Biochemical characteristics.

	Group			p value		
	Pre-intervention (0 months)	Post-intervention T1	Follow-up T2	(0 months) vs (T1)	(0 months) vs (T2)	(T1) vs (T2)
Balance right leg (s)	47.8 ± 19.1	49.9 ± 18.1	57.9 ± 9.2	(n.s)	0.043*	(n.s)
Balance left leg (s)	46.1 ± 20.8	49.3 ± 17.6	50.4 ± 15.6	(n.s)	(n.s)	(n.s)
Leg strength (rep)	13.6 ± 2.0	20.7 ± 4.9	19.5 ± 3.8	0.000*	0.000*	(n.s)
Strength right arm (rep)	15.5 ± 2.6	20.8 ± 2.7	22.0 ± 2.9	0.000*	0.000*	0.029*
Strength left arm (rep)	15.8 ± 2.5	21.3 ± 22.9	21.2 ± 2.3	0.000*	0.000*	(n.s)
Lower extremity flexibility (cm)	-0.3 ± 7.4	1.9 ± 5.6	-0.4 ± 8.1	0.000*	(n.s)	0.038*
Upper extremity flexibility (cm)	0.6 ± 6.0	2.2 ± 6.2	1.4 ± 7.0	(n.s)	(n.s)	(n.s)
Agility (s)	5.2 ± 0.7	4.4 ± 0.5	4.8 ± 0.5	0.000*	0.019*	0.001*
Speed (s)	14.1 ± 2.0	12.5 ± 1.5	12.5 ± 1.2	0.000*	0.001*	(n.s)
Cardiovascular endurance (m)	567.9 ± 57.3	658.5 ± 82.7	630.7 ± 42.7	0.000*	0.010*	0.045*

Table 3: Fitness tests.

Table 2 shows biochemical indicators at each sampling time point. In general, there were no improvements in the parameters except total cholesterol, which slightly decreased after the intervention. There was an improvement in strength ($p<0.001$), velocity ($p<0.001$), agility ($p<0.001$), and endurance ($p<0.001$) (Table 3).

Follow-up (T2)

Physical activity six months after the intervention was assessed in 28 of the participants, and the remaining 3 could not complete the interviews for personal reasons. Although PA decreased during the months following the programme, participants were moderately active, with a statistically significant increase from the beginning of the study ($p<0.008$) (Table 1). The results also confirmed an improvement in MDA (Table 1), especially in fruit, vegetable and nut consumption. In addition, the consumption of sugary drinks, pastries and red meat decreased ($p<0.04$). Biochemical parameters were still stable, except for total cholesterol, which did not show relevant changes. Improvements in PC were maintained until T2 (Table 3).

Discussion

The aim of this study was to determine adherence to physical activity after a 3-month exercise programme. In addition, we aimed to assess whether this adherence was associated with MDA, improvements in biochemical markers, or improvements in PC. Our results confirmed that a 3-month exercise programme can improve adherence to physical activity during the subsequent six months, as well as improve ADM and PC. Exercising regularly and maintaining a balanced diet are some of the recommendations for improving health and quality of life in older adults[2]. Our results revealed relevant changes after the intervention as well as during the subsequent months. Indeed, previous studies have shown how exercise programmes contribute to improvements in several parameters related to PC in adults[23-25]. However, studies, including a longitudinal follow-up, are still scarce[17].

We did not find statistically significant changes in BMI, in contrast to previous studies that reported slight declines[26]. Notwithstanding this finding, we observed how dietary intake improved after the programme. Most of the participants had moderate or high AMD at both posterior measurements (T1 and T2). Nutritional care contributes to delayedageing[27], increased life expectancy[28], control of excess body weight and a reduction inpotential mobility impairments[29].

Our results suggest that improvements in PA might be associated with improvements in AMD. When analysing food intake, we found that improvements in PA were associated with more fruit and vegetable consumption and a decrease in red meat and pastry intake. Similar trends have been previously reported, with increases in fruit and vegetable intake associated with increases in PA[30, 31]. We observed that after exercise, participants showed improved blood triglycerides but not glucose. Notably, participantsshowed reduced LDL cholesterol and slightly reduced HDL cholesterol after the programme. These findings might be relevant from a practical perspective, especially in the prevention of coronary diseases in adult women[3].

Our results regarding total cholesterol, which was elevated in all measurements, are consistent with those of previous studies that found similar trends[3, 32].

Several studies have suggested that menopause might be associated with higher cardiovascular risk in women as a consequence of a deficiency in cardioprotective hormones andoestrogens[33, 34]. In this regard, all participants were postmenopausal, which might have been related tothe lack of change in total cholesterol after the programme.

Previous studies associated being female, being unmarried or divorced, having diabetes, having obesity, having low socioeconomic status and having a low educational level with lower adherence to exercise programmes[35-37].

All participants in our study were university professors, were married/in unions, had high socioeconomic status, had normal weight and were not diabetic. Hence, these characteristics might have contributed to the changes in adherence to physical activity that we observed. Guadalupe-Grauet al.[38], found that elders with less strength had a higher risk of death and/or hospitalization of 45% of women and 30% of men and 25% of women and 16% of men. Since poorer PC is associated with several diseases and mortality, the implementation of specific exercise programmes is fundamental for elderlyadults[39, 40].

Although the association between health and exercise is widely known[41], adherence to exercise programmes is still scarcely investigated, especially in elderly adults[11]. This study proved that a 12-week programme of 2 hours/week of physical activity might contribute to PA and PC improvements over a period of six months after the intervention. Gómez-Cabello et al.[2] suggested that an exercise duration of 2 hours/week or more is a key determinant in improving physical functioning in women.

Limitations

The authors assumed some limitations in the design of this study. First, we acknowledge the lack of objective measures to quantify weekly PA. He sample size was relatively small, greater number of participants are needed to accurately determine training. Finally, the results of the present study are representative of a sedentary postmenopausal women population aged between 60 and 63 years old, and therefore might not be extrapolated to active, younger, or older adults, including those with acute or chronic diseases. In addition, our research was conducted at a regional level, more national studies are necessary. Further research is needed to consider the impact of physical fitness program in postmenopausal women.

Conclusions

This study provides new evidence regarding adherence to physical activity over a 6-month term and its impact on AMD, biochemical indicators, anthropometrics, and PC. To further clarify how PA programmes might succeed or fail, more studies investigating behaviour adherence in the long term are needed. The main findings of our study were as follows: i) a 3-month exercise programme of 2 hours/week increases levels of PA in participants; ii) adherence to PA decreases after 6 months; iii) a 3-month exercise programme improves PC, especially strength, velocity, agility and endurance, and those indicators remain improved after 6 months; iv) our programme improved all of the studied biochemical variables except total cholesterol; and v) increases in PA were associated with improvements in AMD, and this association was maintained over time.

References

1) WHO\OMS. Recomendaciones mundiales sobre actividad física para la salud. Clasificación NLM: QT 255. Ginebra: WHO\OMS; 2010. Available online: https://www.who.int/dietphysicalactivity/factsheet_recommendations/es/ (accessed on 06/07/2019r).
2) Gómez-Cabello A, Vila-Maldonado S, Pedrero-Chamizo R, Villa-Vicente JG, Gusi N, Espino L, et al. La actividad física organizada en las personas mayores, una herramienta para mejorar la condición física en la senectud. Rev Esp Salud Pública. 2018; 92, e1-e10.
3) Kheirat F, Merzouk H, Merzouk AS, Merzouk SA, Belarbi B. One year changes in biochemical and redox markers in training menopausal women with adherence to Mediterranean diet. Sci. Sports. 2018; 33, e25-e32.
4) Soto-Rodríguez A, García-Soidán JL, Arias-Gómez MJ, Del Álamo Alonso A, Leirós Rodríguez R, Reyes Pérez Fernández M. Intervención educativa sobre parámetros cardiovasculares en mujeres perimenopáusicas con un factor de riesgo cardiovascular. Ensayo clínico aleatorizado." Med Clin. 2018; 150: 178-184. DOI: 10.1016/j.medcli.2017.06.020.
5) Greene NP, Martin SE, Crouse SF. Acute exercise and training alter blood lipid and lipoprotein profiles differently in over-weight and obese men and women. Obesity. 2012; 20: 1618-1627.
6) Nikolaidis MG, Paschalis V, Giakas G, Fatouros IG, Koutedakis Y, Kouretas D. et al. Decreased blood oxidative stress after repeated muscle-damaging exercise. Med Sci Sports Exerc. 2007; 39: 1080-1089.
7) Willet E, Sacks F, Trichopoulou A, Drescher G, Ferro-Luzz A, Helsing E. et al. Mediterranean diet pyramid: a cultural model for healthy eating. Am J Clin Nutr. 1995; 61 (Suppl. 1): 1402-1406.

8) Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health; an updated systematic review a meta-analysis. Am J Clin Nutr. 2010; 92: 1189-1196.
9) Schwingshackl L, Hoffmann G. Does a Mediterranean type diet reduce cancer risk? Curr Nutr Rep. 2016; 5: 9-17.
10) Arslan E, Can S, Demirkan E. Effect of short-term aerobic and combined training program on body composition, lipids profile and psychological health in premenopausal women. Sci. Sports. 2017; 32: 106-113.
11) Varo JJ, Martínez JA, Martínez-González MA. Beneficios de la actividad física y riesgos del sedentarismo. Med Clin. 2003; 121: 665-672.
12) Araya S, Padial P, Feriche B, Gálvez A, Pereira J, Mariscal-Arcas M. Incidencia de un programa de actividad física sobre los parámetros antropométricos y la condición física en mujeres mayores de 60 años. Nutr. Hosp. 2012; 27: 1472-1479. http://dx.doi.org/10.3305/nh.2012.27.5.5899.
13) Orrow G, Kinmonth AL, Sanderson S, Sutton S. Effectiveness of physical activity promotion based in primary care: systematic review and meta-analysis of randomised controlled trials. BMJ. 2012; 344: doi: https://doi.org/10.1136/bmj.e1389
14) Crespo-Salgado JJ, Blanco-Moure A. Prescripción de ejercicio físico: ¿cómo mejorar la adherencia?. Med Clin. 2012; 139: 648-649.
15) Subirats E, Subirats G, Soteras I. Prescripción de ejercicio físico: indicaciones, posología y efectos adversos. Med Clin. 2012; 138: 18-24.
16) Harrison RA, Roberts C, Elton PJ. Does primary care referral to an exercise programme increase physical activity one year later? A randomized controlled trial. J Public Health. 2005; 27: 25-32.
17) Grandes G, Sanchez A, Montoya I, Ortega Sanchez-Pinilla R, Torcal J. Two-year longitudinal analysis of a cluster randomized trial of physical activity promotion by general practitioners. PLoS ONE. 2011; 6: doi: 10.1371/journal.pone.0018363.
18) Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J. et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr. 2011; 141: 1140-1145. doi: 10.3945/jn.110.135566.
19) León-Muñoz LM, Guallar-Castillón P, Graciani A, López-García E, Mesas AE, Aguilera MT, et al. Adherence to the Mediterranean diet pattern has declined in Spanish adults. J Nutr. 2012; 142: 1843-1850. DOI:10.3945/jn.112.164616
20) Morales S, Gómez-Cabello A, González-Agüero A, Casajús JA, Ara I, Vicente-Rodríguez G. Sedentarismo y condición física en mujeres postmenopáusicas. Nutr Hosp. 2013; 28: 1053-1059.
21) Rikli RE, Jones J. Senior fitness test manual. Champaign, IL : Human Kinetics, 2001.
22) EUROFIT. Test europeo de aptitud física. Ministerio de Educación y Ciencia, Madrid. 1992.
23) Bullo V, Bergamin M, Gobbo S, Sieverdes JC, Zaccaria M, Neunhaeuserer D, et al. The effects of Pilates exercise training on physical fitness and wellbeing in the elderly: A systematic review for future exercise prescription. Prev Med. 2015; 75: 1-11.
24) Lesinski M, Hortobagyi T, Muehlbauer T, Gollhofer A, Granacher U. Effects of Balance Training on Balance Performance in Healthy Older Adults: A Systematic Review and Meta-analysis. Sports Med. 2015; 45: 1721-1738.
25) Martins WR, de Oliveira RJ, Carvalho RS, de Oliveira Damasceno V, da Silva VZ, Silva MS. Elastic resistance training to increase muscle strength in elderly: a systematic review with meta-analysis. Arch Gerontol Geriatr. 2013; 57: 8-15.
26) Nelson ME, Fi Atarone MA, Morganti CM, Trice I, Greenberg RA, Evans WJ. Effects of high-intensity strength training on multiple risk factors for osteoporotic fractures. A randomized controlled trial. JAMA. 1994; 272: 1909-1194.
27) Scarmeas N, Gu Y, Schupf N, Lee JH, Luchsinger JA, Stern Y, et al. Mediterranean diet and leukocyte telomere length in a multi-ethnic elderly population. Alzheimers. Dement. 2014; 10: 755.
28) De la Montaña Miguélez J, Salve CA, Bernárdez MM. Evaluación del riesgo nutricional mediante el MNA en una población anciana no institucionalizada. Arch. Latinoam. Nutr. 2009; 59: 390.
29) Hergenroeder AL, Brach JS, Otto AD, Sparto PJ, Jakicic JM. The Influence of Body Mass Index on Self-report and Performance-based Measures of Physical Function in Adult Women. Card pulm phy therapy J. 2011; 22: 11-20.
30) Conklin AI, Forouhi NG, Suhrcke M, Surtees P, Wareham NJ, Monsivais P. Variety more than quantity of fruit and vegetable intake varies by socioeconomic status and financial hardship. Findings from older adults in the EPIC cohort. Appetite. 2014; 83: 248-255
31) Mäkinen TE, Sippola R, Borodulin K, Rahkonen O, Kunst A, Klumbiene J, et al. Explaining educational differences in leisure-time physical activity in Europe: the contribution of work-related factors. Scand. J. Med. Sci. Sports. 2012; 22(3): 439447.
32) Rodríguez AS, Soidán JLG, Gómez MJA, del Álamo Alonso A, Rodríguez RL, Fernández MRP. Intervención educativa sobre parámetros cardiovasculares en mujeres perimenopáusicas con un factor de riesgo cardiovascular. Ensayo clínico aleatorizado. Med Clin. 2018; 150: 178-184.
33) Lisabeth L, Bushnell C. Stroke risk in women: The role of menopause and hor-mone therapy. Lancet Neurol. 2012; 11: 82-91.
34) Libby P. Patogenia, prevención y tratamiento del aterosclerosis. En: Fauci A, Braunwald E, Kasper D, Hauser S, Longo D, Jameson J, et al., editores. Harri-son principios de medicina interna. 17.a ed México: McGraw-Hill; 2009. pp. 1501-1509.
35) Arthur H, Blanchard C, Gunn E, Kodis J, Walker S, Toner B. Exercise trajectories of women from entry to a 6-month cardiac rehabilitation program to one year after discharge. Biomed Res Int. 2013; 12: 121030.
36) Forhan M, Zagorski B, Marzonlini S, Oh P, Alter D. Predicting exercise adherence for patients with obesity and diabetes referred to a cardiac rehabilitation and secondary prevention program. Can J Diabetes. 2013; 37:, 189-194.
37) Assumpcao AM, Máximo LS, Sirineu D, Felício D, Sherrinton C. Adherence to exercise programs for older people is influenced by program characteristics and personal factors: A systematic review. J Physiother. 2014; 60: 151-156.
38) Guadalupe-Grau A, Carnicero JA, Gómez-Cabello A,

Gutiérrez Avila G, Humanes S, Alegre LM, et al. Association of regional muscle strength with mortality and hospitalisation in older people. Age Ageing. 2015; 44(5): 790-795.

39) Taylor AH, Cable NT, Faulkner G, Hillsdon M, Narici M, Van Der Bij AK. Physical activity and older adults: a review of health benefits and the effectiveness of interventions. J Sports Sci. 2004; 22: 703-725. PubMed PMID: 15370483.

40) Paterson DH, Jones GR, Rice CL. Ageing and physical activity: evidence to develop exercise recommendations for older adults. Can J Public Health. 2007; 98: S69-108.

41) Muñoz-Arribas A, Vila-Maldonado S, Pedrero-Chamizo R, Espino L, Gusi N, Villa G, et al. Evolución de los niveles de condición física en población octogenaria y su relación con un estilo de vida sedentario. Nutr. Hosp. 2014; 29(4). http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S0212-16112014000400024

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Article

Physical Activity and Sleep Quality in Spanish Primary School Children: Mediation of Sex and Maturational Stage

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Abstract: Background: sleep is a physiological process that is critical for physical and mental health in children. Childhood encompasses diverse developmental stages that may affect the impact of physical activity on sleep quality, which may also be influenced by sex. The purpose of this study was to examine the mediation effect of sex and, as well as maturational stage on the association between physical activity and sleep quality, among primary school children. Methods: this was a cross-sectional study of 954 Spanish primary school students (437 early childhood and 517 middle childhood) with a mean age of 10.5 ± 1.2 years. Participants reported their sleep quality using the Pittsburgh Sleep Quality Index and their physical activity levels using the Physical Activity Questionnaire. Results: our study found that physical activity is associated with improved sleep quality in children, particularly during middle childhood. Higher physical activity was linked to better sleep quality and reduced sleep latency ($p = 0.044$). Sleep quality was generally better in males than in females ($p = 0.002$) and was also better in early than middle childhood ($p = 0.000$). Conclusions: especially in middle childhood, physical activity promotes children's sleep quality. Thus, educational institutions should promote or improve the implementation of physical activity in the school context in order to benefit children's sleep quality and, hence, improve their quality of life and wellbeing.

Keywords: sleep quality; children; primary school; physical activity; biological maturation

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1. Introduction

Sleep is a physiological process whose correct progress is essential for physical and mental human health. This statement acquires even more significance in children due to the special role of sleep in their healthy development and wellbeing [1]. It has a wide range of functions, which include promoting growth and development, facilitating learning and memory retention, improving the efficiency of synaptic connections, regulating behavior and emotion, strengthening the immune system, and facilitating the removal of harmful neurotoxins [2]. Research shows that there has been a deterioration in the quality of childhood sleep over the last decade, a fact that is generating certain concerns in public health institutions [3]. According to the literature, this sleep deterioration is multifactorial and is based on different aspects such as exposure to synthetic lighting, prolonged use of electronic screens during the night, consumption of caffeine, and the absence of established sleep schedules and rules within the household [4]. The consequences of this sleep loss vary from lack of focus, decreased ability to make decisions and perform tasks, and lower academic achievement to higher likelihood of developing obesity and cardio-metabolic disorders [5].

The term "sleep quality" is frequently used in sleep medicine, but it is difficult to objectively define and measure it since it represents a complex phenomenon. It may include various quantitative aspects of sleep, such as total sleep time, sleep onset latency, sleep maintenance, wake after sleep onset, sleep efficiency, and sometimes sleep disruptions such as spontaneous arousal or apnea [6]. The factors that determine sleep quality may differ among individuals. Surveys to analyze large-scale populations are commonly based on inquiries pertaining to overall habitual sleep patterns and the various types of disruptions or abnormalities in sleep. In the case of childhood, it is important to comprehend the consequences of inadequate sleep quality in order to create effective public policies and develop strategies to reduce the harmful effects of sleep deficiency. The research on this topic plays a significant part in providing information for public policies, instructions, and schools. Then, advice and suggestions should be given through interventions to educate parents and children on how to maintain healthy sleep habits. Out of the many strategies recommended to improve children's sleep quality, physical activity is often highlighted, since it can help establish healthy sleep patterns and habits. This can include going to bed earlier, sleeping for longer durations, and enhancing sleep efficiency, which is the proportion of total time spent sleeping relative to the time spent in bed [7]. Physical activity has been linked to longer and better sleep quality for children and adolescents due to the discipline and social interaction that comes with participating in sports, as well as the significant energy expenditure and physical conditioning it provides [8]. This positive impact can improve the quality of life for children and adolescents by enhancing their sleep patterns. Research has shown that adolescents who engage in more physical activity, both as reported by themselves (subjective) and as measured objectively, are more likely to experience better sleep quality both subjectively (perception of sleep quality) and objectively (measured by scientific means) [9].

An interesting question proposed in the bibliography over the last years is the possible sex difference in sleep decline. Apparently, due to biological and sociocultural factors that influence sleep patterns, there is more impaired sleep in females. This is a phenomenon generally observed from adolescence, when hormonal events underlying puberty may be involved [10]. Nevertheless, there are conflicting results when it comes to understanding if sleep health differs between boys and girls in childhood. It is uncertain whether one gender is more or less likely to experience problems with children's sleep [11] and that causes the necessity of further investigation regarding this issue. It still remains unknown whether there are differences or variations in the way that sex affects the interaction between physical activity and sleep quality.

Childhood includes different developmental phases. Early childhood is considered chronologically from three to nine years old, and middle childhood is from ten to eleven years old [12]. Each degree of maturational growth implies specific hormonal and skeletal characteristics [13], which could affect the relationship between physical activity and sleep quality. Nevertheless, it is currently uncertain whether the positive influence of physical activity on sleep quality is affected by the maturational growth stage. Additionally, the differences in biological growth maturation rhymes by sex could widely affect this equation. Thus, this study aims to determine the mediation of sex and degree of maturation stage on the association between physical activity and sleep quality in primary school children.

2. Materials and Methods

2.1. Design

This is a cross-sectional study based on self-report data conducted in accordance with the Declaration of Helsinki and approved by the Clinical Research Ethics Committee of the Sports Administration of Catalonia 07/02/2018/CEICGC. The data in the present study belong to the initial evaluation of a crossover study project (Searching for the "normal" reference values of biomarkers of cardiac damage after sessions of physical activity) carried out between February and May 2019.

This project was conducted by an independent group of health sciences evaluators. In order to recruit participants, primary education centers were invited to participate in this study. All school principals received an information sheet on the nature and purpose of the study. The procedure began with a concise and easily comprehensible introduction to the study, after which the participants were given a thorough explanation of the various components of the questionnaires. There was no specific time limit imposed for completing the forms, and on average, participants took approximately 40 min to complete them. Subjects and parents or legal guardians were instructed about the anonymous and voluntary nature of participation, and all of them signed informed consent.

2.2. Participants

All participants were recruited following the general inclusion criteria (free of any chronic disease) and exclusion criteria (being older than 12 years old). A total of 954 children (429 boys and 525 girls, 10.5 ± 1.2 years) took part in this study. The sample was formed by 437 early childhood (students in the second cycle, 9.4 ± 0.6 years) and 517 children representing middle childhood (students in the third cycle, 11.4 ± 0.6 years), belonging to 13 primary schools around the Spanish province of Lleida.

2.3. Outcomes

2.3.1. Sleep Quality

The sleep quality was measured with the Spanish version of the Pittsburgh Sleep Quality Index (PSQI) [14]. The questionnaire serves as a dependable method for identifying sleep-related issues in both clinical and non-clinical populations, possessing high levels of reliability and validity. While its structural validity may not be exceptionally robust in all samples, the questionnaire still appears to be effective in fulfilling its intended purpose [15]. This tool was validated to assess adolescents' sleep quality in young people [16]. It includes 19 questions on seven components of sleep quality: subjective sleep quality, sleep duration, sleep latency, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. The PSQI questionnaire rates seven aspects of sleep quality using a scale that goes up in increments of three points, with zero points signifying optimal sleep quality and three points indicating suboptimal quality. The sum of all the scores is the overall PSQI score, which can range from 0 (excellent sleep quality) to 21 (very poor sleep quality). The PSQI is a highly effective tool for detecting inadequate sleep quality, with a total score of more than 5 indicating potential problems [15], similar in effectiveness to assessments conducted in clinical and laboratory settings (such as polysomnography).

2.3.2. Level of Physical Activity

The level of physical activity was measured with the Spanish version of the Physical Activity Questionnaire for older children PAQ-C validated by Manchola-González (2017) [17]. The questionnaire provides a summary activity score. The PAQ-C assesses general moderate to vigorous physical activity levels carried out in the last seven days of a typical week, through 10 questions about the type and frequency of activities carried out. The questionnaire has 10 questions, and the first nine are used to calculate the final score, and the remaining question is used to identify whether the child was ill or there was some circumstance that prevented him or her from routinely performing physical activity that week. A score from 1 to 5 is obtained from the responses, with a higher score indicating greater activity. Based on their final score, the children were classified into three terciles to then perform the analysis [18].

2.4. Statistical Analysis

For statistical analysis, IBM Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, version 20.0; IBM Corp, Armonk, NY, USA) software was used with a statistical significance level set at $\alpha = 0.050$. Descriptive statistics of the main variables were performed using mean, standard deviation, and 95% confidence interval according to

sex. A one-way ANOVA was used to test the data on the relationship between the sleep quality variables according to the independent factors of sex, maturational stage, or levels of physical activity. Three-way ANOVA was used to determine if there was an interaction effect between the three independent variables on sleep quality.

3. Results

3.1. Physical Activity Levels and Sleep Quality

The descriptive values of the whole sample and the comparison of the sleep variables according to sex and maturational stage are presented in Table 1.

Table 1. Comparative values of physical activity levels and sleep quality according to sex and maturational stage.

	Total	Males		Females		Early Childhood		Middle Childhood	
	(*n* = 954)	(*n* = 429)		(*n* = 525)		(*n* = 437)		(*n* = 517)	
			IC 95%		*IC* 95%		*IC* 95%		*IC* 95%
Age (y)	10.5± 1.2	10.4 ± 1.2	10.3–10.5	10.6 ± 1.2	10.4–10.6	9.4 ± 0.7	9.4–9.5	11.4 ± 0.6 #	11.3–11.4
Physical activity (1–5)	3.0 ± 0.7	3.1 ± 0.7	3.1–3.2	3.0 ± 0.7 *	2.9–3.0	3.1 ± 0.7	3.0–3.1	3.0 ± 0.7	3.0–3.1
Sleep Quality									
Quality (0–3)	0.7 ± 0.7	0.6 ± 0.7	0.6–0.7	0.8 ± 0.7 *	0.7–0.8	0.6 ± 0.7	0.5–0.7	0.8 ± 0.8 #	0.8–0.9
Latency (0–3)	0.5 ± 0.7	0.4 ± 0.6	0.4–0.5	0.6 ± 0.7 *	0.5–0.6	0.4 ± 0.6	0.4–0.5	0.6 ± 0.7 #	0.5–0.6
Duration (0–3)	0.0 ± 0.2	0.1 ± 0.3	0.0–0.1	0.0 ± 0.2	0.0–0.0	0.0 ± 0.2	0.0–0.1	0.0 ± 0.3	0.0–0.1
Efficiency (0–3)	0.1 ± 0.4	0.1 ± 0.4	0.1–0.2	0.1 ± 0.4	0.1–0.2	0.1 ± 0.4	0.1–0.2	0.1 ± 0.4	0.1–0.2
Disturbance (0–3)	1.3 ± 0.6	1.2 ± 0.6	1.1–1.2	1.4 ± 0.6 *	1.3–1.4	1.3 ± 0.6	1.2–1.4	1.3 ± 0.6	1.2–1.4
Daytime Dysfunction (0–3)	0.5 ± 0.6	0.5 ± 0.7	0.5–0.6	0.5 ± 0.6	0.4–0.5	0.5 ± 0.7	0.4–0.5	0.5 ± 0.6	0.5–0.6
Global PSQI (0–21)	3.0 ± 2.0	3.0 ± 2.0	2.8–3.2	3.4 ± 1.9 *	3.2–3.5	3.0 ± 1.9	2.8–3.1	3.4 ± 2.0 #	3.2–3.6

Mean ± DS. IC 95% = Confidence interval to 95%. * = $p < 0.05$ females vs. males. # = $p < 0.05$ middle childhood vs. early childhood.

The results show significant differences according to sex in physical activity levels, being higher in males than females ($p = 0.004$).

Analogously, results show significant sex differences in several of the components of sleep quality, including the global score. Sleep quality is generally better in males than in females ($p = 0.002$), and this accounts for quality ($p = 0.004$), latency ($p = 0.001$), and disturbance ($p = 0.000$).

3.2. Interaction between Physical Activity, Sex, and Maturational Stage and Their Mediation on Sleep Quality

Results for PSQI score are shown in Table 2 by sex, by level of physical activity, and by cycle. Additionally, results are shown by sex versus cycle, sex versus physical activity, and sex versus cycle versus physical activity. Three-way ANOVA analysis showed some interaction effects of physical activity level, maturational stage, and sex in the sleep disturbances (Table 2). The maturational stage and sex were shown to influence sleep quality on their own. In males, higher levels of physical activity improve sleep disorders in mid-childhood, but not in early childhood.

It is observed an interaction between the maturational stage and physical activity in global scores and latency. In general, higher physical activity levels improve sleep quality (0.044) and latency (0.017), with the difference being somewhat greater in middle childhood.

Table 2. Interaction between physical activity, sex, and maturational stage and their mediation on sleep quality.

	PA Levels Early Childhood 8–10 Years			PA Levels Middle Childhood 10–12 Years			PA Levels Early Childhood 8–10 Years			PA Levels Middle Childhood 10–12 Years			*p* Value						
	1st Tertil	2nd Tertil	3rd Tertil	1st Tertil	2nd Tertil	3rd Tertil	1st Tertil	2nd Tertil	3rd Tertil	1st Tertil	2nd Tertil	3rd Tertil	Sex	MS	PA	Sex* MS	Sex * PA	MS * PA	Sex* MS * PA
N	22	120	66	22	139	60	38	134	57	38	200	58							
PA	1.8 ± 0.4	2.9 ± 0.3	4.0 ± 0.3	1.9 ± 0.3	3.0 ± 0.4	4.0 ± 0.3	1.9 ± 0.3	2.9 ± 0.4	4.0 ± 0.3	1.9 ± 0.2	2.9 ± 0.3	3.8 ± 0.3							
Sleep Quality																			
Quality	0.5 ± 0.6	0.6 ± 0.6	0.4 ± 0.7	1.0 ± 0.7	0.7 ± 0.8	0.8 ± 0.7	0.7 ± 0.7	0.7 ± 0.7	0.6 ± 0.8	0.9 ± 0.7	0.9 ± 0.7	0.8 ± 0.8	0.072	0.000	0.469	0.317	0.807	0.235	0.629
Latency	0.3 ± 0.5	0.4 ± 0.6	0.3 ± 0.5	0.7 ± 0.7	0.5 ± 0.7	0.5 ± 0.6	0.5 ± 0.5	0.6 ± 0.7	0.4 ± 0.6	0.9 ± 0.8	0.6 ± 0.7	0.6 ± 0.7	0.004	0.000	0.131	0.742	0.827	0.017	0.982
Duration	0.0 ± 0.0	0.0 ± 0.2	0.1 ± 0.2	0.1 ± 0.3	0.1 ± 0.4	0.0 ± 0.3	0.0 ± 0.0	0.0 ± 0.3	0.0 ± 0.1	0.0 ± 0.2	0.0 ± 0.2	0.0 ± 0.3	0.221	0.242	0.719	0.492	0.964	0.515	0.347
Efficiency	0.0 ± 0.0	0.1 ± 0.4	0.2 ± 0.4	0.1 ± 0.5	0.2 ± 0.5	0.1 ± 0.2	0.2 ± 0.4	0.1 ± 0.4	0.1 ± 0.3	0.2 ± 0.4	0.1 ± 0.4	0.1 ± 0.3	0.384	0.549	0.272	0.962	0.151	0.201	0.231
Disturb.	0.9 ± 0.8	1.2 ± 0.6	1.3 ± 0.6 *	1.3 ± 0.6	1.2 ± 0.6	1.1 ± 0.5	1.5 ± 0.7	1.3 ± 0.6	1.4 ± 0.6	1.5 ± 0.8	1.3 ± 0.6	1.6 ± 0.5 **	0.000	0.262	0.353	0.846	0.031	0.151	0.029
DDysf.	0.3 ± 0.6	0.5 ± 0.7	0.4 ± 0.8	0.5 ± 0.7	0.6 ± 0.7	0.6 ± 0.7	0.5 ± 0.6	0.4 ± 0.5	0.5 ± 0.7	0.4 ± 0.5	0.5 ± 0.6	0.5 ± 0.6	0.643	0.186	0.678	0.116	0.360	0.836	0.673
Global PSQI	2.0 ± 2.0	2.9 ± 1.9	2.6 ± 1.9	3.8 ± 2.3	3.2 ± 2.0	3.0 ± 1.8	3.3 ± 1.8	3.2 ± 1.8	3.0 ± 1.8	4.0 ± 2.4	3.4 ± 1.8	3.6 ± 2.0	0.001	0.000	0.629	0.251	0.307	0.044	0.315

Mean ± DS. Level of significance $p < 0.05$; * $p < 0.05$ vs. 1er tercil of physical activity level. ** $p < 0.05$ vs. 2nd tercil of physical activity level. PA = Phisical Activity. PA levels: 1st tertil. low PA; 2nd tertil. medium PA; 3rd tertil. high PA. Disturb. = disturbance; DDysf = daytime dysfunction. Global PSQI = total Pittsburgh Sleep Quality Index scores. MS = maturational stage. Sex * PA = sex vs. physical activity; MS * PA = maturational stage vs. physical activity; Sex * MS * PA = sex vs. maturational stage vs. physical activity

4. Discussion

The current research examined how physical activity and sleep are connected among children. It also analyzed the mediation of sex and growth maturation on this connection. The main findings were that physical activity influences children's sleep in such a way that, mainly in middle childhood, the greater the physical activity, the better the quality of sleep and less latency. Physical activity and sports had been related to bringing benefits to the quality of sleep and life of children and adolescents [13]. Nevertheless, it is in adolescents where the promotion of sleep by physical activity has been wide more studied and evidenced, since this line of research has been less developed in children. Our findings are in the same line as those of Afonso A. et al. (2022) [19], who recently found that children who accumulated at least 60 min of physical activity and sports per day went to bed earlier and had a longer sleep duration. The same study observed that children who participated in or competed in sports presented better sleep efficiency. The cause behind the clearer association between exercise and sleep quality in adolescents could be their greater growth maturation, which could let them carry out bigger amounts of exercise and consequently achieve greater levels of fatigue than children [7–9]. This maturation factor could be the reason why we found a stronger influence of physical activity on sleep in middle childhood than in early childhood.

The characteristics of discipline and social interaction promotion, in addition to high energy expenditure and physical conditioning, could be factors triggering this positive association between exercise and sleep in children, and this synergy seems to be highly beneficial for children's health by improving their body composition. This was constated by Stone M.R et al. (2013), who observed that children who slept for less than nine hours were less active overall and had a higher likelihood of being overweight or obese compared to those who slept for ten or more hours ($p < 0.05$) [20]. Other factors decisive in the healthy life of children, such as screen time and sedentary behavior, have been observed to play a transcendental role in this association between physical activity and sleep quality [21].

The observed improvement of sleep latency under the influence of regular physical activity in middle childhood is in line with those results found all around the bibliography according to the meta-analytic review of Kredlow M.A. et al. (2015) [22]. The authors found that engaging in regular exercise had a somewhat positive impact on the time it took to fall asleep, suggesting that individuals who maintained a consistent exercise routine experienced significantly better sleep onset latency than those who did not exercise regularly. According to their results, this phenomenon happened specifically to younger individuals. The effect they found of regular exercise on sleep latency (d = 0.75) is similar to the outcomes of the meta-analysis of Smith et al. (2002) [23], which evaluated pharmacological and behavioral treatments for insomnia: The mean effect sizes, based on data from subjective sleep diaries, ranged from moderate to very large for sleep onset latency (d = 0.45 for pharmacotherapy and d = 1.05 for behavioral therapy). The cause explaining this positive impact could be that the energy expenditure that physical activity implies could bring as a consequence higher levels of fatigue at the time to go to bed, which would accelerate the moment of sleep commencement.

Females showed worse sleep quality than males ($p = 0.001$). Contrary to our results, some studies using self-reported methods observed that male children had worse sleep quality attending factors, such as shorter sleep duration [24–26], and those factors are attributed to differences in social and nutritional factors. Nevertheless, other studies observed results along the same line as ours, finding that female children were more likely to have poorer sleep quality [27], including shorter sleep duration [28], more difficulty waking up [29], higher daytime sleepiness [30], and more irregular sleep between a week and weekend nights [29]. Causes of these sleep sex differences could be the higher internalization of problems that females experience during their youth [31]. The way females assumed the social role assigned to them and perhaps their greatest concern for being accepted by their peers [32] could affect their sleep more than it does in their counterparts. Anyway, the different results observed on how sleep health in childhood is affected by

gender contribute to the need for future studies to explore and understand the underlying factors that contribute to these gender differences. This could involve examining potential biological, social, and environmental influences that may affect sleep health in boys and girls differently, as well as investigating any potential cultural or societal factors that may contribute to these disparities. Additionally, future studies could aim to identify effective interventions or strategies for improving sleep health in both boys and girls, with a particular focus on addressing any gender-specific challenges or barriers that may be present. Ultimately, a better understanding of the gender-specific factors affecting sleep health in childhood could have important implications for promoting healthy sleep habits and overall wellbeing in children of all genders.

We observed better sleep quality overall in early childhood than in middle childhood. The explanation for these differences could be the hormonal component of growth maturation. Sex hormones, estrogen, and progesterone, primarily in females, as well as testosterone, mostly in males, have been shown to have a certain influence on sleep quality [11]. Their levels change at different stages of life, with significant increases happening during puberty. Typically, males start puberty between the ages of 9 to 14 years, while females start between 8 to 12 years old. It takes around three to four years for both sexes to reach full maturity after puberty begins [33]. As it can be noted, the ages of hormonal influence match in some way with the second maturational stage analyzed in this study. This coincidence could explain the maturational stage differences in children's sleep quality. Additionally, the earlier hormonal influence in females could be be cause of the sex differences observed.

This study has notable strengths, such as (1) the size of its sample, which is noteworthy and may provide some assurance regarding the validity of the results obtained, as well as (2) the recruitment of individuals from a big amount of different primary schools, which allows the knowledge of the sleep and physical habits from a big region's childhood. However, certain limitations can be taken into consideration. First, we did not consider other potential confounders in the analyses, such as training schedules, nutrition, or screen time. Second, someone could argue that the study lacks objective data on activity and sleep. However, research has shown that subjective information regarding sleep quality is consistent with results obtained from sleep-electroencephalography recordings [16], and the tools here used to assess sleep quality are validated and supported.

5. Conclusions

The analysis of the interaction between physical activity and sleep quality in a big sample of primary school children shows that physical activity has a positive effect. Specifically, during middle childhood, greater physical activity is associated with better sleep quality and less sleep latency. Additionally, this study found that sleep quality is generally better in males than in females and is also better in early than middle childhood. Parents should be aware of all the factors that can affect a child's ability to have a good night's sleep. Therefore, educational and health institutions need to establish evidence-based guidelines that are appropriate and up to date in promoting healthy sleep habits in children. These guidelines should convey to parents the suitability of their children's adherence to physical activity, especially from middle childhood, and should also recommend paying special attention to girls' sleep. Additionally, educational institutions should promote or improve the implementation of physical activity in the school context in order to benefit children's sleep quality and, hence, improve their quality of life and well-being.

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References

1. Matricciani, L.; Paquet, C.; Galland, B.; Short, M.; Olds, T. Children's sleep and health: A meta-review. *Sleep Med. Rev.* **2019**, *46*, 136–150. [CrossRef]
2. Rana, M.; Riffo Allende, C.; Mesa Latorre, T.; Rosso Astorga, K.; Torres, A.R. Sleep in children: Physiology and update of a literature review. *Medicina* **2019**, *79* (Suppl. 3), 25–28.
3. Matricciani, L.; Olds, T.; Petkov, J. In search of lost sleep: Secular trends in the sleep time of school-aged children and adolescents. *Sleep Med. Rev.* **2012**, *16*, 203–211. [CrossRef]
4. Gruber, R.; Carrey, N.; Weiss, S.K.; Frappier, J.Y.; Rourke, L.; Brouillette, R.T.; Wise, M.S. Position statement on pediatric sleep for psychiatrists. *J. Can. Acad. Child Adolesc. Psychiatry* **2014**, *23*, 174–195. [PubMed]
5. Owens, J.A.; Weiss, M.R. Insufficient sleep in adolescents: Causes and consequences. *Minerva Pediatr.* **2017**, *69*, 326–336. [CrossRef] [PubMed]
6. Fabbri, M.; Beracci, A.; Martoni, M.; Meneo, D.; Tonetti, L.; Natale, V. Measuring Subjective Sleep Quality: A Review. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1082. [CrossRef]
7. Master, L.; Nye, R.T.; Lee, S.; Nahmod, N.G.; Mariani, S.; Hale, L.; Buxton, O.M. Bidirectional, Daily Temporal Associations between Sleep and Physical Activity in Adolescents. *Sci. Rep.* **2019**, *9*, 7732. [CrossRef]
8. Rosa, C.C.; Tebar, W.R.; Oliveira, C.B.S.; Farah, B.Q.; Casonatto, J.; Saraiva, B.T.C.; Christofaro, D.G.D. Effect of Different Sports Practice on Sleep Quality and Quality of Life in Children and Adolescents: Randomized Clinical Trial. *Sports Med.—Open* **2021**, *7*, 83. [CrossRef] [PubMed]
9. Lang, C.; Kalak, N.; Brand, S.; Holsboer-Trachsler, E.; Pühse, U.; Gerber, M. The relationship between physical activity and sleep from mid adolescence to early adulthood. A systematic review of methodological approaches and meta-analysis. *Sleep Med. Rev.* **2016**, *28*, 32–45. [CrossRef]
10. Mong, J.A.; Cusmano, D.M. Sex differences in sleep: Impact of biological sex and sex steroids. *Philos. Trans. R. Soc. B Biol. Sci.* **2016**, *371*, 20150110. [CrossRef]
11. Elkhatib Smidt, S.D.; Hitt, T.; Zemel, B.S.; Mitchell, J.A. Sex differences in childhood sleep and health implications. *Ann. Hum. Biol.* **2021**, *48*, 474–484. [CrossRef]
12. Balasundaram, P.; Avulakunta, I.D. Human Growth and Development. In *StatPearls*; StatPearls Publishing: Treasure Island, FL, USA, 2022.
13. Beunen, G.P.; Rogol, A.D.; Malina, R.M. Indicators of Biological Maturation and Secular Changes in Biological Maturation. *Food Nutr. Bull.* **2006**, *27*, S244–S256. [CrossRef]
14. Macías-Fernández, J.A. Royuela-Rico La versión española del Índice de Calidad de Sueño de Pittsburgh. *Inf. Psiquiatr.* **1996**, *146*, 465–472.
15. Buysse, D.J.; Reynolds, C.F.; Monk, T.H.; Berman, S.R.; Kupfer, D.J. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Res.* **1989**, *28*, 193–213. [CrossRef]
16. de la Vega, R.; Tomé-Pires, C.; Solé, E.; Racine, M.; Castarlenas, E.; Jensen, M.P.; Miró, J. The Pittsburgh Sleep Quality Index: Validity and factor structure in young people. *Psychol. Assess.* **2015**, *27*, e22–e27. [CrossRef]
17. Manchola-González, J.; Bagur-Calafat, C.; Girabent-Farrés, M. Fiabilidad de la versión española del Cuestionario de actividad física PAQ-C/Reliability of the Spanish Version of Questionnaire of Physical Activity PAQ-C. *Rev. Int. Med. Cienc. Act. Fisica Deporte* **2017**, *65*, 139–152. [CrossRef]
18. Ramírez Pastore, L.; Gotz, S.; Riera, J.; Pastore, B.; Vera, N.; Castaño, L.; Sequera, V.G. Nivel de actividad física y estado nutricional en una población pediátrica de un consultorio ambulatorio Asunción. *Pediatr. Asunción* **2020**, *47*, 11–16. [CrossRef]
19. Afonso, A.; Jacinto, G.; Infante, P.; Engana, T. Primary School Children's Sleep Habits: Association with Socioeconomic Factors and Physical Activity Habits. *Children* **2022**, *9*, 965. [CrossRef]

20. Stone, M.R.; Stevens, D.; Faulkner, G.E.J. Maintaining recommended sleep throughout the week is associated with increased physical activity in children. *Prev. Med.* **2013**, *56*, 112–117. [CrossRef] [PubMed]
21. Saunders, T.J.; Gray, C.E.; Poitras, V.J.; Chaput, J.-P.; Janssen, I.; Katzmarzyk, P.T.; Olds, T.; Connor Gorber, S.; Kho, M.E.; Sampson, M.; et al. Combinations of physical activity, sedentary behaviour and sleep: Relationships with health indicators in school-aged children and youth. *Appl. Physiol. Nutr. Metab.* **2016**, *41*, S283–S293. [CrossRef]
22. Kredlow, M.A.; Capozzoli, M.C.; Hearon, B.A.; Calkins, A.W.; Otto, M.W. The effects of physical activity on sleep: A meta-analytic review. *J. Behav. Med.* **2015**, *38*, 427–449. [CrossRef]
23. Smith, M.T.; Perlis, M.L.; Park, A.; Smith, M.S.; Pennington, J.; Giles, D.E.; Buysse, D.J. Comparative Meta-Analysis of Pharmacotherapy and Behavior Therapy for Persistent Insomnia. *Am. J. Psychiatry* **2002**, *159*, 5–11. [CrossRef] [PubMed]
24. Bagley, E.J.; Kelly, R.J.; Buckhalt, J.A.; El-Sheikh, M. What keeps low-SES children from sleeping well: The role of presleep worries and sleep environment. *Sleep Med.* **2015**, *16*, 496–502. [CrossRef]
25. Magriplis, E.; Farajian, P.; Panagiotakos, D.B.; Risvas, G.; Zampelas, A. The relationship between behavioral factors, weight status and a dietary pattern in primary school aged children: The GRECO study. *Clin. Nutr.* **2019**, *38*, 310–316. [CrossRef]
26. Biggs, S.N.; Lushington, K.; James Martin, A.; van den Heuvel, C.; Declan Kennedy, J. Gender, socioeconomic, and ethnic differences in sleep patterns in school-aged children. *Sleep Med.* **2013**, *14*, 1304–1309. [CrossRef] [PubMed]
27. Pano-Rodriguez, A.; Beltran-Garrido, J.V.; Hernadez-Gonzalez, V.; Bueno-Antequera, J.; Oviedo-Caro, M.A.; Mayolas-Pi, C.; Legaz-Arrese, A.; Reverter-Masia, J. Sleep quality is mediated by physical activity level in adolescents. *J. Sport. Med. Phys. Fit.* **2023**. [CrossRef] [PubMed]
28. Nuutinen, T.; Ray, C.; Roos, E. Do computer use, TV viewing, and the presence of the media in the bedroom predict school-aged children's sleep habits in a longitudinal study? *BMC Public Health* **2013**, *13*, 684. [CrossRef]
29. Garmy, P.; Clausson, E.K.; Nyberg, P.; Jakobsson, U. Insufficient Sleep Is Associated with Obesity and Excessive Screen Time Amongst Ten-Year-Old Children in Sweden. *J. Pediatr. Nurs.* **2018**, *39*, e1–e5. [CrossRef]
30. Gaina, A.; Sekine, M.; Hamanishi, S.; Chen, X.; Wang, H.; Yamagami, T.; Kagamimori, S. Daytime Sleepiness and Associated Factors in Japanese School Children. *J. Pediatr.* **2007**, *151*, 518–522.e4. [CrossRef]
31. Bor, W.; Dean, A.J.; Najman, J.; Hayatbakhsh, R. Are child and adolescent mental health problems increasing in the 21st century? A systematic review. *Aust. N. Z. J. Psychiatry* **2014**, *48*, 606–616. [CrossRef]
32. Guyer, A.E.; Caouette, J.D.; Lee, C.C.; Ruiz, S.K. Will they like me? Adolescents' emotional responses to peer evaluation. *Int. J. Behav. Dev.* **2014**, *38*, 155–163. [CrossRef] [PubMed]
33. Abreu, A.P.; Kaiser, U.B. Pubertal development and regulation. *Lancet Diabetes Endocrinol.* **2016**, *4*, 254–264. [CrossRef] [PubMed]