

Survey of the Relationship Between Activity Energy Expenditure Metabolic Equivalents and Barrier Factors of Physical Activity in the Elderly in Kashan

Ali Sadrollahi,¹ Zahra Khalili,^{2,*} Robab Pour Nazari,³ Majid Mohammadi,⁴ Maryam Ahmadi Khatir,⁵ and Najima Mossadegh⁶

¹MSc Geriatric Nursing, Faculty of Medical Surgical Nursing, Bandargaz Branch, Islamic Azad University, Bandargaz, IR Iran

²MSc Geriatric Nursing, Khalkhal Branch, Islamic Azad University, Khalkhal, IR Iran

³Ardabil University of Medical Sciences, Ardabil, IR Iran

⁴Iran University of Medical Sciences, Tehran, IR Iran

⁵Disaster and Emergency Medical Service Management Center, Department of Clinical Affairs, Mazandaran University of Medical Sciences, Sari, IR Iran

⁶Department of Clinical Affairs, Golestan University of Medical Sciences, Gorgan, IR Iran

*Corresponding author: Zahra Khalili, MSc Geriatric Nursing, Khalkhal Branch, Islamic Azad University, Khalkhal, IR Iran. Tel: +98-9355980622, E-mail: khalili.nurse@gmail.com

Received 2015 July 12; Revised 2015 October 11; Accepted 2015 November 14.

Abstract

Background: Physical activity in the elderly is influenced by aspects of aging that cause personal, mental, environmental, and social changes. Increases in factors that are barriers to activity cause physical energy expenditure to decrease.

Objectives: The aim of the present study was to survey the relationship between energy expenditure in metabolic equivalent units (MET) and factors that are barriers to physical activity in elderly people in Kashan, Iran

Methods: This is a descriptive analysis done in 2014. The study population was 400 people above 60 years old in medical facilities in Kashan. Multistage sampling was used in 10 clinics in 5 areas of Kashan. The sample size was varied according to gender and elderly population. Contributors were given questionnaires concerning energy expenditure levels in physical activity and factors that are barriers to being active.

Results: The average age among the study population was 67.6 ± 6.8 years median, and the interquartile range (IQR) of barriers to physical activity among Kashan's elderly was $(8.75) \pm 33$. Average energy expenditure was 326.21 ± 364.84 based on metabolic equivalent units (MET). In fact, 340 persons (85%) were practically without any active energy expenditure. The most common barrier was the lack of an appropriate place for doing physical activity; 298 (74%) of the participants cited this barrier. The results show the Spearman rank-order correlation is significant ($P = 0.038$, $r = 0.104$) between barriers to physical activity and activity energy expenditure in Kashan's elderly.

Conclusions: Decreasing barriers to physical activity among the elderly causes physical activities to increase; therefore, energy expenditure is increased. Decreasing social and environmental problems for the elderly is effective in increasing physical activity and energy expenditure.

Keywords: Aging, Physical Activity, Barrier Factors, Energy Expenditure

1. Background

Physical activity is an important factor in physical health among the elderly (1). Being active affects independence and improves quality of life and health (2). The elderly population is increasing and is expected to reach almost 2 billion (1,968,153,000) in 2050 (3). Decreasing health problems in the elderly and the associated costs of prevention and treatment are necessary (4). Physical activity is one of most effective factors in prevention, control, treatment, and improvement of physical and mental disorders. It also helps elders to be more socially independent

(5). In fact, physical activity is very important to maintaining a satisfying lifestyle until the end of life (6). In old age, physical changes can limit activity and create disorders (7) so that after 65 years old, one-fourth of the elderly population cannot do daily activities independently, and 10% of them are disabled (8). By definition, every movement in the skeletal and muscle structure that causes energy use is called physical activity (9). Physical activities in older people consist of personal activity, home chores, jobs, sports, and sedentary activities (10). Energy expenditure is different according to type, time, and amount of activity (11).

Activity energy expenditure (AEE) is one of the indexes of the prevention of disease and for promoting physical health (12). AEE is the amount of basic metabolic energy that is expended in physical activities (13). Previous studies have shown that having an appropriate and high level of physical activity can decrease blood pressure and mortality in elderly people (14), and people who expend more energy have more suitable body weights (15). A person's AEE depends on his physical activity level. The amount of physical activity decreases as age goes up (16); therefore, the amount of AEE is decreased in the elderly (17). Many complicated and multidimensional factors affect activity in the elderly. These factors include the social value of the activity, biological factors, a person's characteristic behaviors concerning activity, age, enjoyment of doing exercise, environmental factors, social support, and access to facilities (18). The lack of opportunities causes most of them to avoid activity. These factors, situational and personal, that cause elder people to avoid being active are considered as the barrier factors in doing physical activity (19). A study by Roberts et al. (2005) showed energy expenditure in older Americans was affected by increasing age, but activity energy usage with increasing age has not visible changes than other groups of ages (20). Tookuni et al. (2005) showed that being overweight was a barrier to physical activity among the elderly and caused energy use to decrease (21). Dideriksen et al. (2006) found high index was a barrier factor in doing physical activity and caused energy expenditure levels to decrease (22). Siddiqi et al. (2011) found that a lack of time and probability of injury were other barrier factors (23). Gobbi et al. (2009) reported that barriers among elderly people studied in Brazil included air pollution and a lack of social support (24). Dearth-Wesley et al. (2014) showed that the activity energy expenditure level was low in Russia's elderly (25). Luhrmann et al. (2009) found that body mass index influenced activity energy expenditure among the elderly in Germany (26).

Factors affecting physical activity among older people are different from one place to another (27). Lack of facilities and opportunities should be considered significant barriers for this population. This study has noted such barriers among the elderly in Kashan, and these barrier factors affect activity energy expenditures among an increasing population of elderly.

2. Objectives

Barrier factors affecting energy expenditure levels have not been adequately considered in previous studies. Therefore, this research considered the relationship between activity energy expenditure metabolic equivalents and barrier factors in physical activity in Kashan's elderly.

3. Methods

3.1. Study Population and Sampling

The current research was a descriptive cross-sectional study done in 2014. The study population included 400 people over 60 years old who had healthcare records in health centers in Kashan city. Kashan is a warm, dry city on the edge of a great desert in the center of Iran and has a population of about 200,000. Participants were selected by multistage sampling from 10 healthcare facilities in 5 areas of Kashan. Based on previous studies and an estimation of inactivity in 87% of older people (28), a 95% level of confidence ($z=1.96$, $d=0.05$, $P=0.13$, $q=0.87$), and Cochran's formula ($N=Z^2 \times p(1-p)/d^2$), a sample size of 261 people was selected for the study. It was increased 1.5-fold due to cluster sampling, and finally 400 individuals were investigated.

Inclusion criteria were over age 60, of Iranian nationality, no history of recognized mental disorders (psychosis) or dementia, ability to communicate and respond to questions, and residing in Kashan city at the time of the study. Diagnosis and detection of psychological disorders was based on information in healthcare center documents.

After coordinating with the department of health and medical education and obtaining necessary permissions, the researchers divided Kashan city into 5 regions (center, north, south, west, and east) based on a map, and 2 healthcare facilities were randomly selected from every region for a total of 10 centers. The number of elderly people covered by every healthcare center was determined. Based on population and gender, a quota was allocated to each region. Quota size was different in each section based on gender and population. At this stage, prospective participants were selected randomly from each database. After coordination with the Health Connector Base to confirm concurrence with the inclusion criteria, the subjects were contacted by telephone. Researchers stated the objectives of the study and invited the elderly to participate. To reach a quota that met the inclusion and exclusion criteria, 485 elderly were contacted. Among them, 53 subjects declined to participate; 23 did not attend the meeting, and 9 subjects did not complete the questionnaire and were excluded from the study.

In the meantime, the elders were made aware of the research goals and how the questionnaire would be completed. The questionnaire was completed for each person separately and privately. For those who could not read and write, the questionnaire was read to them in individual interviews, and the items in the questionnaire were filled in according to their ideas and choices. For participants who could read and write, the questionnaire was given to them to fill out, and at the same time the form was collected by the questioner. If the questionnaire had some missing

data, the researchers contacted the subject to complete the items, and if it was not possible, another subject was randomly chosen as a replacement. Then the researchers went to the houses of those subjects, explained the objectives of the study, and had the questionnaires completed.

3.2. Questionnaire

Data was gathered using a multipart questionnaire. The first part of the assessment was a self-designed tool relating to the participants' energy expenditure level; participants answered these 24 questions based on their normal physical activity during the previous week. The international physical activity questionnaire (IPAQ) was used in this part (29). To calculate the amount of energy expenditure per person in physical activity, energy expenditure of each activity was multiplied by the duration of the activity and the number of days that it occurred based on metabolic equivalent units (MET). Light, normal daily activity was equivalent to 1/3 MET unit per minute, walking was equivalent to 3.3 MET units of energy consumption, moderate physical activity equaled 4 MET units, and intense physical activity equaled 8 MET units. In the questionnaire, questions 3 to 11 related to vigorous activity, questions 12 to 15 to moderate activity, and questions 16 to 24 to light or low activity. Finally, the total amount of energy usage for the various activities was calculated.

Questionnaire scores were based on a scale with a lower limit of zero and no upper limit. For classification of energy consumption, 4 levels were considered: no usage, low usage, moderate usage, and high usage. No energy usage was defined as zero to 20 MET expended during the previous week. Low usage energy ranged from 20 to 600 MET for the week. Moderate energy usage ranged from 600 to 1500 MET. And finally, high energy usage was more than 1500 MET (30, 31). To test the questionnaire's reliability, the device was shared among 10 experts; results showed that 19 items had content validity index (CVI) scores of more than 0.79; these were determined to be suitable. Others had CVI scores between 0.79 and 0.7, which showed that they needed adjustment. For consideration of stability, the questionnaire was filled out by 30 elder people in two steps as a pilot. McNemar's statistical test yielded a P-value of all items at more than 0.05. Cohen's kappa factor for 20 items was equal to or more than 0.75, and others were between 0.4 and 0.74. Total Cronbach's alpha was calculated at 0.83.

The second part of the tool was a standard questionnaire about barrier factors of physical activity. To determine the elders' understanding of factors that limit physical activity, the researchers used the exercise benefits/barrier factors scale questionnaire, which was prepared by Sechrist et al. Among the tool's 43 questions were

14 questions devoted to limiting factors of physical activity; these were extracted from the questionnaire for the use of this study. Responses were based on a Likert-type scale of 4 to 1 respectively indicating strongly agree, agree, disagree, and strongly disagree. The score of limiting factors of physical activity was at least 14 and at most 56. The questionnaire did not have a cutoff point. The higher the score on questions of physical activity barriers, the more problems a person was facing in physical activity.

The number and percentage of individual factors were evaluated. Total Cronbach's alpha of this scale was 0.89. Cronbach's alpha coefficient for questions relating to physical activity barrier factors was 0.95 and relating to benefits was 0.9 (32). Validity and reliability of this tool was confirmed by Aghamolaei et al. Cronbach's alpha coefficient calculated for the Exercise Benefits/Barrier Factors questionnaire in a non-elderly group in Iran is 0.87 (30). The elderly have different conditions based on physical and cognitive abilities compared to other groups; therefore, the use of a non-specific questionnaire was considered for this study. To evaluate the reliability in the elderly population, the questionnaire was conducted as a pilot in 30 elder people in Kashan; the total Cronbach's alpha was 0.79. In order to evaluate internal reliability of isolated questions through the Cronbach's alpha test, the reliability score of questions relating to limiting factors of physical activities was 0.87.

3.3. Ethical Considerations

The study proposal was confirmed by the research council of the Kashan University of Medical Sciences. The code of ethics was 197 in 5/25/2014. Necessary authorizations were acquired, and oral and written consent were obtained from participants. Study subjects were assured that the data would be used exclusively for research purposes and would remain confidential. The participants were told they had an unconditional and absolute right to withdraw from the study at any time. All of the subjects signed informed consents and received an explanation of the study's objectives.

3.4. Data Analysis

Data analysis was carried out using SPSS version 16 software. Median and interquartile index numbers (IQR) were based on descriptive statistics. The Kolmogorov-Smirnov test was used to determine data normality. According to the Kolmogorov-Smirnov test for age variables, the score of limiting factors to physical activities and activity energy usage at $P < 0.05$ were meaningful from a statistical viewpoint, so in this study the assumption of normality was not true; thus, nonparametric tests were used for analysis. The

relationship between quantitative variables such as the average of limiting factors of doing activities and mean of activity energy usage was determined by using Spearman's correlation coefficient test. To predict the impact of each limiting factor on activity energy levels, ordinal regression was used. Confidence levels in all analyses were $\alpha < 0.05$.

4. Results

Among the study participants, 237 (59.2%) were female. The average age of the contributors was 67.6 ± 6.8 years (range 60 - 90 years, median = 65, interquartile index = 8). The majority, 291 participants (72.8%), were married. A total of 188 (28.5%) subjects were illiterate. A total of 199 subjects reported housekeeper as their job. Also, 337 participants (84.2%) were living in houses, and 300 participants (75%) had chronic diseases.

The median and interquartile range (IQR) of barrier factors to physical activity of Kashan's elderly was 8.75 ± 33 . Their average energy expenditure was 326.21 ± 364.84 , based on metabolic equivalent units during a week (IQR = 222). Twenty-three of the participants (5.9%) did not have energy expenditure that was considered to be physical activity and were in the no usage range; 317 persons (79.2%) were in the low level range, 59 persons (14.8%) were in the moderate level range, and 1 person (0.02%) was in the range of high level of activity energy expenditure (see Table 1).

The results shown in Table 2 reveal that the most common barrier factors in physical activity among participants was related to a lack of appropriate places to do physical activity; 298 persons (74.5%) either agreed or strongly agreed with this option. Another barrier factor frequently chosen by the participants was high weight; this was selected by 272 elderly (68%). Creating tiredness was chosen by 252 persons (63%), and old age was chosen by 246 subjects (61.5%) as being barriers.

According to Diagram 1, the result of the Spearman rank-order correlation ($r = -0.104$, $P = 0.038$) is significant between barrier factor scores in doing activity and activity energy expenditure among the study participants.

The result of the correlation matrix, in a survey of the relationship between activity energy expenditure and barrier factors among participants, showed there is a significant relationship between no energy expenditure ($P = 0.002$), low energy use ($P = 0.006$), high energy use ($P = 0.041$), and the average score of barrier factors (Table 3).

The result of ordinal regression (OR) in the prediction of barrier factors, where age and gender are considered as helpful variables, showed that the prediction capability is low (R-square = 17%). The most effective predictions related to scorn (OR = 3.61, $P < 0.0001$), financial problems (OR =

3.59), old age (OR = 2.38, $P = 0.014$), and extra weight (OR = 2.38, $P = 0.014$) (Table 4).

5. Discussion

The results of this study showed there is a significant and converse relationship between barrier factors of physical activity and activity energy expenditure in Kashan's elderly. The relationship was about levels: no energy usage, low energy usage, moderate energy usage, and high energy usage. Hurkmans et al. (2011) showed there is a significant relationship between barrier factors and physical activities, and subsequently, activity energy expenditure (31). A study by Wlodarek et al. (2012) showed there is a meaningful relationship between barrier factors like age and activity energy expenditure (33). Barrier factors are obstacles to activity, and they cause the amount and level of activities to decrease. Energy expenditure level declines with decreases in physical activity. Therefore, for the elderly to maintain appropriate energy expenditure levels in physical activity, barrier factors should be decreased according to age, personal characteristics, and effects of aging. The study showed that 85 percent of participants were in the no or low energy expenditure ranges.

The energy expenditure average in a study of London elderly's was in the moderate level, and the average score was higher than the average score of this study (34). Cawthon et al. (2013) found that energy usage in elderly males was low (35). Aleman-Mateo et al. (2006) reported lower energy usage in Cuba, Chile, and Mexico with increasing age among the elderly (36). Energy expenditure varies in different people because it is influenced by type and amount of physical activity. Because physical activity depends on personal characteristics and physical ability, increasing age causes many physical activities to decrease (37). The physiological effects of old age cause changes in the processes of absorbing and using energy. The tools used in estimating and testing energy usage levels are effective for the statistical presentation of energy use. The common effect of these factors and the average score of elders' ages are important for determining different amounts of energy use among older people in studies.

This study revealed that the most common barrier factor among elderly participants was related to a lack of appropriate places for doing physical activity. However, the result of ordinal regression for the factor was not meaningful in predicting the effect of barrier factors in using energy. Manini et al. (2009) showed that having a high body mass index was one of the barrier factors in energy expenditure (38). Crombie et al. (2004) reported that the most common barrier factors were related to time limitations for doing physical activity (39). Anderson-Hanley et

Table 1. Median and Average Distribution of Activity Energy Expenditure and Barrier Factor Scores, Based on Levels of Energy Usage in Physical Activity of Kashan's Elderly in 2014

Activity Energy Expenditure Mean	Average Score of Barrier Activity				Average Score of Energy Expenditure			
	IQR	Median	Mean	SD	IQR	Median	Mean	SD
No activity energy expenditure	5	29	32.43	7.16	00	00	16.95	4.47
Low activity energy expenditure	8.50	33	32.39	6.42	248	171	232.19	151
Moderate activity energy expenditure	10	32	31.93	6.92	263	925	880.41	168.54

Table 2. Absolute and Relative Frequency Distribution of Barrier Factors in Doing Physical Activity Among Kashan's Elderly in 2014

Barrier Factors in Doing Activities	Opposing, Fi (%)	Strongly Opposing, Fi (%)	Agreeing, Fi (%)	Strongly Agreeing, Fi (%)
Not enough time	101 (25.2)	75 (18.8)	150 (37.5)	74 (18.5)
Old age	153 (26.2)	49 (12.2)	16 (1.2)	85 (21.2)
Extra weight	77 (19.2)	51 (12.8)	199 (49.8)	73 (18.2)
Embarrassment	164 (41)	92 (23)	129 (32.2)	15 (3.8)
Financial problems	140 (35)	136 (34)	116 (29)	8 (2)
Lack of sport program	146 (36.5)	112 (28)	118 (29.5)	24 (6)
Creating tiredness	81 (20.2)	67 (16.8)	168 (42)	84 (21)
Lack of encouragement	138 (34.5)	87 (21.8)	150 (37.5)	25 (6.2)
Decreasing relationship with family	133 (33.2)	106 (26.5)	153 (38.2)	8 (2)
Scorning elderly	100 (25)	87 (21.8)	150 (37.5)	63 (15.8)
Useless activity	134 (33.5)	122 (30.5)	114 (28.5)	30 (7.5)
Creating problems in social responsibility	138 (34.5)	143 (35.8)	96 (24)	23 (5.8)
Lack of stimulus	117 (29.2)	91 (22.8)	158 (39.5)	34 (8.5)
Lack of appropriate place	54 (13.5)	48 (12)	185 (46.2)	113 (28.2)

Table 3. Correlation Matrix, Relationship of Activity Energy Expenditure to Barrier Factors Among Kashan's Elderly in 2014

Barrier factors score	Barrier Factors Score	No Energy Usage	Low Energy Usage	Moderate Usage	High Usage
No energy usage	R = -0.117, P = 0.02				
Low energy usage	R = -0.137, P = 0.06	R = -0.282, P = 0.0001			
Moderate usage	R = -0.084, P = 0.095	R = -0.155, P = 0.002	R = 0.167, P = 0.001		
High usage	R = 0.102, P = 0.041	R = -0.152, P = 0.002	R = -0.019, P = 0.703	R = 0.061, P = 0.224	

al. (2011) showed that in American elderly, barrier factors included a shortage of social facilities (40). The diversity of barrier factors in different studies showed that physical activity is influenced by different cultural, social, and environmental factors in different societies (37) The lack of appropriate places for physical activity was an important barrier factor for many reasons. First of all, the effects of advancing age can increase the risk of injury. Second, having appropriate and safe places for activity not only helps

to decrease fear, stress, and mental barriers among older people, but also it decreases the dangers posed in inappropriate places. A desire for suitable and safe places for elder activity has been identified among older people recently.

Other barrier factors that affected activity energy usage among the elderly were related to high age, tiredness, and high weight. However, the result of ordinal regression was low about capability prediction affection (R-square = 17%); it showed high age and high weight are effective pre-

Table 4. Prediction Result of Effective Barrier Factors in Doing Physical Activity Based on Age and Gender Properties in the Activity Energy Expenditure Position of Kashan's Elderly in 2014

Barrier Factors	R-Square	Estimate	SE	Wald	P-Value	OR	Confidence Level 95% (CI)	
							Low Edge	High Edge
Old age	0.17	0.873	0.354	6.094	0.014	2.38	0.18	1.567
High weight		-0.635	0.307	4.274	0.039	1.88	-1.238	-0.033
Financial problems		1.284	0.349	13.563	0.0001	3.59	0.601	1.968
Being scorned		-1.288	0.342	14.186	0.0001	3.61	-1.959	0.618

dictor factors for energy use. These limitations are influenced by aging and its consequences, use of medicines, and diseases that affect older people. Actually, improving environmental situations and decreasing limitations can mitigate barrier factors that affect activity. Scorn and financial problems are also prediction factors in the energy expenditure situation. These factors are a reflection of cultural and social attitudes and having a comfortable situation in society. People's perspectives will be changed according to the validity that physical activity is given by society (37, 41). Elder people avoid being active in public places because they think it causes undue attention or scorn from others.

5.1. Limitations and Strengths

This study considered a limited number of factors that affect physical activity in the elderly. It is suggested in order to recognize other factors, a more suitable device should be designed. Accuracy of the result was not good because information was self-reported and this was influenced by the problems of recognition and memory that afflict many elderly. We tried to overcome this problem by interviewing the participants. There were some items in the questionnaire that elderly do not engage in often. This may cause a floor effect with the questionnaire. This study also has some strengths. This is one of a limited number of studies available about physical activity in a community-based population of elderly. Second, it gives concrete and helpful data about the type of activities that elderly usually engage in. This study can provide necessary information for future planning for physical activity improvements in elderly.

This study showed that decreasing barriers to physical activity will change energy expenditure levels. The study suggests that designing and preparing suitable places and environments are in order to decrease barrier factors. In fact, paying attention to barrier factors in codifying the promotion of physical activity programs can lead to better results. Because the elderly in the study were kept by

healthcare station center, results above arranging in the centers were better. Data of this study can be used to educate planners and policy-makers in various medical groups concerning the activity needs of the elderly. Since the elderly studied were covered by healthcare centers, it is suggested to design and build sports rooms in each of these centers. Also, with staff training at these centers, healthcare professionals can encourage the elderly to participate in this environment and increase their physical activity. Identifying the barrier factors of physical activity can be helpful for considering suitable promotions for health programs and changes to accommodate the elderly. Overall, the findings of this study can be used in three domains: education, healthcare, and appropriate environments for the elderly.

Acknowledgments

We appreciate all of Kashan's elderly who helped us during the research. All costs of the study, which was research program number 9305, were covered by the Kashan University of Medical Sciences.

Footnotes

Authors' Contribution: Ali Sadrollahi performed the data collection, prepared the literature review and first draft of the manuscript, supervised the study, made critical revisions to the paper, and prepared the last revision of the manuscript. Zahra Khalili performed the data collection and literature review, and prepared the first draft of the manuscript. Majid Mohammadi, Robab Pour Nazari, Maryam Ahmadi Khatir, and Najima Mossadegh supervised the study, performed data analysis, and helped in the process of sampling.

Financial Disclosure: Kashan University of Medical Sciences

Funding/Support: This study was part of an MSc thesis in critical geriatric nursing and was funded by the Deputy of Research, Kashan University.

References

- Middleton LE, Manini TM, Simonsick EM, Harris TB, Barnes DE, Tyllavsky F, et al. Activity energy expenditure and incident cognitive impairment in older adults. *Arch Intern Med*. 2011;171(14):1251-7. doi: [10.1001/archinternmed.2011.277](https://doi.org/10.1001/archinternmed.2011.277). [PubMed: 21771893].
- Tarara DT, Hegedus EJ, Taylor JB. Real-time test-retest and interrater reliability of select physical performance measures in physically active college-aged students. *Int J Sports Phys Ther*. 2014;9(7):874-87. [PubMed: 25540703].
- Adler M, Ziglio E. Gazing into the oracle: The Delphi method and its application to social policy and public health. London and Philadelphia: Jessica Kingsley Publishers; 1996.
- Rosenberg DE, Grothaus L, Arterburn D. Characteristics of older adult physical activity program users. *Am J Manag Care*. 2014;20(7):245-9. [PubMed: 25295543].
- Molanorouzi K, Khoo S, Morris T. Validating the Physical Activity and Leisure Motivation Scale (PALMS). *BMC Public Health*. 2014;14:909. doi: [10.1186/1471-2458-14-909](https://doi.org/10.1186/1471-2458-14-909). [PubMed: 25182130].
- Branco JC, Jansen K, Sobrinho JT, Carrapatoso S, Spessato B, Carvalho J, et al. Physical benefits and reduction of depressive symptoms among the elderly: results from the Portuguese "National Walking Program". *Cien Saude Colet*. 2015;20(3):789-95. doi: [10.1590/1413-81232015203.09882014](https://doi.org/10.1590/1413-81232015203.09882014). [PubMed: 25760119].
- Araujo-Soares V, Sniehotta FF, Laing CM, Gellert P, Jackson D, Speakman JR. Social cognitions measured in 4 to 6 year olds are predictive of objectively measured physical activity. *Psychol Health*. 2015;30(10):1240-57. doi: [10.1080/08870446.2015.1041395](https://doi.org/10.1080/08870446.2015.1041395). [PubMed: 26031437].
- Barry PP. An overview of special considerations in the evaluation and management of the geriatric patient. *Am J Gastroenterol*. 2000;95(1):8-10. doi: [10.1111/j.1572-0241.2000.01697.x](https://doi.org/10.1111/j.1572-0241.2000.01697.x). [PubMed: 10638552].
- Milanovic Z, Pantelic S, Trajkovic N, Jorgic B, Sporis G, Bratic M. Reliability of the Serbian version of the International Physical Activity Questionnaire for older adults. *Clin Interv Aging*. 2014;9:581-7. doi: [10.2147/CIA.S57379](https://doi.org/10.2147/CIA.S57379). [PubMed: 24741300].
- Milanovic Z, Pantelic S, Trajkovic N, Sporis G, Jorgic B. Reliability of the Serbian version of the International Physical Activity Questionnaire (IPAQ) for elderly people. *Eur J Aging*. 2013;2013.
- Hu G, Barengo NC, Tuomilehto J, Lakka TA, Nissinen A, Jousilahti P. Relationship of physical activity and body mass index to the risk of hypertension: a prospective study in Finland. *Hypertension*. 2004;43(1):25-30. doi: [10.1161/01.HYP.0000107400.72456.19](https://doi.org/10.1161/01.HYP.0000107400.72456.19). [PubMed: 14656958].
- Andersson M, Slinde F, Gronberg AM, Svantesson U, Janson C, Emtner M. Physical activity level and its clinical correlates in chronic obstructive pulmonary disease: a cross-sectional study. *Respir Res*. 2013;14:128. doi: [10.1186/1465-9921-14-128](https://doi.org/10.1186/1465-9921-14-128). [PubMed: 24237876].
- Howley ET. Type of activity: resistance, aerobic and leisure versus occupational physical activity. *Med Sci Sports Exerc*. 2001;33(6 Suppl):S364-9. [PubMed: 11427761] discussion S419-20.
- Neilson HK, Robson PJ, Friedenreich CM, Csizmadia I. Estimating activity energy expenditure: how valid are physical activity questionnaires?. *Am J Clin Nutr*. 2008;87(2):279-91. [PubMed: 18258615].
- Levine JA, Lanningham-Foster LM, McCrady SK, Krizan AC, Olson LR, Kane PH, et al. Interindividual variation in posture allocation: possible role in human obesity. *Science*. 2005;307(5709):584-6. doi: [10.1126/science.1106561](https://doi.org/10.1126/science.1106561). [PubMed: 15681386].
- Rothenberg EM, Bosaeus IG, Westerterp KR, Steen BC. Resting energy expenditure, activity energy expenditure and total energy expenditure at age 91-96 years. *Br J Nutr*. 2000;84(3):319-24. [PubMed: 10967610].
- Amorim JS, Salla S, Trelha CS. Factors associated with work ability in the elderly: systematic review [in English, Portuguese]. *Rev Bras Epidemiol*. 2014;17(4):830-41. [PubMed: 25388484].
- Corrada MM, Kawas CH, Mozaffar F, Paganini-Hill A. Association of body mass index and weight change with all-cause mortality in the elderly. *Am J Epidemiol*. 2006;163(10):938-49. doi: [10.1093/aje/kwj114](https://doi.org/10.1093/aje/kwj114). [PubMed: 16641311].
- Ribeiro RM, Tribess S, Dos Santos AS, Pinto LL, Ribeiro Mda C, Roza LB, et al. Barriers to the involvement of the elderly in public services to promote physical activity. *Cien Saude Colet*. 2015;20(3):739-49. doi: [10.1590/1413-81232015203.03702014](https://doi.org/10.1590/1413-81232015203.03702014). [PubMed: 25760114].
- Roberts SB, Dallal GE. Energy requirements and aging. *Public Health Nutr*. 2005;8(7A):1028-36. [PubMed: 16277818].
- Tookuni KS, Bolliger Neto R, Pereira CAM, Souza D, Greve JMDA, Ayala ADA. Comparative Analysis of Postural Control in Individuals with and Without Injuries on Knee Anterior Cruciate Ligament [in Portuguese]. *Acta Ortop Bras*. 2005;13:115-9.
- Dideriksen K, Reitelseder S, Holm L. Influence of amino acids, dietary protein, and physical activity on muscle mass development in humans. *Nutrients*. 2013;5(3):852-76. doi: [10.3390/nu5030852](https://doi.org/10.3390/nu5030852). [PubMed: 23486194].
- Siddiqi Z, Tiro JA, Shuval K. Understanding impediments and enablers to physical activity among African American adults: a systematic review of qualitative studies. *Health Educ Res*. 2011;26(6):1010-24. doi: [10.1093/her/cyr068](https://doi.org/10.1093/her/cyr068). [PubMed: 21873458].
- Gobbi S, Nascimento C, Brazao MC, Hirayama MS, Gobbi LTB, Emerson S. Physical activity, barriers, and stage of behavior change in older Brazilians living in a medium-size city. *J Aging Phys Activ*. 2008;S91.
- Dearth-Wesley T, Popkin BM, Ng SW. Estimated and forecasted trends in domain specific time-use and energy expenditure among adults in Russia. *Int J Behav Nutr Phys Act*. 2014;11:11. doi: [10.1186/1479-5868-11-11](https://doi.org/10.1186/1479-5868-11-11). [PubMed: 24475868].
- Luhrmann PM, Bender R, Edelmann-Schafer B, Neuhauser-Berthold M. Longitudinal changes in energy expenditure in an elderly German population: a 12-year follow-up. *Eur J Clin Nutr*. 2009;63(8):986-92. doi: [10.1038/ejcn.2009.1](https://doi.org/10.1038/ejcn.2009.1). [PubMed: 19190667].
- Koochek A, Johansson SE, Kocurk TO, Sundquist J, Sundquist K. Physical activity and body mass index in elderly Iranians in Sweden: a population-based study. *Eur J Clin Nutr*. 2008;62(11):1326-32. doi: [10.1038/sj.ejcn.1602851](https://doi.org/10.1038/sj.ejcn.1602851). [PubMed: 17657226].
- Eshaghi SR, Shahsanai Armindokht MA. Assessment of the physical activity of elderly population of Isfahan, Iran [in Persian]. *J Isfahan Med School*. 2011;29(147):939-46.
- Committee IR. Guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ)-Short and long forms: Retrieved September. 2005;17.; 2008.
- Aghamolaei T, Tavafian SS, Hassani L. Exercise Self-efficacy, Exercise Perceived Benefits and Barriers among Students in Hormozgan University of Medical Sciences [in Persian]. *Iran J Epidemiol*. 2009;4(3):9-15.
- Hurkmans HL, Ribbers GM, Streur-Kranenburg MF, Stam HJ, van den Berg-Emons RJ. Energy expenditure in chronic stroke patients playing Wii Sports: a pilot study. *J Neuroeng Rehabil*. 2011;8:38. doi: [10.1186/1743-0003-8-38](https://doi.org/10.1186/1743-0003-8-38). [PubMed: 21756315].
- Sechrist KR, Walker SN, Pender NJ. Development and psychometric evaluation of the exercise benefits/barriers scale. *Res Nurs Health*. 1987;10(6):357-65. doi: [10.1002/nur.4770100603](https://doi.org/10.1002/nur.4770100603).
- Wlodarek D, Majkowska M, Majkowska L. Physical activity of elderly people living in district Koprzywnica (Poland) [in Polish]. *Rocz Panstw Zakl Hig*. 2012;63(1):111-7. [PubMed: 22642078].
- Milanovic Z, Pantelic S, Trajkovic N, Sporis G, Kostic R, James N. Age-related decrease in physical activity and functional fitness among

- elderly men and women. *Clin Interv Aging*. 2013;**8**:549-56. doi: [10.2147/CIA.S44112](https://doi.org/10.2147/CIA.S44112). [PubMed: [23723694](https://pubmed.ncbi.nlm.nih.gov/23723694/)].
35. Cawthon PM, Blackwell TL, Cauley JA, Ensrud KE, Dam TT, Harrison SL, et al. Objective assessment of activity, energy expenditure, and functional limitations in older men: the Osteoporotic Fractures in Men study. *J Gerontol A Biol Sci Med Sci*. 2013;**68**(12):1518-24. doi: [10.1093/gerona/glt054](https://doi.org/10.1093/gerona/glt054). [PubMed: [23682162](https://pubmed.ncbi.nlm.nih.gov/23682162/)].
36. Aleman-Mateo H, Salazar G, Hernandez-Triana M, Valencia ME. Total energy expenditure, resting metabolic rate and physical activity level in free-living rural elderly men and women from Cuba, Chile and Mexico. *Eur J Clin Nutr*. 2006;**60**(11):1258-65. doi: [10.1038/sj.ejcn.1602446](https://doi.org/10.1038/sj.ejcn.1602446). [PubMed: [16721397](https://pubmed.ncbi.nlm.nih.gov/16721397/)].
37. Pan SY, Cameron C, Desmeules M, Morrison H, Craig CL, Jiang X. Individual, social, environmental, and physical environmental correlates with physical activity among Canadians: a cross-sectional study. *BMC Public Health*. 2009;**9**:21. doi: [10.1186/1471-2458-9-21](https://doi.org/10.1186/1471-2458-9-21). [PubMed: [19149865](https://pubmed.ncbi.nlm.nih.gov/19149865/)].
38. Manini TM, Everhart JE, Anton SD, Schoeller DA, Cummings SR, Mackey DC, et al. Activity energy expenditure and change in body composition in late life. *Am J Clin Nutr*. 2009;**90**(5):1336-42. doi: [10.3945/ajcn.2009.27659](https://doi.org/10.3945/ajcn.2009.27659). [PubMed: [19740971](https://pubmed.ncbi.nlm.nih.gov/19740971/)].
39. Crombie IK, Irvine L, Williams B, McGinnis AR, Slane PW, Alder EM, et al. Why older people do not participate in leisure time physical activity: a survey of activity levels, beliefs and deterrents. *Age Ageing*. 2004;**33**(3):287-92. doi: [10.1093/ageing/afh089](https://doi.org/10.1093/ageing/afh089). [PubMed: [15082435](https://pubmed.ncbi.nlm.nih.gov/15082435/)].
40. Anderson-Hanley C, Snyder AL, Nimon JP, Arciero PJ. Social facilitation in virtual reality-enhanced exercise: competitiveness moderates exercise effort of older adults. *Clin Interv Aging*. 2011;**6**:275-80. doi: [10.2147/CIA.S25337](https://doi.org/10.2147/CIA.S25337). [PubMed: [22087067](https://pubmed.ncbi.nlm.nih.gov/22087067/)].
41. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc*. 2002;**34**(12):1996-2001. doi: [10.1249/01.MSS.0000038974.76900.92](https://doi.org/10.1249/01.MSS.0000038974.76900.92). [PubMed: [12471307](https://pubmed.ncbi.nlm.nih.gov/12471307/)].