JGG 2023;71:175-181
doi: 10.36150/2499-6564-N274

Relationship between healthy habits and obesity in older adults

Ismael San Mauro Martin[1], Elena Avila Diaz[1], Marta Villanueva Nieto[1], Licia de la Calle[1], Sara Sanz Rojo[1], Maria del Carmen Morais Moreno[1], Manuela Echeverry López[1], Marta García Bernat[1], Yaiza Quevedo Santos[1], Marta Blanco López[1], Paloma Elortegui Pascual[1], Elena Borregon Rivilla[1], Victor Paredes Barato[1], Paula Crecis[1], Estefanía Roldán[1], Raquel Conty[1], Luis Collado Yurrita[2], Maria José Ciudad Cabañas[2], Sara López Oliva[1], Elena Garicano Vilar[1]

[1] Research Centers in Nutrition and Health, Madrid, Spain; [2] Department of Medicine, Universidad Complutense de Madrid, Madrid, Spain

Background. Epidemiological studies show that over the last two decades obesity has risen to become a major public health problem. Eating habits, lack of physical activity and the degree of obesity worsen over the years, turning adults and older adults overweight. The aim was to understand the relation between several modifiable factors (eating habits, physical activity, sedentary lifestyle and hours of sleep) and the body weight of older adults in the Community of Madrid.
Methods. An observational retrospective cross-sectional study was conducted. 342 older adults aged 65 to 96 years were recruited in Madrid. Anthropometric data (weight, height, waist circumference, body mass index, fat mass and muscle mass), diet (Predimed), physical activity (adapted IPAQ), sedentary lifestyle and hours of sleep were collected.
Results. There were no major differences between the normal weight and the excess weight group. A greater number of healthy habits did not diminish the prevalence of excess weight.
Conclusions. Lifestyle assessment should become an essential part of a new approach in geriatric clinical practice to reduce the burden of obesity in older adults.

Key words: older adults, obesity, diet, physical activity, sleep

Received: September 30, 2020
Published: July 27, 2023

Correspondence
Ismael San Mauro Martin
Research Centers in Nutrition and Health, Paseo de la Habana 43, 28036, Madrid, Spain
E-mail: info@grupocinusa.es

How to cite this article: San Mauro Martin I, Avila Diaz E, Villanueva Nieto M, et al. Relationship between healthy habits and obesity in older adults. Journal of Gerontology and Geriatrics 2023;71:175-181. https://doi.org/10.36150/2499-6564-N274

© Copyright by Società Italiana di Gerontologia e Geriatria (SIGG)

OPEN ACCESS

This is an open access article distributed in accordance with the CC-BY-NC-ND (Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International) license. The article can be used by giving appropriate credit and mentioning the license, but only for non-commercial purposes and only in the original version. For further information: https://creativecommons.org/licenses/by-nc-nd/4.0/deed.en

INTRODUCTION

The prevalence of obesity is rising progressively, even among older age groups, to the point of becoming a severe public health problem [1]. In 2015, there were 32 million obese elders in Europe, varing from 20% to 30%. The prevalence of obesity increases with age to peak at 60 years. Thereafter, body weight bearly changes and begins to decline in older age. However, current trends indicate that the prevalence of obesity in older adults will increase [2].
Mortality and morbidity associated with overweight and obesity only increases at a body mass index (BMI) > 30 kg/m^2, although percentage cutoffs of fat mass, BMI and waist circumference have not been defined for older adults [2].

There is good evidence that obesity in older adults increases cardiometabolic risk, physical disability, impaired quality of life, lower urinary tract symptoms as well as decreases cognitive function and dementia [3]. There are continuos debates whether obesity is harmful in older adults or not [4] since the relative increase in mortality is less in older than in younger adults, although obesity is generally associated with increased risk of morbidity [5] and mortality [6].

In a cross-sectional study carried out in 3136 Spanish subjets aged 65 years, 84% of the population was categorized as overweight and/or obese. 56% of the Spanish elderly population suffered from central obesity and 67% had an increased fat mass percentage. Besides, a strong relationship between adiposity levels and both physically active and sedentary lifestyles was found. Given that the lifestyle could be a determinant factor in the development of obesity among older adults [7] a lifestyle intervention should be a key step in obese older adults management. The intervention should consists of a 500 kcal energy deficit diet and an adequate intake of high biological quality protein, together with vitamin D and calcium and behavioral therapy, including sleeping habits and exercise [8]. However, studies that analyse the influence of different modifiable factors on body weight are limited in older adults.

OBJECTIVE

The aim of this study was to observe, by unifactorial and multifactorial analysis, the interaction between various modifiable factors (eating habits, physical activity, sedentary lifestyle and hours of sleep) and body weight in a group of older adults in the Community of Madrid.

METHODS

Study population

A total of 342 participants of both sexes (72.8% women and 27.2% men), aged 65 to 96 years, were selected from the Community of Madrid in 2016-2017. The sample was enrolled in a geographic division from 22 centers in all regions of Madrid (north, south, east, west and the city center). Inclusion criteria were participants over 65 years, of both sexes, with no severe diasease, who agreed to participate voluntarily and filled in the informed consent. Participants who did not meet inclusion criteria (n = 38), complete all questionnaires or were absent on the day of the survey were excluded. Hence a total of 304 participants were finally included in the study.

Study factors

An anthropometric study of all participants was conducted. Their physical activity and eating habits were analysed using the adapted IPAQ [9] and PREDIMED [10] questionnaries, respectively. Their sleep quality was also examined using an ad-hoc questionnaire [11]. All questionnaires were administered by trained staff in face-to-face interviews.

Anthropometric measurements

The anthropometric measurements were taken first thing in the morning and included weight, height, waist circumference, fat mass and muscle mass. Weight, fat mass and muscle mass were measured with a digital bioimpedance analyser TANITA model BP-601, with a range of 0.1-150 kg. The anthropometric study was conducted in 2 separate areas, one for each sex. Height was measured with the subjects standing barefoot, according to the WHO [12] protocol, with a SECA mobile stadiometer with an accuracy of 1 mm; weight circumference was measured around the midpoint between the lowest rib and the iliac crest, with a non-extensible tape measure (range 0-150 cm). BMI was calculated based on weight and height according to the Quetelet index [13]. To define cut-off points in BMI, the SEGG (Spanish Society of Geriatry and Gerontology) and SENPE (Spanish Society of Parenteral and Enteral Nutrition) guidelines were resorted for nutritional assessment in older adults [14]. BMI < 27 was considered underweight and normal weight, BMI > 27 was considered overweight and obese.

Physical activity assessment

Regular physical activity over the last seven days was assessed, both during work hours and in their free time, using a modified version of the International Physical Activity Questionnaire (IPAQ). A minimum of 150 minutes of exercise a week was established as sufficient, as reflected by the WHO physical activity recommendations for healthy > 65-years [15].

Sleep quality assessment

Sleep quality was assessed by compiling hours of sleep on week days, including naps, as well as hours of sleep at the weekend. The average week hours was compared with the National sleep foundation's recommendations [16], which establishes that older adults over 65 years should sleep between 7 and 8 hours a day.

Dietary assessment

The *PREvención con DIeta MEDiterránea* (PREDIMED) study was a primary prevention randomized clinical trial designed to test the hypothesis that the Mediterranean

diet would be superior to a low-fat diet for CVD protection. The validated 14-point Mediterranean Diet Adherence Screener (MEDAS) from the PREDIMED study was used to evaluate the adherence to the Mediterranean diet in this study [17]. The MEDAS consists of 2 questions on food intake habits considered characteristic of the Spanish Mediterranean diet and 12 questions on food consumption frequency. Each question was scored 0 or 1. One point was given for using olive oil as the principal source of fat for cooking, preferring white meat over red meat, or consuming: 1) 4 or more tablespoons (1 table spoon = 13.5 g) of olive oil/day (including that used in frying, salads, meals eaten away from home, etc.); 2) 2 or more servings of vegetables/day; 3) 3 or more pieces of fruit/day; 4) 1 serving of red meat or sausages/day; 5) 1 serving of animal fat/day; 6) 1 cup (1 cup = 100 mL) of sugar-sweetened beverages/day; 7) 7 or more servings of red wine/week; 8) 3 or more servings of pulses/week; 9) 3 or more servings of fish/week; 10) fewer than 2 commercial pastries/week; 11) 3 or more servings of nuts/week; or 12) 2 or more servings/week of a dish with a traditional sauce of tomatoes, garlic, onion, or leeks sauteed in olive oil. If the condition was not met, 0 points were recorded for the category. The final PREDIMED score ranged from 0 to 14. A score ≤ 9 means low adherence to the Mediterranean diet, 9 to 12 improvable adherence and > 12 good adherence. For the statistical analysis, this 3-range division was considered in the qualitative classification.

Statistical analysis

The statistical analysis entailed descriptive analyses, presenting the results in means, standard deviation and percentages. Parametric statistical tests, such as Student's t-test, were used for quantitative variables to analyse the differences between groups, while Chi-square test was used for non-parametric qualitative variables. A *P* value < 0.05 was considered a significant difference. Statistical analysis was performed using the SPSS 24.0 statistical software package (IBM Corp. Armonk, NY: USA).

RESULTS

The sample consisted of 304 people, 72.8% women and 27.2% men, aged 65 to 96 years, with a mean age of 75.22 ± 6.47 years (Tab. I). 59.3% of subjects were overweight or obese (BMI > 27), of whom 61.6% were women and 50.7% were men.

The mean PREDIMED score was 8.53 ± 2.45 points. At a qualitative level, 47.5% needed to improve their diet, 50.5% could still improve their diet and only 2% scored for a good adherence to the Mediterranean diet. When analyzed by gender, men showed worst adherence to the Mediterranean dietary pattern.

Physical exercise performed a week by the participants (415.28 ± 339.04 min/week) was superior to the recommended guidelines (Tab. I). When observing the compliance with the physical activity recommendations, 75.8% of the sample with a BMI > 27 met the recommended guidelines, with statistically significant differences found (p = 0.007) as a function of the weight state (Tab. II).

On the other hand, no significant differences were found regarding physical activity, sedentary leisure time, sleep and adherence to the Mediaterranean diet, according to sex. Overall, men presented higher adherence to the recommendations than women, except for PREDIMED score (Tab. III).

Table IV shows the percentage of elders satisfying all, three, two, one, or none of the dietary recommendations (PREDIMED), hours of physical activity (≥ 150 min/week), hours of inactivity (< 2 hours /day) and hours of sleep (≥ 8 hours/day). Most of the older adults complied with 3 out of 4 recommendations (41.3%), while only 0.6% did not

Table I. Personal, anthropometrical and lifestyle data.

	Total		Men		Women	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	75.22	6.47	75.01	5.65	75.29	6.74
Weight (kg)	70.36	12.81	77.1	12.09	67.68	11.73
Height (m)	1.56	0.86	1.66	0.65	1.53	0.68
BMI (kg/m^2)	28.67	4.59	28.09	3.7	28.76	4.74
Waist circumference (cm)	96.55	13.63	102.63	11.62	94.1	13.43
Waist/height index	0.62	0.08	0.63	0.09	0.61	0.09
Physical activity (min/week)	415.28	339.04	459.21	342.68	405.94	344.23
Sleep (hours/day)	5.78	2.74	5.99	3.14	5.76	2.57
PREDIMED score	8.53	2.45	8.54	2.38	8.63	2.38

SD: standard deviation.

Table II. Degree of compliance with the recommendations of diet, physical exercise, sedentarism and sleep hours in relation to weight state.

	Underweight or normal weight (BMI < 27)	Overweight or obese (BMI ≥ 27)	P-value
	Yes (%)	Yes (%)	Chi square
Physical activity ≥ 150 min/week	88	75.8	0.007
Sedentarism ≤ 2h	34.7	20.9	0.008
Sleep ≥ 8h	95.3	93	0.383
PREDIMED ≥ 7	57.3	48.1	0.110

Body Mass Index (BMI)

Table III. Degree of compliance with the recommendations of diet, physical exercise, sedentarism and sleep hours in relation to gender.

	Total	Men	Women	P-value
	Yes (%)	Yes (%)	Yes (%)	Chi square
Physical activity ≥ 150 min/week	80.1	84.9	78.9	0.268
Sedentarism ≤ 2h	28.5	31.3	27.7	0.532
Sleep ≥ 8h	93	94.2	93.2	0.763
PREDIMED ≥ 7	52.4	50.6	54	0.614

Table IV. Degree of compliance with the set of recommendations in relation to weight state.

	Total (%)	Normal weight (%)	Excess weight (%)	P-value
No compliance	0.6	1.4	0	0.338
Complies 1 of 4	4.9	2	8.6	
Complies 2 of 4	21.6	21.8	19.7	
Complies 3 of 4	41.3	40.1	40.1	
Complies all	31.6	34.7	31.6	

comply with any of the recommendations. No statistically significant differences (p = 0.338) were found regarding the four recommendations and the weight state.

DISCUSSION

In 2014, more than 1.9 billion adults were overweight worldwide, of whom 600 million were obese. The impact of obesity on morbidity, mortality, and health care costs is very high, with nearly three million adults dying anually as a result of being overweight or obese [18]. Dietary and lifestyle habits are considered key determinants in the prevalence of obesity [19].

The Behavioural Risk Factor Surveillance System data showed that, in the age group 65 to 74 years, 25% of subjects had a BMI > 30 kg/m^2, which was significantly higher than the 16.6% prevalence in the 75 to 84 year age group and the 9.9% prevalence in the > 85 year age group [2]. However, in our sample, 59.3% of subjects were overweight or obese (BMI > 27). When sorted out by age groups, data appeared to be reverse. 55.7% of subjects between 65 to 74 years had a BMI of > 27 kg/m^2 which was significantly lower than the 62.3% prevalence in the 75- to 84-year age group and the 66.7% prevalence in the > 85-year age group.

Diet

Adherence to a Mediterranean dietary pattern is a well-established protective factor against obesity and cardiovascular disease. However, diet quality is only one aspect of the overall healthy lifestyle adopted by Mediterranean populations. The latter has never been evaluated as a multi-factorial composite lifestyle [20].

A recurrent question is whether the high-fat Mediterranean diet might promote increased body weight. High-fat foods such as the generous amount of olive oil and nuts consumed by participants in the PREDIMED trial can be thought as leading to weight gain and promote obesity. Despite this popular belief, available scientific evidence suggests that frequent consumption of olive oil or nuts in the context of a healthy diet does not lead to any appreciable weight gain [21].

A long-term intervention with an unrestricted-calorie, high-fat, high-vegetable fat Mediterranean diet was associated with decrease body weight and less gain in central adiposity. This apparent paradox might be explained by the fact that consumption of these foods has been shown to increase satiety,

induce thermogenesis, increase resting energy expenditure and post-prandial fat oxidation, and decrease energy intake from other sources by food compensation [21,22].

Physical activity, sedentary lifestyle and hours of sleep

Finite circadian cycle challenges the assumption that a sole activity acts independently from others, and suggests that the time spent in one activity is intrinsically co-dependent of the time spent on the rest of the activities during a day [23].

The interrelationships between physical activity, sedentary behaviors and sleep have been barely explored in a large population of older adults at high CVD risk – a typically overweight, sedentary and physically inactive group. Considering the high prevalence of cardiometabolic disorders in this sector of the population and their consequent higher risks for several chronic diseases, such studies are warranted in order to contribute to the development of preventive strategies [24].

Rosique-Esteban et al. [24] reported that 1 hour/day increase in moderate-vigorous physical activity was significantly and independently associated with lower prevalence of obesity, and abdominal obesity. Contrary, detrimental associations were observed when increasing 1 hour/day in TV-viewing for the same cardiometabolic risk factors. Furthermore, beneficial effects were observed when they theoretically replaced 1 hour/day TV-viewing and sleeping by equal amounts of moderate-vigorous physical activity. Similar findings have been reported in our study and in other large cohorts regarding these outcomes [25-28]. Combined strategies, such as less sedentary behaviours and engaging in more moderate-vigorous physical activity may be effective to prevent obesity and other relevant cardiometabolic risk factors [29].

It is recognized that sleeping > 7-9 hours/day is basic to promote optimal health [30], whereas outside this range sleep has been generally unfavorable linked with obesity [31,32], as well as other cardiometabolic risk factors [33]. The participants in our study engaged an average of 6 sleeping hours per night on a regular basis, not meeting the recommendation. The relationships between sleep duration and cardiometabolic conditions are complex, yet sleep deprivation (i.e. sleeping < 7 hours/day, a common practice among the general population) has been consistently related to higher average weight gain [33], and to higher risk of obesity [31,32], among other disturbances [24].

CONCLUSIONS

Our investigation addressed the combined associations of meeting/not-meeting the recommendations in relation to obesity, indicating that the combination of not-meeting the recommendations may be a strong risk factor for obesity.

Meeting the recommended guidelines for physical activity was not associated to normalweight. Reducing sedentary lifestyle behaviours brought a lesser count of subjects with overweight. No statistically significant differences were found for sleep hours in relation to weight state. Subjects with healthy lifestyle behaviors benefited from adherence to Mediterranean diet, suggesting another dimension on prevention strategies.

Acknowledgments

We would like to thank Dirección General de Mayores de La Comunidad de Madrid and Cognitiva Unidad de Memoria for their collaboration.

Conflict of interest statement

The authors declare no conflict of interest.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical consideration

The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki.

Written informed consent was obtained from each participant/patient for study participation and data publication.

Take away message

Only 2% of the older adults adhered adequately to the Mediterranean diet. Men were the worst adhered to the Mediterranean dietary pattern, although men sticked better to the overall recommendations than women. No better weight state could be attributed to the compliance of all four recommendations in this case. However, holistic lifestyle assessment among older adults should become an essential part of a new approach in geriatric clinical practice to reduce the burden of obesity in this population [20].

References

1 Boutari C, Mantzoros CS. A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. Metabolism 2022;133,155217. https://doi.org/10.1016/j.metabol.2022.155217

2 Abdelaal M, Le Roux CW, Docherty NG. Morbidity and mortality associated with obesity. Ann Translat Med 2017;5:161-161. https://doi.org/10.21037/atm.2017.03.107

3 Han TS, Tajar A, Lean MEJ. Obesity and weight management in the elderly. Br Med Bull 2011;97:169-196.

4 Abarca-Gómez L, Abdeen ZA, Hamid ZA, et al. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet 2017;390:2627-2642. https://doi.org/10.1016/s0140-6736(17)32129-3

5 Seidell JC. Waist circumference and waist/hip ratio in relation to all-cause mortality, cancer and sleep apnea. Eur J Clin Nutr 2010;64:3541.

6 World Health Organization. Regional Office for Europe, 2022;May 3). WHO European Regional Obesity Report 2022 (https://apps.who.int/iris/handle/10665/353747, [cited 2023 Jan 3]).

7 Pérez-Rodrigo C, Gianzo Citores M, Hervás Bárbara G, et al. Prevalence of obesity and abdominal obesity in Spanish population aged 65 years and over: ENPE study. Medicina Clínica 2022;158:49-57. https://doi.org/10.1016/j.medcle.2020.10.026

8 Smethers AD, Rolls BJ. Dietary management of obesity. Medical Clinics of North America 2018;102:107-124. https://doi.org/10.1016/j.mcna.2017.08.009

9 Booth M. Assessment of physical activity: an international perspective. Res Q Exerc Sport 2000;71(2 Suppl):S114-S120.

10 Estruch R, Ros E, Salas-Salvadó J, et al.; PREDIMED Study Investigators. Primary prevention of cardiovascular disease with a mediterranean diet supplemented with extra-virgin olive oil or nuts. N Engl J Med 2018;378:E34. https://doi.org/10.1056/NEJMoa1800389

11 Ministerio de Sanidad, Consumo y Bienestar Social - Portal Estadístico del SNS - Encuesta Nacional de Salud de España, 2017 (https://www.sanidad.gob.es/estadEstudios/estadisticas/encuestaNacional/home.htm, [cited 2023 Jan 5]).

12 World Health Organization. Waist circumference and waist-hip ratio: report of a WHO Expert Consultation. World Health Organization, 2008.

13 Nuttall FQ. Body Mass Index: obesity, BMI, and health: a critical review. Nutr Today 2015;50:117-128. https://doi.org/10.1097/NT.0000000000000092

14 Camina-Martín MA, De Mateo-Silleras B, Malafarina V, et al. Valoración del estado nutricional en Geriatría: declaración de consenso del Grupo de Nutrición de la Sociedad Española de Geriatría y Gerontología. Revista Española De Geriatría Y Gerontología 2016;51:52-57. https://doi.org/10.1016/j.regg.2015.07.007

15 World Health Organization. Physical activity and older adults. WHO. World Health Organization, 2022;Oct 5 (https://www.who.int/news-room/fact-sheets/detail/physical-activity [cited 2023 Jan 5]).

16 Hirshkowitz M, Whiton K, Albert SM, et al. National sleep foundation's sleep time duration recommendations: methodology and results summary. Sleep Heal. National Sleep Foundation 2015;1:40-43. http://dx.doi.org/10.1016/j.sleh.2014.12.010

17 onde-Pipó J, Bouzas C, Zurita-Ortega F, et al. Adherence to a mediterranean diet pattern, physical activity, and physical self-concept in spanish older adults. Nutrients 2022;14:2404. https://doi.org/10.3390/nu14122404

18 Guo X, Tresserra-Rimbau A, Estruch R, et al. Polyphenol levels are inversely correlated with body weight and obesity in an elderly population after 5 years of follow up (the randomised PREDIMED study). Nutrients 2017;9:1–19 (http://www.mdpi.com/2072-6643/9/5/452).

19 Ross R, Blair S, de Lannoy L, et al. Changing the endpoints for determining effective obesity management. Prog Cardiovasc Dis 2015;57:330-336.

20 Georgousopoulou EN, Mellor DD, Naumovski N, et al.; MEDIS study group. Mediterranean lifestyle and cardiovascular disease prevention. Cardiovasc Diagn Ther 2017;7(Suppl 1):S39-S47. https://doi.org/10.21037/cdt.2017.03.11

21 Guasch-Ferré M, Salas-Salvadó J, Ros E, et al.; PREDIMED Investigators. The PREDIMED trial, mediterranean diet and health outcomes: how strong is the evidence? Nutr Metab Cardiovasc Dis 2017;27:624-632. https://doi.org/10.1016/j.numecd.2017.05.004

22 McLeod A, Bernabe B, Schiffer L, et al. Effect of a mediterranean diet intervention with and without weight loss on the gut microbiota in obese, older adults. Curr Develop Nutr 2020;4(Suppl 2):1575-1575. https://doi.org/10.1093/cdn/nzaa062_032

23 Chastin SFM, Palarea-Albaladejo J, Dontje ML, Skelton DA. Combined effects of time spent in physical activity, sedentary behaviors and sleep on obesity and cardio-metabolic health markers: a novel compositional data analysis approach. PLoS One 2015;10.

24 Rosique-Esteban N, Diaz-Lopez A, Martinez-Gonzalez MA, et al. Leisure-time physical activity, sedentary behaviors, sleep, and cardiometabolic risk factors at baseline in the PREDIMED-PLUS intervention trial: a cross-sectional analysis. PLoS One 2017;12:1-19.

25 Leiva AM, Martínez MA, Cristi-Montero C, et al. El sedentarismo se asocia a un incremento de factores de riesgo cardiovascular y metabólicos independiente de los niveles de actividad física [Sedentary lifestyle is associated with metabolic and cardiovascular risk factors independent of physical activity]. Rev Med Chil 2017;145:458-467. https://doi.org/10.4067/S0034-98872017000400006

26 Vella CA, Taylor K, Nelson MC. Associations of leisure screen time with cardiometabolic biomarkers in college-aged adults. J Behav Med 2020;43:1014-1025. https://doi.org/10.1007/s10865-020-00161-2

[27] Cassidy S, Chau JY, Catt M, et al. Low physical activity, high television viewing and poor sleep duration cluster in overweight and obese adults; a cross-sectional study of 398,984 participants from the UK Biobank. Int J Behav Nutr Phys Act 2017;14:57 https://doi.org/10.1186/s12966-017-0514-y

[28] Yuan F, Gong W, Ding C, et al. Association of physical activity and sitting time with overweight/obesity in Chinese occupational populations. Obesity Facts 2021;14:141-147. https://doi.org/10.1159/000512834

[29] Warburton DER, Bredin SSD. Reflections on physical activity and health: what should we recommend? Canad J Cardiol 2016;32:495–504.

[30] Sabia S, Dugravot A, Léger D, et al. Association of sleep duration at age 50, 60, and 70 years with risk of multimorbidity in the UK: 25-year follow-up of the Whitehall II cohort study. PLoS Med 2022;18-19:E1004109. https://doi.org/10.1371/journal.pmed.1004109

[31] Li, Q. The association between sleep duration and excess body weight of the American adult population: a cross-sectional study of the national health and nutrition examination survey 2015-2016. BMC Public Health 2021:21:335. https://doi.org/10.1186/s12889-021-10369-9

[32] Bacaro V, Ballesio A, Cerolini S, et al. Sleep duration and obesity in adulthood: an updated systematic review and meta-analysis. Obes Res Clin Pract 2020;14:301-309. https://doi.org/10.1016/j.orcp.2020.03.004

[33] Korostovtseva L, Bochkarev M, Sviryaev Y. Sleep and cardiovascular risk. Sleep Med Clin 2021;16:485-497. https://doi.org/10.1016/j.jsmc.2021.05.001