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Body composition assessment of sedentary men: A cross sectional study

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Abstract:

Excess body weight results from an imbalance between energy intake and energy expenditure and sedentary lifestyle is an important contributor to age-related changes in body composition. We conducted a cross-sectional study among 120 sedentary men aged 20–59 years to assess body weight, body mass index (BMI), body fat percentage (using the skinfold caliper method) and fat-free mass (FFM). Body weight, BMI and body fat percentage increased significantly with advancing age, with high increase observed in participants aged 30–39 years compared with those aged 20–29 years. Although FFM showed a slight, non-significant increase in the 30–39-year age group, it declined progressively thereafter, suggesting age-related loss of lean body mass. Thus, data shows that advancing age combined with a sedentary lifestyle is associated with increased adiposity and reduced lean mass, emphasizing the importance of regular physical activity for maintaining healthy body composition.

Keywords: Body composition, body mass index (BMI), body fat %, fat free mass (FFM), sedentary lifestyle

Background:

Sedentary lifestyle continues to prevail in the world's population; More than 25% of the adult population does not perform enough physical activity which is increasing in low-income countries. The WHO defines a physically inactive/sedentary person as someone who engages in less than 150 min of moderate or 75 min of vigorous physical activity and remains seated for more than three hours per day. Adults with insufficient physical activity increase their risk of death by up to 30% compared to subjects who engage in at least 150 to 300 min of moderate exercise or 75 to 150 min of intense aerobic activity per week **[1]**. Body composition analysis provides an insight to nutritional status, functional capacity of human being in formulating nutritional management and for observing of therapeutic nutrition intervention **[2-4].** Obesity associated health problems refer to complex metabolic diseases, including diabetes, cardiovascular diseases, arthritis, polycystic ovarian diseases, etc. that are intimately associated with obesity **[5, 6].** Increasing age influences the distribution of adipose tissue. BMI is considered to be the most common yardstick to measure obesity worldwide, yet as it is not capable of differentiating between body fat and muscle mass, it fails to be a reliable predictor of disease risk **[7].** Obesity is preventable; however according to World Health Organization (WHO), overweight and obesity is the 5th leading risk for global deaths in 2013; 2.8 million adults die as a result of being overweight or obese. In addition, 44 % of certain cancer burdens are attributable to overweight and obesity **[8].** Skinfold measurement is a widely used body composition testing method for assessing Body Fat Percentage (BFP). Skinfold thickness is reliable, simple, accessible, fast, non-invasive and validated technique used to analyze body composition. Considering their cost- effectiveness, non-invasiveness and ability to provide valuable insights into regional adiposities, skinfold thickness measurements represent invaluable tools for predicting metabolic risks and assessing health conditions associated with adiposity **[9]**. However, most of them exhibited limitations as they did not identify the fat distribution in human body. Furthermore, skinfold thickness measurement could be used to estimate body density and corporal distribution of fat due to skinfolds not being altered by factors such as food intake, daily activity or hydration status **[10]**. A skinfold caliper is used for measuring thickness of skin and transformed or computed into body fat composition in percentage. Different type of skinfold caliper measures a double layer of skinfold thickness in mm, mostly from three to nine different anatomical sites around the body **[11, 12]**. Therefore, it is of interest to evaluate the body composition of sedentary adult men of different age group is lacking in India.

Materials and Methods:

Inclusion criteria:

Total of 120 male subjects who are having 8 hours of office work a day with sedentary lifestyle were selected for our study. Subjects were categorized into four groups according to age:

Global Physical activity questionnaire (GPAQ) **[13]** was used to label the subjects as sedentary.

Exclusion criteria:

Following subjects were excluded from the above study

- **[1]** Subjects with chronic illness like Diabetes Mellitus, Hypertension, Bronchial asthma, Tuberculosis *etc.*
- **[2]** Subjects who had active lifestyle (Exercising daily for > 45 mins)
- **[3]** Subjects with addictions like smoking, drinking alcohol, tobacco chewing, *etc.*

Anthropometric measurements were initiated by recording the height (cms) and weight (kg) of all subjects.

- **[1]** Total height: Standing height was measured in cms using a scale mounted on wall, in a barefoot subject, with his heels, buttocks and back touching the wall.
- **[2]** Total weight: The weight (kilograms) was measured by using a lever system weight balance with minimum clothes and without shoes.
- **[3]** Body mass Index (BMI) was assessed by following formula
- **[4]** BMI = Weight (kg) / Height (m)^2
- **[5]** Body Fat % was estimated by skinfold thickness caliper method.

The standardized procedure for obtaining each skinfold measurement began with the secure grasp of the skinfold between the thumb and index finger of the observer's left hand, ensuring the inclusion of all underlying adipose tissue within the fold. Subsequently, the skinfold caliper was positioned in the right hand, applied to the skinfold and maintained at a consistent distance of approximately 1 cm from the fingers of the left hand, ensuring that only the caliper's faces and not the observer's fingers, applied pressure to the fold. Following the precise placement of the caliper, the observer released the fingers of their right hand, allowing the instrument to exert its maximum pressure while sustaining the grip of the fold with their left hand. Measurements were recorded by reading the dial of the caliper to the nearest 0.2 mm. To enhance accuracy, the caliper was held in place for 2 seconds before each measurement was recorded.

Specific anatomical landmarks guided the placement of each skinfold measurement were as follows:

- **[1] Bicipital:** On the arm midway between tip of acromion and cubital fossa.
- **[2] Tricipital:** On the back of arm midway between the acromion process and the olecranon process.
- **[3] Subscapular:** Below the inferior angle of the scapula, skinfold parallel to the medial border of scapula was taken.
- **[4] Suprailiac:** Just above the iliac crest at the mid axillary line, the fold is lifted diagonally, following the natural line of iliac crest.

The sum of all four sites was done and then the percentage body fat was determined from the chart given in the manual of Fat-O-measure kit **[14]**.

The total body fat (in kilograms) and Fat Free Mass (in kilograms) were calculated using following formula:

Body Fat (kg) = weight [kg] x body fat [%]/ 100

Fat free mass (kg) = weight [kg] x [1 – (body fat %/ 100)]

Statistical analysis:

All the data was expressed as Mean ± SD. The anthropometric data was recorded and maintained using Microsoft Excel 2010. Statistical analysis was done using unpaired t test using Microsoft Excel 2010.This study was approved by Institutional Ethical Committee. With advancing age, body weight, BMI and body fat % was increased. Though not significant, Fat Free mass (FFM) was increased in Group II as compared to Group I; but it goes on decreasing in Group III & Group IV as compared to Group II. Statistically significant difference in BMI and body fat % was observed in Group II, Group III & Group IV when compared to Group I. But increase in body weight, BMI and body fat % was statistically more significant in Group II as compared to Group I.

Results:

The demographic characteristics of the study participants according to age group are presented in **Table 1**. The anthropometric and body composition parameters of all four age groups are summarized in **Table 2**. Body weight, BMI, total skinfold thickness, body fat percentage and body fat mass increased progressively with advancing age. Fat-free mass showed a slight increase in Group II compared with Group I, followed by a gradual decline in Groups III and IV. Pairwise comparison of BMI between the four age groups demonstrated statistically significant differences for all comparisons (**Table 3**). Similarly, body fat percentage differed significantly between all age groups, indicating a progressive increase in adiposity with advancing age (**Table 4**). No statistically significant differences were observed in fat-free mass between the age groups (**Table 5**). The age-related increase in body weight is illustrated in **Figure 1**, showing a steady rise from Group I to Group IV. Changes in BMI across the four age groups are presented in **Figure 2**, showing a progressive increase with advancing age. The gradual increase in body fat percentage with age is depicted in **Figure 3**, whereas **Figure 4** illustrates the corresponding increase in total skinfold thickness. Age-related changes in fat-free mass are shown in **Figure 5**, showing a modest increase in early adulthood followed by a gradual decline in older age groups. A combined comparison of body weight, BMI, total skinfold thickness, body fat percentage and fat-free mass across all age groups is presented in **Figure 6**, highlighting the progressive increase in adiposity measures with age, while fat-free mass remained relatively stable before declining slightly in the older age groups.

Table 1: Study group divisions according to age

Group	Age (years)	Sample size
I	20-29	30
II	30-39	30
III	40-49	30
IV	50-59	30

Table 2: Comparison of different age group for Body weight, Body mass index (BMI), Body Fat %, Body Fat in kg and Fat Free Mass (FFM)

	Group I	Group II	Group III	Group IV
Height (cms) (Mean ± SD)	170.6 ± 6.07	167.9 ± 6.09	167.09 ± 5.28	165.4 ± 6.81
Weight (lb) (Mean ± SD)	125.06 ±19.31	143.50± 24.92	149.77 ± 25.79	152.76 ± 33.81
Weight (Kg) (Mean ± SD)	56.73 ± 8.76	67.06 ±9.06	72.83 ± 8.42	80.03 ± 11.27
BMI (kg/m²) (Mean ± SD)	19.42 ± 2.43	23.84 ± 3.58	26.07 ± 3.27	29.26 ±3.62
Bicipital (cms) (Mean ± SD)	4.66 ± 1.53	7.73 ± 2.69	8.32 ± 2.74	9 ± 3.50
Tricipital (cms) (Mean ± SD)	8.22 ± 3.51	12.6 ± 4.97	11.93 ± 4.24	14.36 ± 4.01
Subscapular (cms)	11.43 ± 6.33	17 ± 5.97	19.41 ± 6.57	21.03 ± 6.99

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(Mean ± SD)				
Suprailiac (cms) (Mean ± SD)	12 ± 5.83	19.1 ± 7.56	23.22 ± 7.48	24.86 ± 9.71
Total Skin fold thickness (cms) (Mean ± SD)	36.36 ± 16.14	56.5 ± 19.38	62.90 ± 25.39	69.26 ± 22.37
Body Fat % (Mean ± SD)	12.71 ± 5.01	20.49 ± 4.27	25.39 ± 5.33	28.32 ± 4.51
Body fat (kg) (Mean ± SD)	7.32 ± 3.33	13.40 ± 4.64	17.65 ± 6.18	20.18 ± 7.35
Fat Free Mass (FFM) (Kg) (Mean ± SD)	49.40 ± 7.47	51.69 ± 7.71	50.25 ± 6.20	49.11 ± 8.50

Table 3: Comparison of different age group for Body Mass Index (BMI)

Age Group	I	II	III	IV
I	-	S	S	S
II	S	-	S	S
III	S	S	-	S
IV	S	S	S	-

S= Significant ($p < 0.05$)
NS = Not significant

Table 4: Comparison of different age group for Body Fat %

Age Group	I	II	III	IV
I	-	S	S	S
II	S	-	S	S
III	S	S	-	S
IV	S	S	S	-

S= Significant ($p < 0.05$)
NS = Not significant

Table 5: Comparison of different age group for Fat Free Mass (FFM)

Age Group	I	II	III	IV
I	-	NS	NS	NS
II	NS	-	NS	NS
III	NS	NS	-	NS
IV	NS	NS	NS	-

S= Significant ($p < 0.05$)
NS = Not significant

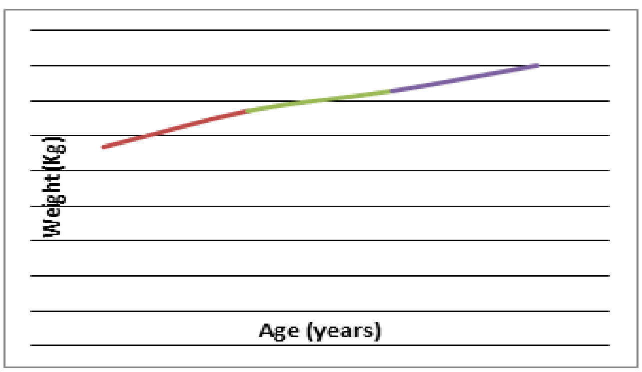

Figure 1: Changes in body weight according to different age group

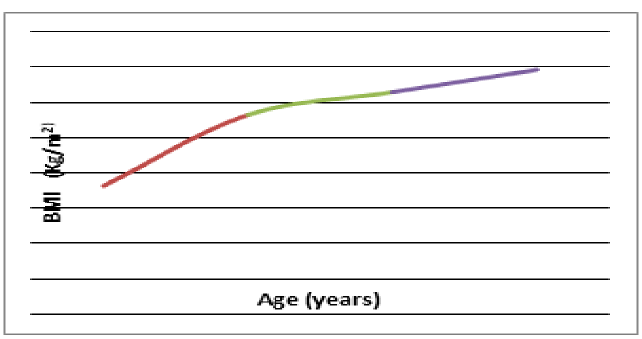

Figure 2: Changes in BMI according to different age group

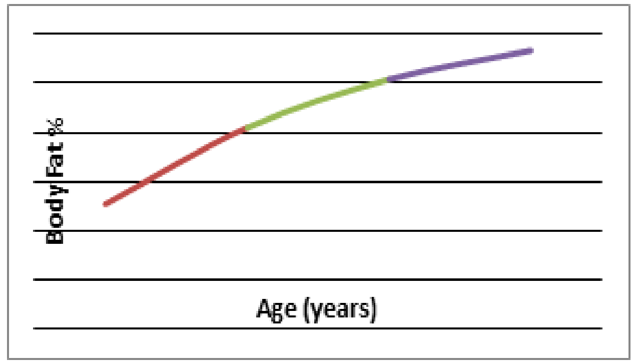

Figure 3: Changes in Body Fat % according to different age group

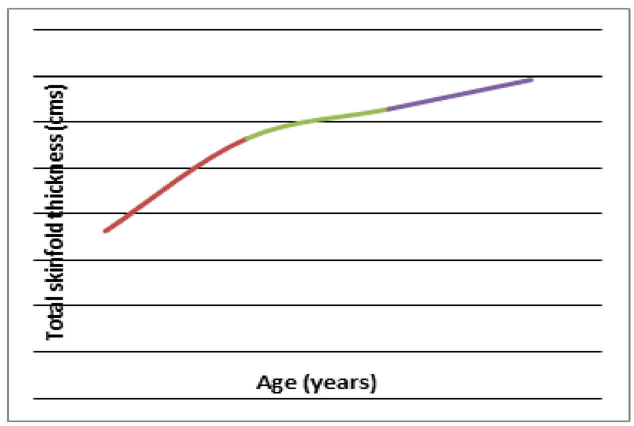

Figure 4: Changes in Total Skinfold thickness according to different age group

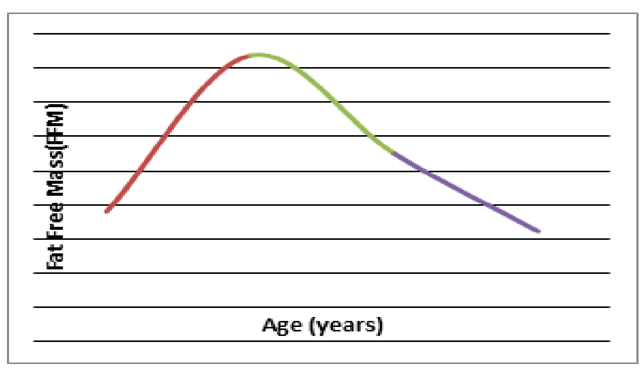

Figure 5: Changes in Fat Free Mass (FFM) according to different age group

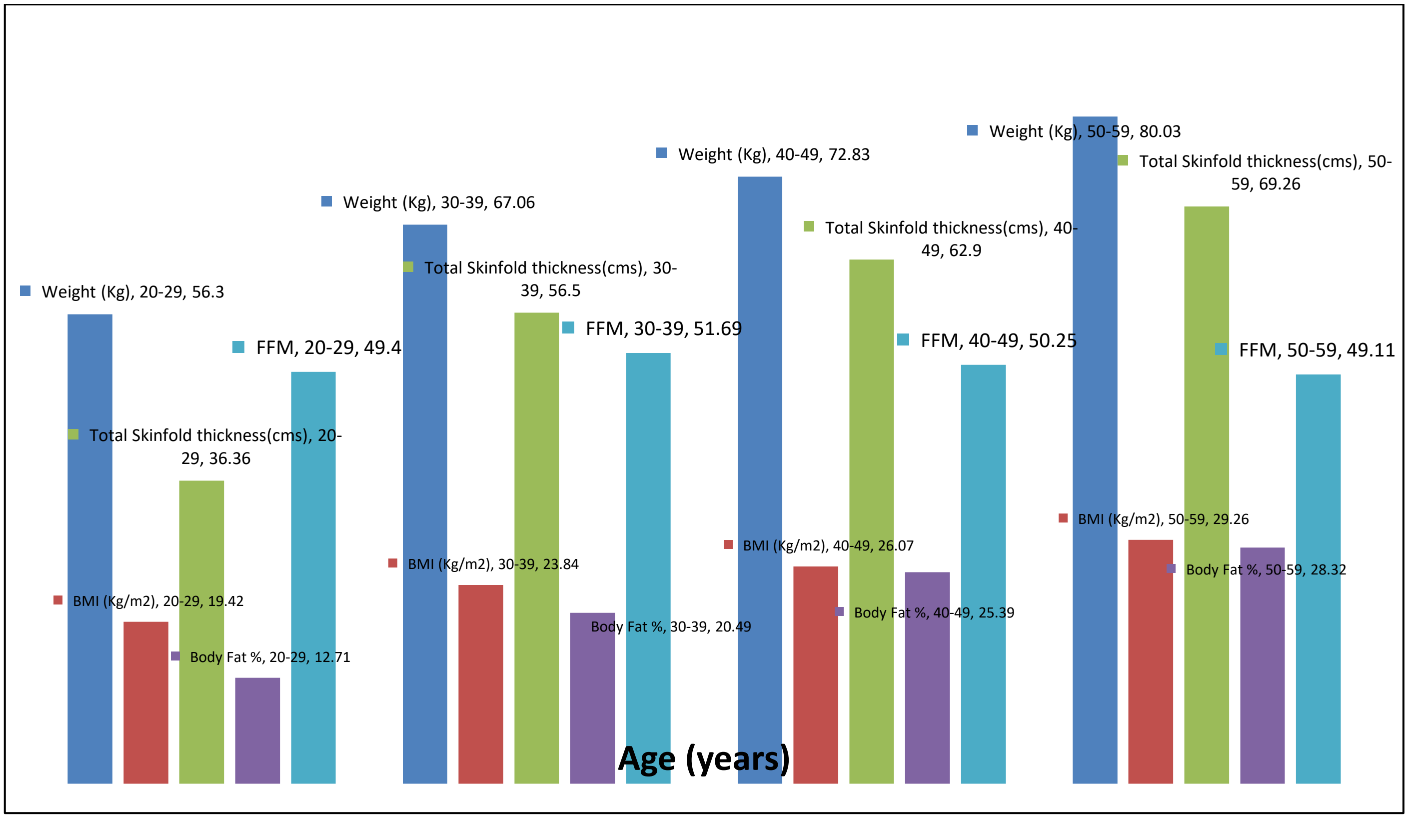

Figure 6: Changes in Body weight, BMI, Total Skinfold thickness, Body Fat % and Fat Free Mass (FFM) according to different age group

Discussion:

We found that with advancing age body weight, BMI and body fat % was increased. Body weight was increased with advancing age which was contributed much by increase in body fat %. This increase in fat deposition with advancing age might be because of sedentary lifestyle of study group subjects. We also found that though not statistically significant Fat Free mass (FFM) was increased in group II as compared to group I. Increase in hormonal activity might have caused this increase in Fat Free mass (FFM) in age group II as compared to group I. Also it was observed that Fat Free mass (FFM) goes on decreasing in group III and group IV as compared to group II. This reduction in Fat Free mass (FFM) might be associated with reduction in motor unit number and atrophy of muscle fibres. This study addressed weight gain between ages 20 to 40, a time of life that is susceptible to changes in lifestyle leading to weight gain. Contributors to weight gain with aging include reduction in resting metabolic rate **[15]**, Sarcopenia **[16]** and reductions in total energy expenditure and physical activity levels **[17]**. Westerterp *et al.* **[18]** studied diversified age groups in which found that visceral fat % and BMI both showed a significant positive correlation with subcutaneous fat and a negative correlation with skeletal muscle percentage irrespective of individual obesity status. Young men without obesity have a higher lean skeletal muscle mass as compared to the overweight and obese individuals of the same age and sex-matched group. Ponti *et al.* **[19]** has observed Peak FFM around age 30yr in females and males. They also observed that older age counteracted the positive association of Physical activity with FFM. Nomani *et al.* **[20]** in his study stated that the aging process is indeed characterized by an increase in body total fat mass and a concomitant decrease in lean mass and bone density, that are independent from general and physiological fluctuations in weight and body mass index (BMI). Body adiposity is also re-distributed with age, resulting in a general increase in trunk fat (mainly abdominal fat) and a reduction in appendicular fat (mainly subcutaneous fat). Moreover, the accumulation of fat infiltration in organs such as liver and muscles also increases in elderly, while subcutaneous fat mass tends to decrease. Sathyaprabha **[21]** in his review article stated that less or no physical activity is also responsible for a person to gain weight. The trend of obesity and overweight is commonly related to the age group of the individual. The older age group is at high risk of becoming obese as compared to the second and third decade of age group. Those who are in the third and fourth decade of life are placed at the second-lowest risk category of overweight and obesity. Middle-aged people are put in the highest risk group of obesity or overweight. Societal/ environmental changes are the primary cause of the worldwide obesity epidemic. Another significant cause could be an increase in time sedentarily spent and decreases in time being physically active spent and advancement in multimedia (*e.g.,* internet, cell phones) since 1980 and increased use of motor vehicles during the last forty years. Thomas **[22]** in her article mentioned that the decrease in the FFM in the Indian subpopulation is a consequence of aging or it is secondary to a decrease in physical activity remains to be determined. She also stressed that further studies involving energy intakes, total energy expenditure and physical activity are required to elucidate the changes associated with senescence in this population. Stevens *et al.* **[15]** in their study found that the metabolic rate of individual organs is lowering in older compared with younger individuals. With aging reductions in the mass of individual organs/tissues and in tissue specific organ metabolic rate contribute to a reduction in Resting Metabolic Rate (RMR) that in turn promotes changes in body composition favoring increased fat mass and reduced fat-free mass. Vitale *et al.* **[23]** stated that Sarcopenia is distinct from muscle wasting, which more broadly refers to involuntary loss of body mass (both muscle mass and fat). Sarcopenia is associated with a reduction in muscle mass and strength occurring with normal aging, associated with a reduction in motor unit number and atrophy of muscle fibers, especially the type II fibers. Takebe *et al.* **[24]** mentioned that one major cause of muscle mass loss with aging appears to be the alteration in hormonal activity involved in muscle regeneration and protein synthesis. Filippin *et al.* **[25]** concluded that unfavorable lifestyle factors such as low physical activity, skipping breakfast, inappropriate sleep duration and smoking were closely associated with weight gain in adulthood. Jakicic and Otto **[26]** in his review article mentioned the term sarcopenia which refers to the loss of muscle mass that occurs with aging. Sarcopenia is defined by the European Working Group on Sarcopenia in Older People (EWGSOP) as low muscle mass and low muscle function (strength and performance). Its prevalence varies depending on the definition used for it, but estimates propose a loss of approximately 8 % per decade until the age of 70 years. Jackson *et al.* **[27]** in his study stated that excess body weight is a result of an imbalance between energy intake and energy expenditure. Physical activity is the most variable component of energy expenditure and therefore has been the target of behavioral interventions to modify body weight. Physical activity also appears to have an independent effect on health related outcomes when compared with body weight, suggesting that adequate levels of activity may counteract the negative influence of body weight on health outcomes. Williams **[28]** stated that although aerobic exercise does not completely prevent the lower FFM in aging participants, resistance exercise may be more helpful. The study found that gain in BMI among men ages 20-40 years was associated with greater likelihood of consuming a non-vegetarian diet and physical activity of <150 minutes weekly. This suggests that men who gain more weight are likely to be engaged in lifestyle behaviors that are likely to promote further increase in BMI. These findings are concerning in light of evidence indicating that obesity leads to increased vulnerability to risk factors that cause obesity.

Conclusion:

Advancing age in sedentary men is associated with a significant increase in body weight, BMI and body fat percentage, with a gradual decline in fat-free mass after early adulthood. Skinfold thickness measurement is a simple, inexpensive and reliable method for assessing body composition for identifying individuals at increased risk of obesity-related metabolic disorders. Regular physical activity and lifestyle modification should be encouraged to preserve lean body mass, reduce adiposity and improve long-term health outcomes.

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Conflicts of interest: There are no conflicts of interest.

References:

[1] https://www.who.int/news-room/fact-sheets/detail/physical-activity
[2] Kuriyan R. *Indian J Med Res*. 2018 **148**:648. [PMID: 30666990]
[3] Holmes CJ & Racette SB. *Nutrients*. 2021 **13**:2493. [PMID: 34444653]
[4] Andreoli A *et al. Eur J Radiol*. 2016 **85**:1461. [PMID: 26971404]
[5] Dar L *et al. Int J Clin Pract*. 2018 **72**. [PMID: 29231278]
[6] https://ir.vidyasagar.ac.in/handle/123456789/241
[7] http://www.who.int/mediacentre/factsheets/fs311/en/
[8] Rios-Escalante C *et al. Int J Environ Res Public Health*. 2023 **20**:7089. [PMID: 38063518]
[9] Esparza-Ros F *et al. Nutrients*. 2022 **14**:2085. [PMID: 35631225]
[10] https://odphp.health.gov/healthypeople/objectives-and-data/data-sources-and-methods/data-sources/national-health-and-nutrition-examination-survey-nhanes
[11] Kagawa M *et al. Br J Nutr*. 2006 **95**:1002. [PMID: 16611393]
[12] https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/steps
[13] Chen HM *et al. Frontiers in Public Health*. 2026 **14**:1876542 [DOI: 10.3389/fpubh.2026.1876542]
[14] St-Onge MP & Gallagher D. *Nutrition*. 2010 **26**:152. [PMID: 20004080]
[15] Stevens J *et al. Eur J Clin Nutr*. 2010 64:6. [PMID: 19738633]
[16] Roberts SB & Dallal GE. *Public health nutrition*. 2005 **8**:1028. [PMID: 16277818]
[17] Ghosh S *et al. Sci Rep*. 2023 **13**:4895. [PMID: 36966257]
[18] Westerterp KR *et al. The American Journal of Clinical nutrition*. 2021 **114**:1583. [PMID: 34477824]
[19] Ponti F *et al. Front Endocrinol (Lausanne)*. 2020 **10**:861. [PMID: 31993018]
[20] Nomani A *et al. J IntegComm Health*. 2021 **10**:12. [DOI: 10.24321/2319.9113.202107]
[21] Sathyaprabha TN. *Indian J Physiol Pharmacol*. 2000 **44**:179. [PMID: 10846632]
[22] Thomas DR. *Clinical nutrition (Edinburgh, Scotland)*. 2007 **26**:389. [PMID: 17499396]
[23] Vitale G *et al. European journal of internal medicine*. 2016 **35**:10. [PMID: 27484963]

[24] Takebe N *et al*. *Diabetes MetabSyndrObes*. 2021 **14**:2065. [PMID: 34040401]
[25] Filippin LI *et al*. *Aging Clin Exp Res*. 2015 **27**:249. [PMID: 25365952]
[26] Jakicic JM & Otto AD. *Am J Clin Nutr*. 2005 **82**:226S. [PMID: 16002826]
[27] Jackson AS *et al*. *Br J Nutr*. 2012 **107**:1085. [PMID: 21810289]
[28] Williams PT. *PloS One*. 2011 **6**:e27657. [PMID: 22132124]