Submitted: 20 August, 2024 Accepted: 25 October, 2024 Published: 30 January, 2025 DOI:10.22514/jomh.2025.007

JOMH Journal of Men's Health

ORIGINAL RESEARCH

The effect of body composition and lifestyle habits on functional movement capacity in inactive overweight adults males

Umut Canli[1], Monira I. Aldhahi[2,*], Ali Mert Sendil[1], Zeynep Dogan[1], Dorin Alupei[3], Maria Cristina Man[4], Cristina Ioana Alexe[5], Cansel Arslanoglu[6]

[1]Sports Science Faculty, Tekirdag Namik Kemal University, 59010 Tekirdag, Türkiye
[2]Department of Rehabilitation Sciences, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, P.O. Box 84428, 11671 Riyadh, Saudi Arabia
[3]Romanian Rowing Olympic Team, Sports Club Dinamo Bucharest, 020121 Bucharest, Romania
[4]Department of Physical Education, "1 Decembrie 1918" University of Alba Iulia, 510009 Alba Iulia, Romania
[5]Department of Physical Education and Sports Performance, "Vasile Alecsandri" University of Bacau, 600115 Bacau, Romania
[6]Sports Science Faculty, Sinop University, 57000 Karşı, Türkiye

***Correspondence**
mialdhahi@pnu.edu.sa
(Monira I. Aldhahi)

Abstract

Background: This study investigated the effects of body composition and lifestyle habits on functional movement capacity in inactive overweight men. **Methods**: A cross-sectional study was conducted with 112 men (age = 30 $\pm$ 11 years; BMI = 25.82 $\pm$ 4.79 kg/m^2). Participants completed a lifestyle habits questionnaire. Anthropometric measurements, including height, weight, muscle mass, and body fat percentage, were recorded. Functional Movement Screen (FMS) tests assessed functional movement capacity. Stepwise multiple linear regression analyzed the predictors of FMS scores, and lifestyle habits were compared. **Results**: Body fat percentage accounted for 24% of the variance in FMS scores ($F_{(1-110)}$ = 21.378, $p < 0.001$), with a coefficient of −0.159, indicating a negative association. Participants without chronic diseases had significantly higher FMS scores compared to those with chronic diseases (% change = 12.14; p = 0.037). Other lifestyle habit parameters showed no significant differences. **Conclusions**: Higher body fat percentages negatively influence functional movement capacity. Participants without chronic diseases exhibited better functional movement scores, emphasizing the positive role of general health on movement quality. Strategies focusing on reducing body fat and improving overall health may enhance functional movement capacity in this population.

Keywords

Functional movement capacity; Health; Body fat; Sedentary life

1. Introduction

Functional movement capacity is an important component of quality of life [1]. Whether a competitive athlete, recreational athlete, worker, each person wants to perform basic movements without limitations and pain [2]. As individuals age, their capacity to carry out everyday physical activities and the ease with which they perform these tasks diminish, even among healthy adults [3, 4] . This decline can lead to a higher risk of illness and death, greater need for healthcare, loss of self-sufficiency, and an overall decrease in quality of life [5].

Functional movements are multidirectional movements conceptualized as a set of movements of more than one joint that complement each other and ensure fluidity and may play a more significant role in human performance, especially in solving complex, specific tasks [6, 7]. The Functional Movement Screen (FMS) is a widely used technique for assessing the functional movement abilities of various age groups and population [8]. FMS is a test applied to healthy individuals and people who want to increase their physical capacity, as well as a test that can be applied to individuals with insufficient physical capacity and posturally unhealthy individuals. The test is a functional anatomical approach, rather than an anatomical structural approach. The anatomical approach follows basic kinesiology, and usually the situations that a person may experience posturally are compared and evaluated with the test results [8]. It is possible to mention many factors that can affect the functional mobility of individuals. One of these factors is the body composition of individuals. Body composition is a main component of physical fitness [9]. Body fat, a parameter representing body composition, is associated with all aspects of performance and healthy living. It has been suggested that insufficient and excess body fat may contribute to musculoskeletal injuries [10]. Few studies have been conducted on BMI and functional mobility. Although the topic has been little researched, available evidence suggests that men classified as obese based on BMI may exhibit less range of motion in multiple joints than men with normal BMI measurements [11, 12].

Many parameters known to affect functional movement capacity have been reported in different studies [13–15]. These include lack of regular exercise, excessive exercise and injury, underweight or overweight, postural balance, functional performance, and decreased physical activity [14]. Regular physical activity and participation in structured exercise play pivotal roles in maintaining optimal body functionality, promoting musculoskeletal health, and enhancing overall quality of life. As emphasized by current global and regional health and fitness trends, which highlight that a dynamic lifestyle encompassing a variety of cardiovascular workouts, resistance exercises, and stretching routines can mitigate chronic disease risk factors, improve mental well-being, and support healthy aging [16]. All these factors are closely related to lifestyle, nutrition, and exercise habits acquired at a young age [17, 18]. Therefore, it is important for individuals and societies to effectively address the expected limitations in functional mobility that occur after adulthood. Despite this, the relationship between lifestyle factorssuch as diet, sedentary behavior, and functional movement capacityremains unclear. Additionally, the effects of behaviors such as smoking, alcohol consumption, and chronic diseases on movement capacity have not been fully explored. This study aimed to address these gaps by investigating the impact of body composition and lifestyle habits on functional movement capacity.

2. Materials and methods

2.1 Study design and participants

Over a 3-month period, a total of 112 physically inactive adult males (age = 30 ± 11 years; range = 25–62 years; height = 176.13 ± 6.71 cm; weight = 79.21 ± 15.77 kg) participated in this cross-sectional study. Non-probability convenience sampling was used. Ethical approval was obtained prior to the commencement of the study. Ethical approval for this study was obtained from Tekirdag Namik Kemal University University Clinical Research Ethics Committee (Approval number: 2023.37.02.15) and conducted in accordance with the principles of the Declaration of Helsinki [19]. The study's inclusion criteria included being physically independent between 18 and 65 years of age, not having any history of cardiac, orthopaedic, or musculoskeletal system dysfunction, and not having participated in regular physical exercise more than once a week in the five months prior to the start of the study. Exclusion criteria were history of uncontrolled diabetes or hypertension, lower extremity musculoskeletal injuries within the previous six months and cardiovascular diseases. However, participants with diabetes or hypertension controlled by medication or other treatment were included in the study as participants with chronic diseases.

2.2 Data collection

2.2.1 Body composition measurements

Participants' heights were measured using a portable stadiometer (Mesilife 13539, Istanbul, Türkiye). The participants assumed a barefoot stance in the Frankfort horizontal plane, with their feet together, knees straight, heels, buttocks, and scapulae in contact with the apparatus [20]. Tanita, Tartā Fast, Japan, manufactured bioelectrical impedance analysis (BIA) equipment that was used to estimate body weight, body fat percentage, and BMI. The BIA device was operated at a fixed current of 50 kHz, using eight electrodes. The operating principles of the device were followed throughout the procedure.

2.2.2 Functional movement screen test protocol

The Functional Movement Screen (FMS)™, developed by Gray Cook, Lee Burton, and Keith Fields, is a screening tool designed to assess potential injury risk in athletes [8, 21, 22]. The FMS evaluates the quality of fundamental movement patterns, identifies deficits in neuromuscular control, and provides a framework to enhance athletic performance. This screening battery comprises seven tests that aim to assess basic functional movement patterns essential for both athletic performance and daily activities [8, 23]. During pre-participation examinations or after completing post-surgery rehabilitation, a screening system of this kind can also be an essential tool for predicting injury and determining readiness to return to sports [8]. Deep squat, hurdle step, single-line step, shoulder mobility, active straight leg raise, trunk stability push-up, and rotation stability are the seven basic movements that make up the Functional Movement Screening test. There are four options for the FMS scoring. Scores range from zero to three, with three being the best possible score. The Functional Movement Screen (FMS) had a maximum score of 21 points. Scoring 14 or below conferred a 1.5-fold greater risk of injury than scoring 14 or above [8]. A quantitative analysis evaluated the psychometric characteristics, incorporating six studies on reliability and nine studies assessing injury predictive value. Intrarater reliability showed an Intraclass Correlation Coefficient (ICC) of 0.81 (95% Confidence Interval (CI), 0.69–0.92), while interrater reliability also demonstrated an ICC of 0.81 (95% CI, 0.70–0.92). The likelihood of injury increased 2.74 times when FMS scores were ≤14 (95% CI, 1.70–4.43). Validity studies revealed weaknesses in both the internal and external validity of the FMS. Nevertheless, the FMS exhibited outstanding interrater and intrarater reliability [23].

2.3 Procedure

Prior to commencing the study, participants were provided with theoretical and practical explanations of the test and measurement protocols. Participants completed a lifestyle habit questionnaire (**Supplementary Table 1**). Anthropometric data, including height, body weight, muscle mass, and body fat percentage, were measured. Following anthropometric measurements, Functional Movement Screen (FMS) tests were conducted by the same trained and experienced physical therapist, with the test order remaining consistent across all participants. Video recordings were made of all exercises to ensure accurate scoring later. Two evaluators independently reviewed the videos and assigned scores to each FMS™ exercise based on established criteria [21]. The scoring system was as follows: a score of 3 was assigned for complete and correct execution without visible compensations; 2 points were given when compensations, improper form, or misalignment were observed; 1 point was awarded for incomplete movements; and 0 assigned if the subject experienced pain during the exercise. To determine the overall score, the best performance out of three attempts was recorded for the deep squat and trunk stability exercises. In cases where bilateral assessments were conducted (such as hurdle step, inline lunge, shoulder mobility, rotary stability, and active straight leg raise), the lower score between the two sides was utilized. Nevertheless, to identify any imbalances, scores for both sides were documented and evaluated [24]. A standardized warm-up that included five minutes of running and five minutes of dynamic stretching was performed prior to the FMS assessment. To reduce the impact of circadian rhythms on the results, all tests were conducted at the same time of the day (09:30–11:30). Fig. 1 shows the measurements and their respective sequences in detail.

2.4 Statistical analysis

Data homogeneity of variance and assumption of normality were assessed using Mauchly's sphericity test and Shapiro-Wilk test. Descriptive statistics are presented as frequency (percentage (%)) and mean ± standard deviation (SD). Multiple linear regression analysis was conducted to investigate the impact of lifestyle habits and body composition on the overall FMS score. Functional movement capability, as determined by the FMS total score, was the main dependent variable in our regression models. Body composition was measured for certain anthropometric parameters (height, weight, BMI, body fat, and muscle mass), and lifestyle habits for certain parameters (length of sleep and number of television (TV) hours watched) were among the independent factors. We used a stepwise regression approach to determine the most important predictors of functional movement capacity. A preliminary model was created, variables were chosen according to their importance, and each variable was added individually until the model fit showed no discernible improvement. Group comparisons were performed using one-way analysis of variance (ANOVA) for the three groups. Independent sample t-tests were used for matched group comparisons. Cohen's d and eta squared (η^2) were calculated to determine effect sizes. The statistical significance level was set at $p = 0.05$.

3. Results

The lifestyle habits of the participants are presented in Table 1. On average, the participants slept for 7.34 hours per night. The majority (72%) of the participants were non-smokers and (67%) were non-alcohol users. Most participants (92%) did not report any chronic health conditions. The participants were primarily employees of the education sector (85%). Body composition characteristics and Functional Movement Screen (FMS) parameters are shown in Table 2. The mean body mass index (BMI) indicated overweight status. The average FMS score was 16.65 ± 2.79, suggesting good movement quality and lower injury risk.

TABLE 1. Descriptive data on participants' lifestyle habit variables.

Parameters	Mean	SD
Sleep duration per day (h)	7.34	1.64
TV watching per day (h)	1.10	1.58
Smoking, n (%)		
Yes	40	35.71
No	72	64.29
Alcohol Use, n (%)		
Yes	45	40.17
No	67	59.83
Eating regularly, n (%)		
Yes	50	44.64
No	28	25.00
Sometimes	34	30.36
Chronic Health disease, n (%)		
Yes	20	17.85
No	92	82.15

Notes: SD: Standard deviation; n (%): frequency (percentage); h: hours; TV: television.

The results obtained from the stepwise multiple linear regression analysis showed that body fat explained 24% of the variation in the total FMS scores ($F_{(1-110)} = 21.378$, $p < 0.001$). The coefficient of body fat is = −0.159. A 1-unit increase in body fat caused a −0.159 unit decrease in the total FMS score (Table 3). In addition, as a result of the stepwise model, it was determined that the parameters of height, body weight, muscle mass, sleep duration, and TV viewing time did not affect the FMS total scores and were not included in the

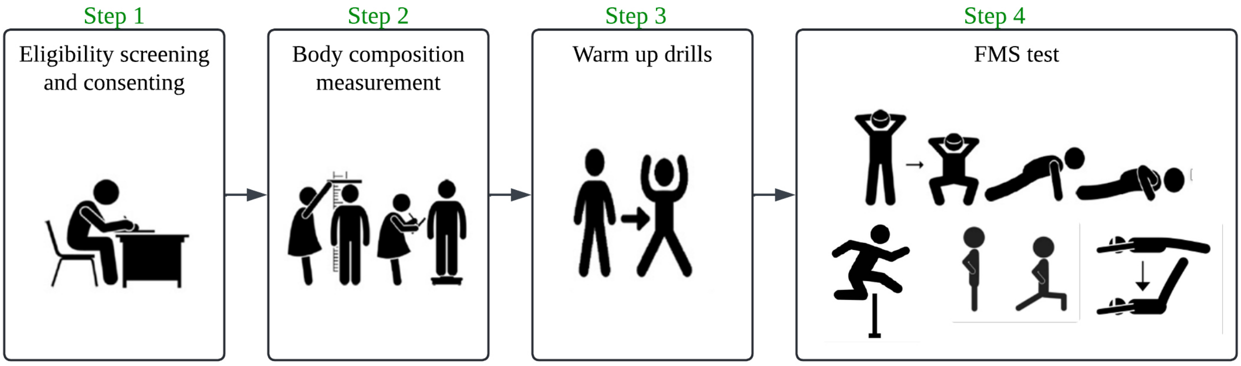

FIGURE 1. An illustrative scheme of measures. FMS: Functional Movement Screen.

TABLE 2. Descriptive characteristics of the participants body composition and FMS test parameters.

Parameters	Mean ± SD
Height (cm)	176.13 ± 6.71
Weight (kg)	79.21 ± 15.77
BMI (m/kg^2)	25.82 ± 4.79
Body Fat (%)	21.02 ± 8.73
Muscle Mass (kg)	59.01 ± 6.29
Deep squat	2.40 ± 0.69
Hurdle step	2.43 ± 0.48
Inline lunge	2.28 ± 0.61
Shoulder mobility	2.46 ± 0.65
Active straight-leg raise	2.41 ± 0.48
Trunk stability-push up	2.64 ± 0.51
Rotary stability	1.99 ± 0.59
Total FMS Score	16.65 ± 2.79

SD: Standard deviation; BMI: body mass index; FMS: Functional Movement Screen.

analysis.

In the comparison of the FMS total scores of the participants in terms of lifestyle habit parameters, it was determined that there was a significant difference only in terms of having a chronic disease. It was determined that the FMS total scores of the participants who did not have chronic disease were significantly higher (% change = 12.14; $p = 0.037$). The effect size of this difference between the two groups was moderate ($d = 0.48$). No significant differences were found in the comparison of all other lifestyle habits in terms of the FMS total score ($p > 0.05$) (Table 4).

4. Discussion

This study aimed to evaluate the impact of body composition and lifestyle habits on functional movement capacity in inactive overweight men. The findings revealed that a higher body fat percentage had a negative effect on the (FMS) total scores, indicating a decrease in functional movement capacity. In contrast, factors such as height, body weight, and BMI showed no significant influence on the FMS scores. These results are consistent with previous research, which suggests that both insufficient and excess body fat could contribute to musculoskeletal injuries [25].

It is well established that regular exercise plays a crucial role in enhancing metabolic function and reducing body fat levels [16]. However, apart from athletic populations, there is a notable absence of studies examining the relationship between body fat and FMS scores. One study involving football players found that an increase in body fat percentage was associated with a decline in both total FMS scores and individual test performance [26]. Similarly, another study assessing a mixed group of rugby, volleyball, and soccer players reported that a high body fat percentage had a detrimental effect on the composite FMS score [27]. Fat mass has also been shown to negatively affect muscle strength [28], with intramuscular adipose tissue inhibiting central activation, leading to reduced muscle strength [29]. Additionally, adipose tissue produces tumor necrosis factor-alpha (TNF-α), which has been linked to a reduction in muscular function [30, 31]. The accumulation of intramuscular adipose tissue, which is commonly observed in obese individuals, further contributes to impaired muscle function and strength. Elevated adiposity has been shown to augment injury risk during sports-related activities, such as sprinting, distance running, and jumping, by altering tissue stress and deformation moments [32, 33]. Excess body fat diminishes the biomechanical efficiency of these movements. Additionally, increased adiposity impairs flexibility, range of motion, and postural stability [34]. Obesity is a primary deterrent to physical activity and negatively affects mobility [10, 35]. Collectively, these findings suggest that excess adiposity in sedentary overweight individuals may hinder unrestricted movement.

In our study, BMI had no effect on the total FMS scores of inactive adults. The most important reason for this may be that the BMI of the study group was within normal limits. However, different results have been reported in the literature based on our research findings. A negative correlation between FMS score and BMI has been reported in adults without a history of musculoskeletal injury. Furthermore, those with a BMI >30 showed significantly lower FMS scores than those with a lower BMI [34]. In another study, the mean composite FMS score of adults with a BMI >30 was 2 points lower than that of adults with a BMI <30 [36]. A study examining physical limitations associated with BMI and obesity scores found that obesity not only limits movement for an individual but also causes an increase in musculoskeletal or joint-related pain while producing movement [37].

In this study, we concluded that sleep duration and television viewing time, which represent lifestyle habits, had no effect on the functional movement capacity of participants. In addition, no significant differences were found in the comparisons of parameters, such as smoking, alcohol consumption, and regular eating habits, on functional movement capacity. However, participants without any chronic diseases had a significantly higher functional movement capacity. Thus, it can be stated that being healthy may positively affect functional movement capacity. It is thought that the main reason why factors that may affect health status, such as smoking, alcohol consumption, and regular eating habits, did not show a significant effect, may be due to the limited sample size in our study. While reviewing the literature, it is generally reported that physical inactivity, smoking, being overweight, and having a history of injury are negatively associated with general health status [38–41]. However, as reported in the literature, there is limited evidence on how lifestyle habits affect physical performance, especially functional movement capacity, in adults [41]. This study's findings, particularly those pertaining to adults, are anticipated to make significant contributions to the existing body of literature. Sedentary behavior has emerged as one of the most prevalent behavioral patterns in contemporary society [42]. Research indicates that adults allocate approximately one-third to one-half of their daily time to sedentary behaviors, including sitting for work, engaging in screen-based leisure ac-

TABLE 3. Multiple linear regression analysis results for body composition parameters and sleep duration and watching TV time predicting performance in FMS total score.

FMS	Predictors	B	SE	β	t	p	R	R^2	Adj.R^2
Model 1									
	(Constant)	19.995	0.783	-	25.549	<0.001	-	-	-
	Body fat	−0.159	0.034	−0.497	−4.624	<0.001	0.497	0.247	0.236
Excluded Variables									
FMS	Predictors	Beta In	t	p					
Model 1									
	Height	−0.156	−1.437	0.156					
	Weight	−0.181	−1.120	0.267					
	BMI	−0.062	−0.258	0.798					
	Muscle Mass	−0.087	−0.765	0.447					
	Sleep duration	0.088	1.175	0.242					
	Watching TV	−0.041	−0.533	0.595					

FMS: Functional Movement Screen; BMI: body mass index; Adj.: Adjusted; TV: television; B: Coefficient; SE: Standard Error.

TABLE 4. Comparison of FMS total scores in terms of participants' lifestyle habits.

Variables	Mean ± SD	t	df	p	d
Smoking cigarette					
Smoker	17.11 ± 2.57	1.118	110	0.268	-
Non-smoker	16.33 ± 2.92				
Alcohol consumption					
Yes	16.81 ± 2.95	−0.381	110	0.705	-
No	16.43 ± 2.56				
Chronic diseases					
Yes	14.82 ± 2.08	2.172	110	0.037*	0.48
No	16.62 ± 2.87				
Variables	Mean ± SD	Mean Square	F	p	$\eta_p{}^2$
Eating regularly					
Yes	16.96 ± 2.35	28.107	3.920	0.055	-
No	15.24 ± 3.65				
Sometime	17.54 ± 2.71				

*Notes: d = Cohen's d, *denotes <0.05. SD: Standard deviation; $\eta_p{}^2$: artial eta squared.*

tivities, and utilizing public transportation [43]. Furthermore, sedentary adults are associated with other detrimental lifestyle habits, such as poor sleep patterns [44], imbalanced dietary practices [45], and insufficient physical activity [46].

The literature emphasizes the detrimental effects of sedentary lifestyles on overall health. Prolonged sedentary behavior in adults has been linked to an elevated risk of insomnia and sleep disturbances [47], accompanied by autonomic nervous system and vascular dysfunction [48]. Additionally, sedentary behaviors often interact with unhealthy dietary habits, such as excessive consumption of calorie-dense foods [49], leading to overweight, obesity, insulin resistance, and increased cardiovascular risk [50]. This study demonstrated that a multicomponent exercise program, incorporating bodyweight exercises and resistance-based alternating modalities, can dose-dependently improve musculoskeletal fitness indicators in inactive adults with overweight/obesity [51]. At this point, especially with our research findings, revealing the effects of overweight individuals' lifestyle habits on functional movement capacity and general health status provides important contributions to the literature. Further, in future interventional studies, more research evaluating functional movement capacity, especially in overweight and obese individuals, should be conducted.

This study had several limitations. One limitation is the sample size of the study. Researchers conducting research on this subject should increase their sample size. Another important limitation of this study is that physical activity levels were assessed using a self-reported questionnaire. While self-report can provide some insight, it is subject to bias and may not accurately capture participants' true activity patterns. In future research, it would be beneficial to utilize objective measures of physical activity, such as accelerometers, to more precisely determine activity levels. Thus, the focus on physically inactive males was an intentional design choice, it restricts the applicability of the results. In future research, it will be essential to recruit both males and females and conduct sex-based analyses to fully understand the gender disperty related to FMS. One of the strengths of this study was that the study group included inactive overweight men. However, there has been no research on this age group in the literature. Additionally, the fact that the parameters of body composition and lifestyle habits were evaluated together in the same study is a strength of this study.

5. Conclusions

The primary finding of this study was the adverse effect of body fat percentage on functional movement capacity. A negative correlation was observed between body fat percentage and total FMS scores. Additionally, participants without chronic diseases demonstrated higher total FMS scores than those with chronic diseases. Therefore, it can be inferred that overall health status positively influences functional movement capacity.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

UC, MIA and CIA—conceptualization. UC, AMS, ZD and CIA—methodology; project administration. CIA, DA and MCM—software. CIA, MIA and DA—validation; visualization. UC, CIA and MCM—formal analysis. UC and MIA—investigation; writing-original draft preparation. MIA, CIA, DA and MCM—resources. UC—data curation. UC, MIA, CIA, ZD and AMS—writing-review and editing. UC and CIA—supervision. CA—methodology. MIA—funding acquisition. All the authors have read and agreed to the published version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted in accordance with the Declaration of Helsinki and was reviewed and approved by Ethical approval for the study was obtained from the Non-Invasive Clinical Research Ethics Committee of Tekirdag Namik Kemal University (Approval number: 2023.37.02.15). The participants provided informed consent and agreed to publication of the details of this research.

ACKNOWLEDGMENT

We extend our gratitude to the participants for their invaluable contribution to this study. Special Thanks to Princess Nourah bint Abdulrahman University Researchers Supporting Project number (PNURSP2025R 286), Princess Nourah bint University, Riyadh, Saudi Arabia.

FUNDING

This research was funded by Princess Nourah bint Abdulrahman University Researchers Supporting Project number (PNURSP2025R 286), Riyadh, Saudi Arabia. The authors confirm that the funding organization had no role in the study design, data collection, analysis, interpretation, manuscript writing, or decision to publish.

CONFLICT OF INTEREST

The authors declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.jomh.org/files/article/1882631809224589312/attachment/Supplementary%20Table%201.pdf.

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How to cite this article: Umut Canli, Monira I. Aldhahi, Ali Mert Sendil, Zeynep Dogan, Dorin Alupei, Maria Cristina Man, *et al*. The effect of body composition and lifestyle habits on functional movement capacity in inactive overweight adults males. Journal of Men's Health. 2025; 21(1): 73-80. doi: 10.22514/jomh.2025.007.