Journal of Applied Psychology & Behavioral Science. Vol., 9 (2), 126-133, 2024
Available online at http://www. japbs.com
ISSN 2536-524X © 2024
doi:10.61186/japbs.9.3.126

The Associations between Physical Activity Intensities with BMI and Muscle Strength among Adults

Savaş Aydin *

Assistant Professor Van Yüzüncü Yıl University Faculty Of Sports Sciences, 278000.

* Corresponding Author Email: savasaydin@yyu.edu.tr

Abstract

Background and aim: This study aims to examine the associations between physical activity intensities with BMI and muscle strength among adults.

Methods: The current research is conducted using a descriptive-correlation methodology, in alignment with its objectives. The statistical population for this study comprises 249 adults, who were chosen through convenience sampling. Standard tests were used for measuring research variables. Pearson's correlation test was applied for the inferential analysis of the relationships among the research variables.

Results: There was an indirect and significant relationship between VPA with BMI ($r=-0.664$, $p<0.001$), but there was a direct relationship between MVPA and muscle strength ($r=0.471$, $p<0.001$). Also, there was an indirect and significant relationship between MPA with BMI ($r=-0.356$, $p<0.001$), but there was a direct relationship between MVPA and muscle strength ($r=0.258$, $p<0.001$). Finally, there was no significant relationship between LPA with BMI and muscle strength ($P>0.05$).

Conclusion: Physical activity plays an important role in body composition and health-related physical fitness of adults.

Keywords: Physical Activity, BMI, Muscle Strength, Adults, Fitness

INTRODUCTION

Extensive developments in the modern world have transformed the way of life of human societies. The consequence of the mechanization of life is poverty, which is one of the most important problems of today's mankind from the point of view of health. This phenomenon is one of the risk factors of obesity (Aggio et al., 2016; Duvigneaud et al., 2008). The report of the World Health Organization shows that there are one billion and 600 million overweight people with a Body Mass Index (BMI) <25 and 400 million people with a BMI <30 in the whole world. According to the report of the same organization, the prevalence of obesity in Iranian women is estimated at 26.53% (Abdoshahi & Ghorbani, 2022; Baniasadi et al., 2022; Martínez-Gómez et al., 2011).

Changes in food patterns and reduction in physical activity cause changes in body composition, which increase the accumulation of fat in the body due to aging and subsequently increase the risk of obesity and chronic diseases such as cardiovascular diseases and cancers (Asl et al., 2016; Atlantis et al., 2009; Baniasadi et al., 2022; Littman et al., 2005). Obesity and inactivity are the most important modifiable risk factors for various diseases and deaths related to them, and the first step to reduce these diseases is to control their risk factors. This issue is more important in sedentary jobs, including university jobs. Physical activity can improve women's health and prevent major diseases and disabilities of women (Bennie et al., 2015; Goodpaster et al., 2008). Decrease in physical activity and consequently decrease in physical fitness is both the cause of weight gain and its effect. Physical activity is not only effective in reducing the prevalence of heart diseases, but also affects the

incidence of other physical diseases and psychological disorders and the quality of life. Quality of life is a concept that has become very important in recent years due to its role in the mental health of people (Baniasadi et al., 2022; Cárdenas Fuentes et al., 2018; Chaharbaghi et al., 2022; Fukumoto et al., 2012). The World Health Organization has defined quality of life as a person's perceptions of his life situation according to the culture and value system he lives in and the relationship of these perceptions with the goals, expectations, standards and priorities of the person (Baniasadi et al., 2022; Chen et al., 2013; Lee et al., 2016).

Today, it has been proven for human societies that better adaptation to the environment requires a balance of physical fitness and body composition in a person, and if people do not have favorable conditions in terms of physical condition and body composition, they usually will not have a proper psychological balance. Therefore, having high levels of health indicators and physical capabilities can indicate the health and capability of a society. One of the health indicators in humans is physical activity and exercise (LaMonte et al., 2017; Shafaei et al., 2024).

Encouraging physical activity and the overall health of adults is of paramount importance. The decline in physiological functions and body composition, coupled with reduced physical activity due to aging, is linked to a deterioration in physical capabilities and a loss of mobility. Engaging in physical activity is recognized as a means to mitigate numerous adverse age-related health changes (Ramsey et al., 2021; Trudelle-Jackson et al., 2011, Ilkım et al., 2017, Ilkim et al., 2021; Yurtseven et al., 2024). For instance, it plays a vital role in sustaining a healthy weight, promoting cardiovascular health, enhancing muscular strength, and improving physical functioning. Conversely, sedentary behavior has been identified as an independent risk factor for poor health outcomes and increased mortality, and it has been correlated with issues such as obesity, muscle weakness, and mobility impairments in older adults (Rauner et al., 2013; Yoshiko et al., 2019). Extensive research highlights the effectiveness of participating in physical activity (PA) as a practical method for decreasing body fat and promoting muscle mass, thereby improving the health of adults. Studies have revealed varying relationships between different intensities of PA and health outcomes (Hughes et al., 2001; Patel et al., 2020). For instance, one study involving adults indicated that moderate-intensity physical activity (MPA) is linked to improved cognitive function, whereas vigorous-intensity physical activity (VPA) does not show the same association. Additionally, another investigation identified light-intensity physical activity (LPA) as having a positive correlation with obesity and its indicators, as well as with mortality rates. Consequently, aggregating overall PA with LPA, MPA, and VPA may obscure the distinctions between these activities and their individual contributions to enhancing overall well-being (Khosravi et al., 2023; Najafzadeh et al., 2024). Recent research, especially in the 20th century, shows that proper and continuous exercises improve and increase the amount of strength, muscle endurance, cardio-respiratory endurance, flexibility, and also cause fitness and reduce body fat. In fact, the goal of continuous activity and exercise is to reach the optimal physical condition to have more health and vitality and a longer useful life (Harris et al., 2013; Muñoz-Vera et al., 2017).

The level of physical fitness can indirectly indicate the level of physical activity and lifestyle of people. Based on this, one of the scientific and reliable methods for assessing the health of people of all ages is measuring body composition and physical fitness. Since the health and well-being of people in society is directly related to their physical fitness level and physical fitness is also related to body composition. Hence, the aim of this study was to explore the associations between physical activity intensities with BMI and muscle strength among adults.

METHODS

The present study employs a descriptive-correlation methodology that aligns with its objectives. The statistical population consists of 269 adults aged between 24 and 53 years, selected through convenience sampling.

Physical activity was evaluated using the short form of the International Physical Activity Questionnaire (IPAQ) (Nie et al., 2021). This tool consists of seven questions that facilitate the gathering of information regarding individuals' physical activity over the previous week. According to the questionnaire's guidelines, the overall intensity of physical activities performed by an individual is classified into three categories: light, moderate, and vigorous, based on the energy expenditure recorded during the last seven days. Activities with a duration of less than 11 minutes are not included in the calculations. In this evaluation, walking is assigned a metabolic equivalent of task (MET) value of 3.3, moderate physical activity is assigned a value of 4, and vigorous physical activity is rated at 8. A MET measures the energy expended per minute by an individual while performing physical activities. To calculate the total weekly physical activity, the process involves summing the products of walking (MET × minutes × days), moderate physical activity (MET × minutes × days), and vigorous physical activity (MET × minutes × days) reported over the past week. This questionnaire is intended for assessing the physical activity levels of adults aged 18 to 65 and has been extensively utilized in various studies, demonstrating strong validity and reliability.

In the current investigation, weight was assessed using a light cover and without shoes, with a precision of 100 grams. Height was measured with a tape measure affixed to the wall, ensuring the individual stood barefoot in a position where the shoulder was tangential to the wall, achieving an accuracy of 0.1 centimeters. The body mass index was calculated by dividing the weight in kilograms by the square of the height in meters.

The Testing scale is a method that assesses the strength of key muscles in both the upper and lower extremities by applying resistance from the examiner and grading the patient's strength on a scale from 0 to 5. The grading criteria are as follows:

1. Flicker of movement
2. Active movement through the full range with gravity counterbalanced
3. Active movement through the full range against gravity
4. Active movement through the full range against some resistance
5. Active movement through the full range against strong resistance

Muscle groups that are frequently evaluated include the shoulder abductors, elbow flexors, elbow extensors, wrist extensors, finger flexors, hand intrinsic, hip flexors, knee extensors, dorsiflexors, great toe extensor, and plantar flexors. These specific muscles are selected to ensure a systematic assessment of critical spinal nerve roots. For instance, evaluating the strength of the elbow flexors, elbow extensors, wrist extensors, finger flexors, and hand intrinsic facilitates a thorough examination of the C5 to T1 nerve roots.

In this research, descriptive statistics, including the mean and standard deviation, were used to define the research variables. The Kolmogorov-Smirnov test was conducted to evaluate the normality of the gathered data. Additionally, Pearson's correlation test was implemented for the inferential analysis of the relationships between the research variables, with a significance threshold established at 0.05.

RESULTS

Table 1 outlines the detailed characteristics of the research participants, including their age, height, weight, and body mass index. The average age of the participants is recorded at 33.95 years. Additionally, the participants demonstrate a body mass index with a mean value of 26.38, which suggests that they fall into the overweight category.

Table 1. Demographic data of the subjects

Variable	Age (year)	Height (cm)	Weight (kg)	BMI
Mean ± SD	33.95 ± 4.21	174.22 ± 3.28	79.69 ± 6.34	26.38 ± 1.23

The mean and standard deviation of the participants' scores across all research variables are presented in Table 2. Concerning the physical activity levels of adults, it is evident that the participants exhibited a level of physical activity that falls below the recommendations set forth by the World Health Organization. In terms of the physical activity patterns observed, the findings revealed that only 25% of the participants engaged in moderate-to-vigorous physical activity, suggesting that approximately 75% of the participants do not meet the necessary physical activity requirements for optimal physical and mental well-being. Additionally, the scores related to muscle strength were found to be within the average range.

Table 2. Description of research variables

Variable	physical activity (day of the week)	physical activity (minutes per week)	physical activity (intensity)			Muscle strength
			light (percent)	moderate (percent)	vigorous (percent)	
Mean ± SD	2.24 ± 0.63	127.65 ± 13.51	75%	25%	10%	6.38±0.75

Table 3 presents the findings of the Kolmogorov-Smirnov test, which was conducted to assess the normality of the data distribution. The outcomes of this test indicate that all research variables conform to a normal distribution, as evidenced by the significance level (P>0.05).

Table 3. The results of normal distribution

Variable	physical activity (day of the week)	physical activity (minutes per week)	physical activity (intensity)			BMI	Muscle strength
			light (percent)	moderate (percent)	vigorous (percent)		
K-S	0.952	0.857	0.796	0.854	0.938	0.957	0.998
P	0.200	0.200	0.200	0.200	0.200		0.200

Table 4 shows the results of the Pearson correlation test. The research results showed that 1) there was an indirect and significant relationship between physical activity (days per week) (r= - 0.556, p<0.001), physical activity (minutes per week) (r= - 0.679, p<0.001) and intensity of physical activity (r= - 0.508, p<0.001) with BMI, 2) there was a direct and significant relationship between physical activity (days per week) (r=0.451, p<0.001), physical activity (minutes per week) (r=0.558, p<0.001) and intensity of physical activity (r=0.636, p<0.001) with muscle strength.

Table 4. The results of the relationship between physical activity with BMI and muscle strength

Variable	BMI	Muscle strength
physical activity (day of the week	r= - 0.556 p<0.001	r=0.451 p<0.001
physical activity (minutes per week)	r= - 0.679 p<0.001	r=0.558 p<0.001
physical activity (intensity)	r= - 0.508 p<0.001	r=0.636 p<0.001

DISCUSSION

The objective of this research was to investigate the relationships between various intensities of physical activity, body mass index (BMI), and muscle strength in adults. The findings indicated a significant indirect correlation between the frequency of physical activity (measured in days per week), the duration of physical activity (measured in minutes per week), and the intensity of physical activity with BMI. Additionally, a direct and significant correlation was found between the frequency of physical activity, the duration of physical activity, and the intensity of physical activity with muscle strength.

It was initially noted that the adults participating in this study engaged in considerably fewer physical activities than the World Health Organization's recommendation of 60 minutes of moderate to vigorous physical activity (MVPA). This indicates that adults demonstrate a low weekly level of physical activity. These results align with previous research that has similarly documented low levels of physical activity among adults (Aadland et al., 2022; Bennie et al., 2019; Leblanc et al., 2015). Given the numerous advantages linked to regular physical activity, it is vital to explore and apply effective strategies and interventions designed to increase adult participation in physical activity and exercise. Additionally, it is particularly important to develop approaches that enhance and sustain motivation among adults to engage consistently in physical activities (Chastin et al., 2019; Manini et al., 2007).

Our research revealed a significant relationship between elevated levels of physical activity (PA) and a reduced body fat percentage. Adults who failed to meet the recommended guidelines for moderate to vigorous physical activity (MVPA) exhibited considerably higher body fat levels compared to those who complied with these recommendations (Chastin et al., 2012; Mora et al., 2006; Rosique-Esteban et al., 2019). Only about 25% of adults achieved the advised daily target of 60 minutes of MVPA. Additionally, this study found that participants spent approximately 67.55% of their total time engaged in sedentary behavior (SB). Prior studies have consistently shown that increased SB is associated with negative body composition (BC) outcomes in children (Ghorbani et al., 2020; Nishida et al., 2011; Taghva et al., 2020). Therefore, it is clear that extended durations of SB can adversely impact health. While the current findings suggest a trend towards a positive and significant correlation between SB and both body mass index (BMI) and metabolic body fat (MBF), it is essential to implement strategies aimed at reducing SB. Replacing SB with high-intensity activities has been demonstrated to produce favorable health benefits (O'Donovan et al., 2010; Shozi et al., 2022; Visser et al., 2005).

The findings of the current study indicate that students engaged in higher levels of physical activity (PA) exhibited better physical fitness scores. This observation aligns with earlier research highlighting the beneficial effects of sports participation on overall physical fitness. The enhanced fitness levels can be linked to regular engagement in PA, which fosters greater joint mobility, muscle development, and flexibility in ligaments and tendons (Bann et al., 2015; Omidvar et al., 2018). Additionally, consistent participation in PA contributes to improvements in respiratory function. These enhancements are marked by stronger respiratory muscles, increased thoracic compliance, improved endurance of the upper respiratory system, and greater respiratory elasticity. In contrast, non-athletic adults displayed stiffer joints and reduced respiratory system resistance, attributable to their lack of participation in sports and physical activities (Seyedi Asl et al., 2020; Shafiei et al., 2024; Tittlbach et al., 2017).

Research concerning children must utilize race- and country-specific reference data for body composition, height, and weight. Nonetheless, this study has certain limitations. Given that it draws upon approximately a decade's worth of data, it may encompass generational variations (Li et al., 2018; Proctor et al., 2000; Schilling et al., 2023). Furthermore, while no significant income disparities were noted, regional and seasonal variations

could have influenced the data, as measurements were taken across multiple regions. Moving forward, it will be essential to investigate age- and sex-related patterns of change in both body shape and body composition in adults, utilizing the findings from this study. We expect that the current data will provide a foundation for additional research focused on adult health and preventive medicine (Chahal et al., 2014; Najafzadeh et al., 2024; Osuka et al., 2015).

CONCLUSION

In conclusion, our research revealed that the adults involved in this study exhibited low levels of physical activity (PA). This underscores the necessity for the development and implementation of effective strategies aimed at enhancing adult participation in sports and physical activities, particularly among females. Moreover, we identified a moderate level of physical fitness, indicating a need for greater oversight and support. Additionally, a notable correlation was found between increased PA and elevated levels of physical fitness in adults. Lastly, the influence of sports trainers is crucial, as their insights regarding adult engagement in PA can profoundly impact the physical well-being of this demographic.

REFERENCES

Aadland, E., Ylvisåker, E., Johannessen, K., & Nilsen, A. K. O. (2022). Prospective association patterns for the physical activity intensity spectrum with body mass index and lower body muscle strength in Norwegian children aged 3–9 years. *Journal of Physical Activity and Health*, *20*(1), 20-27. [Google Scholar] [Publisher] https://doi.org/10.1123/jpah.2022-0157

Abdoshahi, M., & Ghorbani, S. (2022). Effects of Playground Availability on Participation of Children in Physical Activity: The Role of Socioeconomic Status. *International Journal of School Health*, *9*(3), 186-191. [Google Scholar] [Publisher] https://doi.org/10.30476/intjsh.2022.96051.1245

Aggio, D. A., Sartini, C., Papacosta, O., Lennon, L. T., Ash, S., Whincup, P. H., ... & Jefferis, B. J. (2016). Cross-sectional associations of objectively measured physical activity and sedentary time with sarcopenia and sarcopenic obesity in older men. *Preventive medicine*, *91*, 264-272. [Google Scholar] [Publisher] https://doi.org/10.1016/j.ypmed.2016.08.040

Asl, S. T. S., Sadeghi, K., Bakhtiari, M., Ahmadi, S. M., Anamagh, A. N., & Khayatan, T. (2016). Effect of group positive psychotherapy on improvement of life satisfaction and the quality of life in infertile woman. *International journal of fertility & sterility*, *10*(1), 105. [Google Scholar] [Publisher] https://doi.org/10.22074/ijfs.2016.4775

Atlantis, E., Martin, S. A., Haren, M. T., Taylor, A. W., & Wittert, G. A. (2009). Inverse associations between muscle mass, strength, and the metabolic syndrome. *Metabolism*, *58*(7), 1013-1022. [Google Scholar] [Publisher] https://doi.org/10.1016/j.metabol.2009.02.027

Baniasadi, T., Ranjbari, S., Abedini, A., Dana, A., & Ghorbani, S. (2022). Investigation the Association of Internet Addiction with Mental Health and Physical Activity in Teenage Girls: The Mediating Role of Parental Attitude. *Women's Health Bulletin*, *9*(4), 243-250. [Google Scholar] [Publisher] https://doi.org/10.30476/whb.2022.96915.1197

Baniasadi, T., Ranjbari, S., Khajehaflaton, S., Neshati, A., & Dana, A. (2022). Effects of physical activity on adiposity in children: mediating role of self-esteem and body-image. *International Journal of Pediatrics*, *10*(12), 17172-17181. [Google Scholar] [Publisher] https://doi.org/10.22038/ijp.2022.67562.5043

Baniasadi, T., Ranjbari, S., Mofrad, S. K., & Dana, A. (2022). Associations between device-measured physical activity and balance performance in children: Mediating role of motor self-efficacy. *Biomedical Human Kinetics*, *14*(1), 252-258. [Google Scholar] [Publisher] https://doi.org/10.2478/bhk-2022-0031

Bann, D., Hire, D., Manini, T., Cooper, R., Botoseneanu, A., McDermott, M. M., ... & LIFE Study Group. (2015). Light Intensity physical activity and sedentary behavior in relation to body mass index and grip strength in older adults: cross-sectional findings from the Lifestyle Interventions and Independence for Elders (LIFE) study. *PloS one*, *10*(2), e0116058. [Google Scholar] [Publisher] https://doi.org/10.1371/journal.pone.0116058

Bennie, J. A., De Cocker, K., Teychenne, M. J., Brown, W. J., & Biddle, S. J. (2019). The epidemiology of aerobic physical activity and muscle-strengthening activity guideline adherence among 383,928 US adults. *International Journal of Behavioral Nutrition and Physical Activity*, *16*, 1-11. [Google Scholar] [Publisher] https://doi.org/10.1186/s12966-019-0797-2

Bennie, J. A., Pedisic, Z., van Uffelen, J. G., Gale, J., Banting, L. K., Vergeer, I., ... & Biddle, S. J. (2015). The descriptive epidemiology of total physical activity, muscle-strengthening exercises and sedentary behaviour among Australian adults–results from the National Nutrition and Physical Activity

Survey. *BMC public health*, *16*, 1-13. [Google Scholar] [Publisher] https://doi.org/10.1186/s12889-016-2736-3

Cárdenas Fuentes, G., Bawaked, R. A., Martínez González, M. Á., Corella, D., Subirana Cachinero, I., Salas-Salvadó, J., ... & Schröder, H. (2018). Association of physical activity with body mass index, waist circumference and incidence of obesity in older adults. *European journal of public health*, *28*(5), 944-950. [Google Scholar] [Publisher] https://doi.org/10.1093/eurpub/cky030

Chahal, J., Lee, R., & Luo, J. (2014). Loading dose of physical activity is related to muscle strength and bone density in middle-aged women. *Bone*, *67*, 41-45. [Google Scholar] [Publisher]

Chaharbaghi, Z., Baniasadi, T., & Ghorbani, S. (2022). Effects of Teacher's Teaching Style in Physical Education on Moderate-to-Vigorous Physical Activity of High-School Students: an Accelerometer-based Study. *International Journal of School Health*, *9*(3), 143-150. [Google Scholar] [Publisher] https://doi.org/10.30476/intjsh.2022.95204.1224

Chastin, S. F. M., Ferriolli, E., Stephens, N. A., Fearon, K. C., & Greig, C. (2012). Relationship between sedentary behaviour, physical activity, muscle quality and body composition in healthy older adults. *Age and ageing*, *41*(1), 111-114. [Google Scholar] [Publisher] https://doi.org/10.1093/ageing/afr075

Chastin, S. F., De Craemer, M., De Cocker, K., Powell, L., Van Cauwenberg, J., Dall, P., ... & Stamatakis, E. (2019). How does light-intensity physical activity associate with adult cardiometabolic health and mortality? Systematic review with meta-analysis of experimental and observational studies. *British journal of sports medicine*, *53*(6), 370-376. [Google Scholar] [Publisher] https://doi.org/10.1136/bjsports-2017-097563

Chen, L., Nelson, D. R., Zhao, Y., Cui, Z., & Johnston, J. A. (2013). Relationship between muscle mass and muscle strength, and the impact of comorbidities: a population-based, cross-sectional study of older adults in the United States. *BMC geriatrics*, *13*, 1-8. [Google Scholar] [Publisher] https://doi.org/10.1186/1471-2318-13-74

Duvigneaud, N., Matton, L., Wijndaele, K., Deriemaeker, P., Lefevre, J., Philippaerts, R., ... & Duquet, W. (2008). Relationship of obesity with physical activity, aerobic fitness and muscle strength in Flemish adults. *Journal of sports medicine and physical fitness*, *48*(2), 201. [Google Scholar] [Publisher]

Fukumoto, Y., Ikezoe, T., Yamada, Y., Tsukagoshi, R., Nakamura, M., Mori, N., ... & Ichihashi, N. (2012). Skeletal muscle quality assessed from echo intensity is associated with muscle strength of middle-aged and elderly persons. *European journal of applied physiology*, *112*, 1519-1525. [Google Scholar] [Publisher] https://doi.org/10.1007/s00421-011-2099-5

Ghorbani, S., Rezaeeshirazi, R., Shakki, M., Noohpisheh, S., & Farzanegi, P. (2020). The role of BMI, physical activity and the use of electronic device in the status of trunk abnormalities in male adolescents. *Journal of Gorgan University of Medical Sciences*, *22*(3), 129-136. [Google Scholar] [Publisher]

Goodpaster, B. H., Chomentowski, P., Ward, B. K., Rossi, A., Glynn, N. W., Delmonico, M. J., ... & Newman, A. B. (2008). Effects of physical activity on strength and skeletal muscle fat infiltration in older adults: a randomized controlled trial. *Journal of applied physiology*, *105*(5), 1498-1503. [Google Scholar] [Publisher] https://doi.org/10.1152/japplphysiol.90425.2008

Harris, C. D., Watson, K. B., Carlson, S. A., Fulton, J. E., Dorn, J. M., & Elam-Evans, L. (2013). Adult participation in aerobic and muscle-strengthening physical activities—United States, 2011. *Morbidity and Mortality Weekly Report*, *62*(17), 326. [Google Scholar] [Publisher]

Hughes, V. A., Frontera, W. R., Wood, M., Evans, W. J., Dallal, G. E., Roubenoff, R., & Singh, M. A. F. (2001). Longitudinal muscle strength changes in older adults: influence of muscle mass, physical activity, and health. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *56*(5), B209-B217. [Google Scholar] [Publisher] https://doi.org/10.1093/gerona/56.5.B209

Ilkim, M., & Mergan, B. (2021). Examination Of Exercise In Individuals With Disabilities And Inquiry Skills Of Students In Sports Education Department. About This Special Issue, 12. [Google Scholar] [Publisher]

Ilkım, M., Özdemir, M., & Tanır, H. (2017). Evaluation of some physical and motoric characteristics of athletes with down syndrome. In SHS Web of Conferences (Vol. 37, p. 01030). EDP Sciences. [Google Scholar] [Publisher] https://doi.org/10.1051/shsconf/20173701030

Khosravi, M., Asl, S. T. S., Anamag, A. N., Langaroudi, M. S., Moharami, J., Ahmadi, S., ... & Kasaeiyan, R. (2023). Parenting styles, maladaptive coping styles, and disturbed eating attitudes and behaviors: a multiple mediation analysis in patients with feeding and eating disorders. *PeerJ*, *11*, e14880. [Google Scholar] [Publisher] https://doi.org/10.7717/peerj.14880

LaMonte, M. J., Lewis, C. E., Buchner, D. M., Evenson, K. R., Rillamas-Sun, E., Di, C., ... & Shumaker, S. (2017). Both light intensity and moderate-to-vigorous physical activity measured by accelerometry are favorably associated with cardiometabolic risk factors in older women: the Objective Physical Activity and Cardiovascular Health (OPACH) study. *Journal of the American Heart Association*, *6*(10), e007064. [Google Scholar] [Publisher] https://doi.org/10.1161/JAHA.117.007064

Leblanc, A., Taylor, B. A., Thompson, P. D., Capizzi, J. A., Clarkson, P. M., Michael White, C., & Pescatello, L. S. (2015). Relationships between physical activity and muscular strength among healthy adults across the lifespan. *Springerplus*, *4*, 1-10. [Google Scholar] [Publisher] https://doi.org/10.1186/s40064-015-1357-0

Lee, D. C., Shook, R. P., Drenowatz, C., & Blair, S. N. (2016). Physical activity and sarcopenic obesity: definition, assessment, prevalence and mechanism. *Future science OA*, *2*(3), FSO127. [Google Scholar] [Publisher] https://doi.org/10.4155/fsoa-2016-0028

Li, R., Xia, J., Zhang, X. I., Gathirua-Mwangi, W. G., Guo, J., Li, Y., ... & Song, Y. (2018). Associations of muscle mass and strength with all-cause mortality among US older adults. *Medicine and science in sports and exercise*, *50*(3), 458. [Google Scholar] [Publisher] https://doi.org/10.1249/MSS.0000000000001448

Littman, A. J., Kristal, A. R., & White, E. (2005). Effects of physical activity intensity, frequency, and activity type on 10-y weight change in middle-aged men and women. *International journal of obesity*, *29*(5), 524-533. [Google Scholar] [Publisher] https://doi.org/10.1038/sj.ijo.0802886

Manini, T. M., Clark, B. C., Nalls, M. A., Goodpaster, B. H., Ploutz-Snyder, L. L., & Harris, T. B. (2007). Reduced physical activity increases intermuscular adipose tissue in healthy young adults. *The American journal of clinical nutrition*, *85*(2), 377-384. [Google Scholar] [Publisher] https://doi.org/10.1093/ajcn/85.2.377

Martínez-Gómez, D., Welk, G. J., Puertollano, M. A., Del-Campo, J., Moya, J. M., Marcos, A., ... & AFINOS Study Group. (2011). Associations of physical activity with muscular fitness in adolescents. *Scandinavian Journal of Medicine & Science in Sports*, *21*(2), 310-317. [Google Scholar] [Publisher] https://doi.org/10.1111/j.1600-0838.2009.01036.x

Mora, S., Lee, I. M., Buring, J. E., & Ridker, P. M. (2006). Association of physical activity and body mass index with novel and traditional cardiovascular biomarkers in women. *Jama*, *295*(12), 1412-1419. [Google Scholar] [Publisher] https://doi.org/10.1001/jama.295.12.1412

Muñoz-Vera, T., Sañudo, B., del Pozo-Cruz, B., del Pozo-Cruz, J., Lopez-Lluch, G., & Sánchez-Oliver, A. J. (2017). Influence of the level of physical activity on physical fitness, lipid profile and health outcomes in overweight/obese adults with similar nutritional status. *Science & Sports*, *32*(5), 278-285. [Google Scholar] [Publisher] https://doi.org/10.1016/j.scispo.2016.05.006

Najafzadeh, F., Ranjbari, S., Shafaei, H., & Ghorbani, S. (2024). Correlation between Participation in Physical Activity and Psychological Well-being among Elderly Women: The Mediating Role of Resilience. *Women's Health Bulletin*, *11*(3), 188-194. [Google Scholar] [Publisher] https://doi.org/10.30476/whb.2024.102534.1291

Najafzadeh, F., Shafaei, H., Alizadeh, S., & Dana, A. (2024). Correlations between Physical Activity Participation and Anthropometric Features with Gross and Fine Motor Skills in School Children with Attention Deficit Hyperactivity Disorder. *International Journal of School Health*, *11*(3), 209-215. [Google Scholar] [Publisher] https://doi.org/10.30476/intjsh.2024.102533.1408

Nie, J., Haberstroh, M., Acosta, T., Huang, W., Wang, Y., & Barengo, N. C. (2021). Independent and joint associations between leisure time physical activity and strength activities with mortality outcomes in older adults at least 65 years of age: a prospective cohort study. *The Journals of Gerontology: Series A*, *76*(12), 2122-2131. [Google Scholar] [Publisher] https://doi.org/10.1093/gerona/glab114

Nishida, Y., Iyadomi, M., Higaki, Y., Tanaka, H., Hara, M., & Tanaka, K. (2011). Influence of physical activity intensity and aerobic fitness on the anthropometric index and serum uric acid concentration in people with obesity. *Internal medicine*, *50*(19), 2121-2128. [Google Scholar] [Publisher] https://doi.org/10.2169/internalmedicine.50.5506

O'Donovan, G., Blazevich, A. J., Boreham, C., Cooper, A. R., Crank, H., Ekelund, U., ... & Stamatakis, E. (2010). The ABC of Physical Activity for Health: a consensus statement from the British Association of Sport and Exercise Sciences. *Journal of sports sciences*, *28*(6), 573-591. [Google Scholar] [Publisher] https://doi.org/10.1080/02640411003671212

Omidvar, A., Dana, A., Hamzeh Sabzi, A., & Pourpanahi Koltapeh, M. (2018). The effect of education based on developmental physical education on working memory of elementary school students. *Journal of School Psychology*, *7*(1), 83-101. [Google Scholar] [Publisher] https://doi.org/10.22098/jsp.2018.658

Osuka, Y., Yabushita, N., Kim, M., Seino, S., Nemoto, M., Jung, S., ... & Tanaka, K. (2015). Association between habitual light-intensity physical activity and lower-extremity performance: A cross-sectional study of community-dwelling older J apanese adults. *Geriatrics & Gerontology International*, *15*(3), 268-275. [Google Scholar] [Publisher] https://doi.org/10.1111/ggi.12268

Patel, A. V., Hodge, J. M., Rees-Punia, E., Teras, L. R., Campbell, P. T., & Gapstur, S. M. (2020). Peer Reviewed: Relationship Between Muscle-Strengthening Activity and Cause-Specific Mortality in a Large US Cohort. *Preventing Chronic Disease*, *17*. [Google Scholar] [Publisher] https://doi.org/10.5888/pcd17.190408

Proctor, D. N., Melton Iii, L. J., Khosla, S., Crowson, C. S., O'connor, M. K., & Riggs, B. L. (2000). Relative influence of physical activity, muscle mass and strength on bone density. *Osteoporosis International*, *11*, 944-952. [Google Scholar] [Publisher] https://doi.org/10.1007/s001980070033

Ramsey, K. A., Rojer, A. G., D'Andrea, L., Otten, R. H., Heymans, M. W., Trappenburg, M. C., ... & Maier, A. B. (2021). The association of objectively measured physical activity and sedentary behavior with skeletal muscle strength and muscle power in older adults: A systematic review and meta-analysis. *Ageing research reviews*, *67*, 101266. [Google Scholar] [Publisher] https://doi.org/10.1016/j.arr.2021.101266

Rauner, A., Mess, F., & Woll, A. (2013). The relationship between physical activity, physical fitness and overweight in adolescents: a systematic review of studies published in or after 2000. *BMC pediatrics*, *13*, 1-9. [Google Scholar] [Publisher] https://doi.org/10.1186/1471-2431-13-19

Rosique-Esteban, N., Babio, N., Díaz-López, A., Romaguera, D., Martínez, J. A., Sanchez, V. M., ... & Salas-Salvadó, J. (2019). Leisure-time physical activity at moderate and high intensity is associated with parameters of body composition, muscle strength and sarcopenia in aged adults with obesity and metabolic syndrome from the PREDIMED-Plus study. *Clinical nutrition*, *38*(3), 1324-1331. [Google Scholar] [Publisher] https://doi.org/10.1016/j.clnu.2018.05.023

Schilling, R., Schmidt, S. C., Fiedler, J., & Woll, A. (2023). Associations between physical activity, physical fitness, and body composition in adults living in Germany: A cross-sectional study. *Plos one*, *18*(10), e0293555. [Google Scholar] [Publisher] https://doi.org/10.1371/journal.pone.0293555

Seyedi Asl, S. T., Rahnejat, A. M., Elikaee, M. M., Khademi, M., Shahed-HaghGhadam, H., & Taghva, A. (2020). The role of resilience, positive/negative emotions, and character strengths in predicting burnout of military personnel. *EBNESINA*, *22*(4), 4-13. [Google Scholar] [Publisher]

Shafaei, H., Najafzadeh, F., Shakki, M., & Ghorbani, S. (2024). Associations between Physical Activity and Quality of Life, Happiness, and Depression among Elderly Women. *Women's Health Bulletin*, *11*(2), 104-111. [Google Scholar] [Publisher] https://doi.org/10.30476/whb.2024.101984.1276

Shafaei, H., Rezaei, N., Mohammadi, S., & Ghorbani, S. (2024). Correlations between Physical Activity and Social Health, Moral Development and Physical Fitness among Middle School Students. *International Journal of School Health*, *11*(2), 97-104. [Google Scholar] [Publisher] https://doi.org/10.30476/intjsh.2024.101704.1388

Shozi, S., Monyeki, M. A., Moss, S. J., & Pienaar, C. (2022). Relationships between physical activity, body mass index, waist circumference and handgrip strength amongst adults from the North West province, South Africa: The PURE study. *African Journal of Primary Health Care & Family Medicine*, *14*(1), 3206. [Google Scholar] [Publisher] https://doi.org/10.4102/phcfm.v14i1.3206

Taghva, A., Asl, S. T. S., Rahnejat, A. M., & Elikaee, M. M. (2020). Resilience, emotions, and character strengths as predictors of job stress in military personnel. *Iranian journal of psychiatry and behavioral sciences*, *14*(2). [Google Scholar] [Publisher] https://doi.org/10.5812/ijpbs.86477

Tittlbach, S. A., Jekauc, D., Schmidt, S. C., Woll, A., & Bös, K. (2017). The relationship between physical activity, fitness, physical complaints and BMI in German adults–results of a longitudinal study. *European journal of sport science*, *17*(8), 1090-1099. [Google Scholar] [Publisher] https://doi.org/10.1080/17461391.2017.1347963

Trudelle-Jackson, E., Jackson, A. W., & Morrow Jr, J. R. (2011). Relations of meeting national public health recommendations for muscular strengthening activities with strength, body composition, and obesity: The Women's Injury Study. *American journal of public health*, *101*(10), 1930-1935. [Google Scholar] [Publisher] https://doi.org/10.2105/ajph.2011.300175

Visser, M., Simonsick, E. M., Colbert, L. H., Brach, J., Rubin, S. M., Kritchevsky, S. B., ... & Health ABC Study. (2005). Type and intensity of activity and risk of mobility limitation: the mediating role of muscle parameters. *Journal of the American Geriatrics Society*, *53*(5), 762-770. [Google Scholar] [Publisher] https://doi.org/10.1111/j.1532-5415.2005.53257.x

Yoshiko, A., Natsume, Y., Makino, T., Hayashi, T., Umegaki, H., Yoshida, Y., ... & Akima, H. (2019). Higher and lower muscle echo intensity in elderly individuals is distinguished by muscle size, physical performance and daily physical activity. *Ultrasound in Medicine & Biology*, *45*(9), 2372-2380. [Google Scholar] [Publisher] https://doi.org/10.1016/j.ultrasmedbio.2019.05.029

Yurtseven, C. N., Ilkim, M., Toros, T., Aslan, T. V., Keskin, M. T., Efe, M., ... & Dişçeken, O. (2024). The Relationship Between Sports Addiction and Personality Dimensions Based on Cloninger's Theory in Bodybuilding and Fitness Trainers in Eastern Anatolia Region of Turkey. Revista de Psicología del Deporte (Journal of Sport Psychology), 33(3), 296-304. [Google Scholar] [Publisher]