International Journal of Gerontology 8 (2014) 228–229

Contents lists available at ScienceDirect

International Journal of Gerontology

journal homepage: www.ijge-online.com

Brief Communication

Metabolic Costs of Daily Activities in Community-Dwelling Older Adults☆

Sin-Ae Park [1], Ji-Young Lee [1], Kwan-Suk Lee [2], Ki-Cheol Son [1 *]

[1] Department of Environmental Health Science, Konkuk University, [2] Department of Industrial Engineering, Hongik University, Seoul, South Korea

ARTICLE INFO

Article history:
Received 13 November 2013
Received in revised form
11 January 2014
Accepted 6 March 2014
Available online 14 November 2014

Keywords:
calorimeter,
energy expenditure,
exercise intensity,
gardening,
physical activity

SUMMARY

This study was conducted to measure the metabolic costs of daily activities in community-dwelling adults aged over 65 years. Eighteen elderly adults performed five daily activities—walking, cleaning with a vacuum cleaner, washing dishes, and gardening (making a vegetable bed and maintaining a garden)—in a laboratory setting. The participants performed each activity for 5 minutes and then rested in a chair for 5 minutes prior to starting the next activity. They wore a portable telemetric calorimeter and a heart rate monitor during the five activities and resting periods to measure the metabolic cost and heart rate. The five daily activities were observed to be of low to moderate intensity (from 2.3 ± 0.5 metabolic equivalents to 4.6 ± 0.5 metabolic equivalents).

1. Introduction

Although regular physical activity provides many health benefits[1,2], older adults are less likely to participate in physical activity[3]. The majority of older adults do, however, engage in nonrecreational physical activities such as household activities[4–6]. Data from the National Human Activity Pattern Survey revealed that > 7000 older adults over the age of 65–74 years reportedly spent 35.2% of total energy expenditure on household activities and only 5.2% on recreational physical activity[5]. Because there is limited evidence regarding the health benefits of low-intensity activities such as washing dishes, ironing, and other routine domestic tasks[7], and because such activities are most prevalent among older adults, it is imperative that the potential health effects of these daily activities be examined.

The estimated metabolic cost of an activity could potentially lead to the prescription of appropriate daily activities for health promotion in older adults. Metabolic cost can be partly reflected by the metabolic equivalent (MET). The MET refers to oxygen uptake per unit of body mass (1 MET = 3.5 mL O_2/kg/minute; < 3 METs = low-intensity physical activity; 3–6 METs = moderate-intensity physical activity; > 6 METs = high-intensity physical activity)[8]. There is a lack of research-based data on the MET values of daily activities in older adults[9]. Therefore, the objective of this study was to determine the metabolic cost of daily activities such as walking, cleaning with a vacuum cleaner, washing dishes, and gardening (making a vegetable bed and maintaining a garden) in community-dwelling adults over the age of 65 years.

2. Materials and methods

2.1. Study participants

A total of 18 community-dwelling older adults over the age of 65 years (6 males, 12 females) were recruited from the community of Gwangjin-gu in Seoul, South Korea. The average height, weight, and body mass index of the study participants were 70.9 ± 3.3 years, 158.2 ± 8.2 cm, and 24.6 ± 3.6 kg/m^2, respectively.

2.2. Procedure

The five most common household and gardening activities (walking, cleaning with a vacuum cleaner, making a vegetable bed, maintaining a garden, and washing dishes) were performed by the participants in previously prepared settings (corridor, indoor garden, and a laboratory) at Konkuk University, Seoul, South Korea. The mean temperature and humidity during the testing were 27.0 ± 2.4°C and 35.0% ± 5.8%, respectively (Digital Hygro

☆ Conflicts of interest: All contributing authors declare no conflicts of interest.

* Correspondence to: Dr Ki-Cheol Son, 206, Life and Environmental Science Hall, Department of Environmental Health Science, Konkuk University, Seoul 143-701, South Korea.
E-mail address: kcson@konkuk.ac.kr (K.-C. Son).

http://dx.doi.org/10.1016/j.ijge.2014.03.006

Table 1
Metabolic costs of each daily activity.[a]

Activity	Metabolic equivalents (METs)	Heart rate (beats/minute)
Walking	4.6 ± 0.5	103.2 ± 17.8
Cleaning with a vacuum cleaner	3.8 ± 0.9	98.2 ± 19.4
Making a vegetable bed	3.6 ± 0.7	96.4 ± 14.9
Maintaining a garden	3.4 ± 0.6	92.3 ± 14.2
Washing dishes	2.3 ± 0.5	91.8 ± 20.9
p	0.0	0.0

Data are presented as mean ± SD.
[a] Repeated-measures analysis of variance test at $p < 0.05$.

Thermometer; Model Acuba CS-201, Chosun, Guangdong, China). All activities were performed during a single session and conducted in a random order[10]. Each activity was performed for 5 minutes and was followed by a 5-minute resting period in which participants rested in a chair[10].

2.3. Metabolic cost and heart rate measurements

Metabolic cost was measured using a portable telemetric calorimeter (K4b^2; Cosmed, Rome, Italy)[11] while participants performed the activities. Participants' heart rate was measured using a heart rate monitor (Polar T31; FitMed, Kempele, Finland) that was placed under their breast during the activities.

2.4. Data analysis

The metabolic cost data for the first 10 seconds were omitted from analysis because this period represented the time required for walking to the activity spot. The mean comparison of metabolic costs for the five daily activities was made with repeated-measures analysis of variance test at $p < 0.05$ using SAS version 9 for Windows (SAS Institute Inc., Cary, NC, USA).

3. Results and discussion

The five daily activities were conducted by adults over the age of 65 years (average age: 70.9 ± 3.3 years) and were of low to moderate intensity (from 2.3 ± 0.5 METs to 4.6 ± 0.5 METs; Table 1). The results indicated that walking, cleaning with a vacuum cleaner, making a vegetable bed, and maintaining a garden were moderate-intensity physical activities (from 3.4 ± 0.6 METs to 4.6 ± 0.5 METs) in older adults (Table 1). Washing dishes was observed to be a low-intensity activity (2.3 ± 0.5 METs) that resulted in less oxygen consumption (Table 1). Walking was observed to be more intense than cleaning with a vacuum cleaner, making a vegetable bed, maintaining a garden, and washing dishes. Gardening activities were of the same exercise intensity level as walking at a moderate intensity. Thus, moderate-intensity activities such as walking, cleaning with a vacuum cleaner, making a vegetable bed, and maintaining a garden may confer health benefits if the activity is performed frequently and for an adequate duration of time[12].

Although low-intensity activities, such as walking slowly around the home, store, or office, and performing housework or workplace duties, predominantly account for total daily energy expenditure in older adults[13,14], there is only limited evidence on the health benefits of such activities[7,15]. However, several studies have reported that daily activities are associated with health benefits in adults[16–18]. Camhi et al[16] and Healy et al[18] reported that regularly performing several low-intensity activities daily was associated with a lower risk of cardiometabolic problems. Thus, regular engagement in multiple low-intensity activities may represent a convenient means of increasing physical activity and lowering the risk of metabolic syndrome. These results may have implications for practitioners to appropriately prescribe daily physical activities for health promotion in community-dwelling older adults.

Acknowledgments

This study was supported by the SMART Research Professor Program of Konkuk University.

References

1. American College of Sports Medicine Position Stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc*. 1998;30:992–1008.
2. Cheng S-J, Yu H-K, Chen Y-C, et al. Physical activity and risk of cardiovascular disease among older adults. *Int J Gerontol*. 2013;7:133–136.
3. U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services; 1996.
4. Dallosso HM, Morgan K, Bassey EJ, et al. Levels of customary physical activity among the old and the very old living at home. *J Epidemiol Community Health*. 1988;42:121–127.
5. Dong L, Block G, Mandel S. Activities contributing to total energy expenditure in the United States: results from the NHAPS study. *Int J Behav Nutr Phys Act*. 2004;1:4.
6. Jurj AL, Wen W, Gao Y-T, et al. Patterns and correlates of physical activity: a cross-sectional study in urban Chinese women. *BMC Public Health*. 2007;7:213.
7. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc*. 2000;32:S498–S504.
8. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA*. 1995;273:402–407.
9. Kozey SL, Lyden K, Howe CA, et al. Accelerometer output and MET values of common physical activities. *Med Sci Sports Exerc*. 2010;42:1776–1784.
10. Park S-A, Lee K-S, Son K-C. Determining exercise intensities of gardening tasks as a physical activity using metabolic equivalents in older adults. *HortScience*. 2011;46:1706–1710.
11. Kawakami Y, Nozaki D, Matsuo A, et al. Reliability of measurement of oxygen uptake by a portable telemetric system. *Eur J Appl Physiol Occup Physiol*. 1992;65:409–414.
12. Gunn SM, Brooks AG, Withers RT, et al. Determining energy expenditure during some household and garden tasks. *Med Sci Sports Exerc*. 2002;34:895–902.
13. Donahoo WT, Levine JA, Melanson EL. Variability in energy expenditure and its components. *Curr Opin Clin Nutr Metab Care*. 2004;7:599–605.
14. Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. *Diabetes*. 2007;56:2655–2667.
15. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc*. 2007;39:1423–1434.
16. Camhi SM, Sisson SB, Johnson WD, et al. Accelerometer-determined moderate intensity lifestyle activity and cardiometabolic health. *Prev Med*. 2011;52:358–360.
17. Healy GN, Dunstan DW, Salmon J, et al. Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose. *Diabetes Care*. 2007;30:1384–1389.
18. Healy GN, Wijndaele K, Dunstan DW, et al. Objectively measured sedentary time, physical activity, and metabolic risk: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Diabetes Care*. 2008;31:369–371.