

# Reliability and validity of the Japanese version of the short questionnaire to assess health-enhancing physical activity (SQUASH) scale in older adults

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**Abstract.** [Purpose] We tested the reliability and validity of the Japanese version of the Short Questionnaire to Assess Health-enhancing Physical Activity scale in asymptomatic older adults and sought to confirm discriminator validity in women with osteoarthritis. [Subjects] The participants included an asymptomatic comparison group (men and women) and women with knee or hip osteoarthritis. [Methods] The test-retest method was used to assess reliability. The International Physical Activity Questionnaire was chosen to assess criterion-related validity. Discriminator validity was assessed by comparing the asymptomatic and osteoarthritis groups. [Results] Mean age for the asymptomatic groups was  $63 \pm 6$  years for men ( $n = 23$ ) and  $61 \pm 7$  years for women ( $n = 51$ ), and it was  $63 \pm 9$  years for the osteoarthritis group ( $n = 32$ ). The total score and scores for all items, except for heavy housework items, were significantly correlated with the retest. Criterion-related validity showed significantly weak to moderate correlations between the respective scale categories. For discriminator validity, the total scores and scores for bicycle commuting, light housework, and three leisure items differed significantly between the asymptomatic and osteoarthritis groups. [Conclusion] The Short Questionnaire to Assess Health-enhancing Physical Activity scale is a reliable and valid measure in asymptomatic older adults, and can discriminate between osteoarthritic and asymptomatic women.

**Key words:** Physical activity scale, Older adults, Osteoarthritis

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## INTRODUCTION

Osteoarthritis (OA) of the hip or knee is a common chronic and degenerative disease in older adults. OA causes pain, weakens muscle strength, limits range of joint motion, and leads to joint instability<sup>1)</sup>. These impairments in physical functions and their accompanying discomfort result in decreases in physical activity. OA patients have traditionally been evaluated through the Western Ontario and McMaster Universities Osteoarthritis Index, the Oxford Hip Score, and the Oxford Knee Score. These scales, however, assess pain and physical function only in different levels of disease severity<sup>2-4)</sup>. Although these scales are necessary for identifying the degree to which OA affects daily life, they cannot assess the total amount of physical activity, including leisure

activities such as walking or sports. Because physical activity prevents locomotive syndrome and chronic diseases<sup>5)</sup>, assessing physical activity is essential in older adults and patients with OA. To assess physical activity, pedometers<sup>6)</sup> and self-report questionnaires<sup>7-12)</sup> have been used. However, these physical activity scales have several limitations when used for older adults and patients with OA.

Aquatic exercise is a widely used therapy method for individuals with OA because of the reduced stress on the joints<sup>13, 14)</sup>. Pedometers can produce an objective and quantifiable result, but cannot measure aquatic activities such as swimming or water walking. In studies using pedometers, participants are required to wear pedometers at all times<sup>15)</sup>, and the wear compliance rate is lower in older adults<sup>16)</sup>. Pedometers also cost more than self-reported questionnaires<sup>6)</sup>. Thus, pedometers are not recommended as first-line measures of physical activity among older adults and patients with OA.

Commonly used physical activity questionnaires for such individuals are the University of California Los Angeles (UCLA) Activity Scale<sup>7)</sup>, the Baecke Physical Activity Questionnaire<sup>8, 11)</sup>, and the International Physical Activity Questionnaire (IPAQ)<sup>9, 10, 12)</sup>. The UCLA Activity Scale is

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the oldest of these measures, and is used internationally. Its major drawback is that it measures only the level of physical activity. In contrast, the Baecke Physical Activity Questionnaire differentiates work, sports, and leisure activities, but does not have a household activity category. In many cultures, women are more likely than men to engage in household activities. Because the prevalence of OA is higher in women than in men, this scale is not appropriate for women with hip or knee OA.

The IPAQ was developed by the World Health Organization to evaluate physical activity. The original version of the IPAQ was lengthy and time-consuming; a shorter version, taking only 5 minutes to administer, was developed and is used internationally. It measures three levels of activity: vigorous, moderate, and walking. The reliability and validity of the IPAQ (short version) in older adults have previously been established<sup>12</sup>. However, the IPAQ (short version) measures only physical activity intensity and is limited in that the content of the activities is not evaluated. Therefore, no single established measure is wholly suited to measure a variety of activities, remains sensitive to changes in activity, and is appropriate for individuals with hip or knee OA.

The Short Questionnaire to Assess Health-enhancing Physical Activity (SQUASH) scale was developed<sup>17</sup> based on Ainsworth's compendium<sup>18</sup>, which classified specific physical activities according to their rates of energy expenditure, and enhanced the comparability of cross-study results through self-reports of physical activity. The SQUASH can measure commuting, work, household, and leisure activities and takes only 3 to 5 minutes to administer. The reliability and validity of the SQUASH were established among younger adults in the Netherlands<sup>17</sup>. It was subsequently validated in individuals with total hip arthroplasty<sup>19</sup> and has been used in studies of OA patients<sup>20</sup>. SQUASH may be used for older adults and OA patients because it has a shorter response time, places a smaller burden on patients than other physical activity scales, and evaluates the content of physical activities rather than just their intensity. Its reliability and validity in an older adult population have yet to be officially validated, however, and the discriminant validity between OA patients and asymptomatic older adults remains unclear. Additionally, the development and validation of a Japanese version of the SQUASH would allow for the physical activity of osteoarthritic Japanese individuals to be compared with their international counterparts.

The aims of this study were threefold: to develop a Japanese version of the SQUASH, to establish the reliability and validity of the Japanese version of the SQUASH in asymptomatic older adults, and to verify the measure's discriminant validity through comparisons with OA patients.

## SUBJECTS AND METHODS

Asymptomatic older adults were recruited at a traditional Japanese festival in Akita and Miyagi Prefectures, where middle-aged and senior women were expected to attend. This festival was selected because the age and gender of the attendees were expected to be similar to those of the OA group. The inclusion criteria consisted of 1) absence of pain in the lower limbs, 2) absence of previous hospital

attendance for treatment of the lower limbs, and 3) ability to self-administer the Japanese versions of the questionnaires. The exclusion criterion was an age above 80 years because of age-related decreases in activity level. A booth was set up to allow festivalgoers to fill out the SQUASH and IPAQ anonymously. Respondents were asked to participate in the second survey. A mailing address was obtained from those who agreed to participate in the test-retest reliability portion of the study. The SQUASH questionnaire was mailed to these individuals three weeks after the first survey, as was recommended by the developer of the scale<sup>17</sup>.

The Japanese version of the SQUASH was developed through forward translation and back-translation. Reliability and criterion-related validity were assessed in asymptomatic older adults. The test-retest method was used to establish the SQUASH's reliability. Criterion-related validity was investigated by assessing correlations between the SQUASH and the IPAQ (short version). Lastly, discriminator validity was assessed among the 3 groups of participants (asymptomatic men, asymptomatic women, and women with OA). Only women were recruited for the OA group, because the overwhelming majority of OA patients are women<sup>21, 22</sup>. This questionnaire survey was conducted from September through November, in 2011 and 2012. This timing was chosen to avoid accumulations of snow (as much as 2 m in the study area) that substantially reduced activity levels.

To assess discriminator validity, individuals with hip or knee OA were recruited from outpatient departments at Hospital A in Akita Prefecture, and Hospitals B and C in Miyagi Prefecture, Japan. The inclusion criteria were 1) diagnosis of hip or knee OA to be treated at the outpatient departments, 2) women, and 3) ability to self-administer the Japanese versions of the questionnaires. The exclusion criteria were 1) age above 80 years and 2) comorbid diseases that affected activity levels, such as cardiac diseases and stroke, or diagnosis of a psychiatric disorder. Senior surgeons selected individuals from an outpatient database according to the inclusion and exclusion criteria. The SQUASH and IPAQ were mailed to the selected patients by the first author (S.M.).

The SQUASH measures usual physical activity during an average week over several months prior to SQUASH administration. The activity categories included commuting, work, household activities, and leisure time. The intensity of activities is classified as light, moderate, or vigorous. The activity score for each item is based on the metabolic equivalent (MET). One MET is defined as the energy expended by sitting quietly. Activities with a MET value lower than 2 were not included in the SQUASH because low MET activities do not contribute to the overall level of physical activity. Light intensity was equivalent to 2 to < 4 METs, moderate was deemed as 4 to < 6.5 METs, and vigorous activity was designated as  $\geq 6.5$  METs. All activity scores were calculated by multiplying total minutes of activity by intensity. The total activity score was calculated by summing each activity score<sup>17</sup>.

The original SQUASH<sup>17</sup> was translated into Japanese using the back-translation procedure after obtaining permission from Dr. Wendel-Vos. The first author (S.M.) translated the SQUASH into Japanese, following which three nursing researchers evaluated the appropriateness of the translation.

Of these three, two researchers were bilingual in English and Japanese and had work experience in the US or England; one of these two had experience in translating and validating English versions of health-related scales into Japanese.

A professional translator performed the back-translation. Dr. Wendel-Vos checked the back-translated version and suggested minor revisions. The researcher modified and translated the scale. This process was repeated until Dr. Wendel-Vos approved of the full content of the scale. In reviewing common activities in Japanese, some household activities were modified to be representative of Japanese culture. Taking care of other family members is common in Japan, so “care giving” was added to the activity list. In addition, gate ball (similar to croquet), a popular sport among older Japanese adults, was added to the category “sports”. Dr. Wendel-Vos approved the modified Japanese version of the SQUASH.

The IPAQ (short version) was chosen to validate the SQUASH for criterion-related validity because it was easy to administer and has been used internationally. Furthermore, although the IPAQ is only a measurement of intensity, it was used to verify criterion-related validity because it takes work, household, and leisure activities into account, and, like the SQUASH, it is MET based, making use of Ainsworth’s compendium of physical activities<sup>18</sup>).

The reliability and validity of the IPAQ in Japanese older adults has previously been established<sup>12</sup>). The IPAQ measures the frequency and duration of weekly physical activity and categorizes it as vigorous, moderate, or walking activity. Walking activity denotes not just leisure-related walking, but also work-related walking and walking as part of daily life activities. The IPAQ also estimates the daily duration of sitting or lying down using a measure of sitting time. The quantities of physical activity for separate questions are calculated by multiplying the total minutes of activity by the MET. Vigorous activity is equivalent to 8 METs, moderate activity is equivalent to 4 METs, and walking is equivalent to 3.3 METs. Total physical activity is calculated by taking the sum of the quantities of each physical activity item. It takes about 5 minutes to complete the IPAQ<sup>9</sup>). Use of the IPAQ was authorized by the overseer of its Japanese version<sup>10</sup>).

Concerning data analysis of the asymptomatic older adults, we verified the reliability and criterion-related validity of the SQUASH. Test-retest reliability was assessed using Spearman’s correlation coefficients between the first and second SQUASH questionnaires. Criterion-related validity was examined using Spearman’s correlation coefficients between the SQUASH and IPAQ scores. Discriminant validity was compared between the three groups (asymptomatic men, asymptomatic women, and women with OA). To test the differences in the three groups for continuous variables, an analysis of variance (ANOVA) was used when the distribution was normal, and the Kruskal-Wallis test was used when the distribution was skewed. For items that exhibited significant differences, we verified the discrepancies between each pair using a post hoc Steel-Dwass test. The JMP 10 software package (SAS Institute) was used to perform the statistical tests. The significance level was set at  $p < 0.05$ .

This study was approved by the ethics committee of Akita University (No. 821). The orthopedic departments provided

the first author with a list of patients, which included names and addresses. An ID was created for each patient, and the patient list and ID were managed in separate files. A letter with a questionnaire labeled with the ID inquiring about study participation was sent to a list of OA patients explaining the aim and procedures of the research. Returning the questionnaire was regarded as consent to participation in the study. The letter also informed the potential participants of the following: 1) participation status would not affect their care, 2) the data would be used for research purposes only, 3) the data would be presented only in aggregate form to professional journals, and 4) the results would remain anonymous.

Asymptomatic individuals were also informed about the aims, procedures, and ethical considerations in writing. Those who agreed to participate in the retest were requested to record their name and mailing address on paper. An ID was created and was written on the questionnaire in the reliability study; those who returned the questionnaire subsequently received it once more by mail in order to test test-retest reliability.

## RESULTS

In total, 131 sets of questionnaires were returned. Of those, 25 had missing values and were excluded from the analysis (seven of these were from the OA group). Completed questionnaires were returned by 74 asymptomatic individuals, of which 69% were from women. In the asymptomatic group, the mean age was  $63 \pm 6$  years for men and  $61 \pm 7$  years for women. A total of 32 women with OA completed and returned the questionnaires. Their mean age was  $63 \pm 9$  years. The age distribution among the three groups (asymptomatic men, asymptomatic women, and women with OA) did not differ significantly.

Thirty-six asymptomatic individuals volunteered for the test-retest part of the study. The mean age for the retest group was  $63 \pm 7$  years; 56% of the group members were women. The total SQUASH score and scores for all items, except the intense housework item, were significantly correlated with the retest of the SQUASH; the correlation coefficient ranged from 0.48 to 0.95 ( $p < 0.01$ , Table 1). Most of the correlations were strong ( $r > 0.6$ ); moderate correlations ( $0.6 > r > 0.4$ ) were found for total items, leisure time walking, gardening, and odd jobs.

Seventy-four individuals volunteered for the criterion-related validity test. The mean age was  $62 \pm 6$  years; 69% were women. The correlations between the IPAQ and SQUASH scales can be explained according to IPAQ subscales (Table 2). The total IPAQ score was moderately correlated with the total SQUASH score, and was weakly correlated with three SQUASH subscales (all except commuting; Table 2). The vigorous IPAQ subscale showed weak correlations with the work and leisure time SQUASH subscales, and was also weakly correlated with three intense activities in the SQUASH items, such as commuting using a bicycle and intense work/household activity. The moderate IPAQ subscale was only weakly correlated with the total SQUASH score, total leisure time SQUASH subscale score, and two items (odd jobs and sport) in the leisure time SQUASH subscale. Walking on the IPAQ showed a weak correlation with leisure

**Table 1.** Test-retest reliability of the SQUASH in healthy elderly (n = 36)

Item	Mean activity score	Mean activity score	Spearman correlation Coefficient
	First test	Retest	
All items together	5,773± 4,380	5,580± 3,098	0.52 **
Commuting			
Walking	79± 240	82± 209	0.77 **
Bicycle	107± 234	116± 251	0.83 **
Work			
Light	477± 748	1,313± 1,512	0.61 **
Intense	688± 1,829	417± 1,072	0.65 **
Household			
Light	1,236± 1,097	1,147± 1,209	0.71 **
Intense	404± 576	596± 1,025	0.27
Leisure time			
Walking	308± 611	168± 415	0.48 **
Bicycle	279± 700	196± 524	0.65 **
Gardening	874± 2,248	300± 500	0.59 **
Odd jobs	301± 929	264± 516	0.49 **
Sports	1,022± 3,466	982± 2,626	0.95 **

All items are expressed as activity scores per week (mean ± SD). The retest was conducted about 3 weeks after the first test.

\*p < 0.05; \*\*p < 0.01

time walking but not walking as a form of commute. Sitting time on the IPAQ was inversely correlated with the total SQUASH score, leisure time SQUASH subscale scores, and three out of five leisure time activities (Table 2).

Discriminant validity was examined by comparing SQUASH and IPAQ scores among asymptomatic men and women and women with OA (Table 3). Significant differences in scores between the groups were found for the SQUASH total score, and items regarding bicycling, light household activity, leisure time walking, and sports. Gender differences in scores were found for light household activity, with men reporting much lower scores than the two groups of women. OA women reported significantly less leisure time walking than asymptomatic men, and reported almost as little leisure time bicycle activity as asymptomatic women. Similarly, OA women reported less leisure time sports activities than the two asymptomatic groups. With regard to the IPAQ, no significant differences in activity scores among the three groups emerged for any of the four IPAQ categories except for sitting time, and OA women reported significantly longer sitting times than asymptomatic women.

## DISCUSSION

The present study demonstrated the reliability and validity of the Japanese version of the SQUASH as an assessment of physical activity in older adults. The SQUASH was also shown to have better discriminant validity than the IPAQ in the detection of differences regarding the type and amount of physical activity among older adults with low activity levels.

The test-retest reliability of the SQUASH was satisfac-

**Table 2.** Spearman correlation coefficients between the SQUASH and IPAQ in healthy elderly (n = 74)

	IPAQ				
	Total	Vigorous	Moderate	Walking	Sitting time
SQUASH (Total)	0.48 **	0.37 **	0.25 *	–	–0.26 *
Commuting (Total)	–	–	–	–	–
Walking	–	–	–	–	–
Bicycle	–	0.39 **	–	–	–
Work (Total)	0.23 *	0.23 *	–	–	–
Light	–	–	–	–	–
Intense	–	0.36 **	–	–	–
Household (Total)	0.27 *	–	–	–	–
Light	–	–	–	–	–
Intense	0.23 *	0.29 **	–	–	–
Leisure time (Total)	0.30 **	0.38 **	0.26 *	–	–0.27 *
Walking	–	–	–	0.32 **	–
Bicycle	–	–	–	–0.30 **	–0.30 **
Gardening	–	–	–	–	–0.24 *
Odd jobs	–	–	0.26 *	–	–0.40 *
Sports	0.27 *	–	0.24 *	–	–

–: not significant. \*p < 0.05; \*\*p < 0.01

tory, with correlations between the first and second surveys of the SQUASH ranging from moderate to strong, except for the heavy housework item. The results are comparable to previous studies of younger adults and individuals with total hip arthroplasty<sup>17, 19</sup>), although our participants were older and less active. Heavy household work, such as mopping the floor, was a relatively infrequent activity<sup>23</sup>). This may have been the case because the SQUASH assesses mean activity for a weekly period, and infrequent activities may not have been repeated in the test-retest reliability assessment phase.

The criterion-related validity of the Japanese version of SQUASH in older adults may be considered satisfactory, with a moderate correlation between the total score on the SQUASH and that of the IPAQ; this result was comparable to that of the UCLA Activity Scale, which was evaluated using the IPAQ<sup>24</sup>). However, after examining specific item coefficients, most SQUASH intense activity items — but not light activity items — were correlated with the IPAQ largely because the IPAQ does not have a light activity category. Weak correlations between walking on the SQUASH and IPAQ that only emerged in the leisure-walking category can be explained by the fact that the IPAQ only assesses walking that lasts for ≥ 10 minutes. A walking commute lasting less than 10 minutes may not have been included in the IPAQ. The inverse correlation between the IPAQ sitting time and total SQUASH score indicates that those reporting more activities spent less time sitting. This inverse relationship is a reflection of time spent in several leisure activities. It is interesting to note that essential activities, such as work and housework, did not show an inverse correlation with the

**Table 3.** Comparison of SQUASH and IPAQ data for healthy men, healthy women, and women with hip or knee OA

Contents	Healthy men	Healthy women	Women with OA	Kruskal-Wallis test p-value	Steel-Dwass test (p-value)		
	n = 23 Mean ± SD	n = 51 Mean ± SD	n = 32 Mean ± SD		Healthy men vs. healthy women	Healthy men vs. women with OA	Healthy women vs. women with OA
SQUASH (Total)	4,837± 5,963	5,864± 4,161	5,736± 3,389	*	*	–	–
Commuting							
Walking	257± 576	132± 292	99± 290	–			
Bicycle	15± 73	168± 414	117± 663	*	–	–	*
Work							
Light	579± 1,222	979± 1,798	915± 1,597	–			
Intense	189± 500	576± 2,043	506± 1,610	–			
Household							
Light	394± 828	2,208± 1,867	2,312± 2,312	**	**	**	–
Intense	417± 965	665± 1,502	1,005± 1,731	–			
Leisure time							
Walking	394± 755	211± 375	41± 100	*	–	**	–
Bicycle	112± 452	158± 414	5± 27	*	–	–	*
Gardening	845± 2,667	266± 518	643± 1,869	–			
Odd jobs	30± 131	288± 815	68± 198	–			
Sports	1,604± 4,140	213± 574	25± 128	**	–	**	*
IPAQ (Total)	3,629± 5,517	3,889± 5,554	3,460± 5,056	–			
Vigorous	1,447± 3,946	902± 2,452	615± 3,061	–			
Moderate	344± 578	1,413± 4,052	1,499± 3,332	–			
Walking	1,837± 3,556	1,573± 1,573	1,347± 1,347	–			
Sitting time (min)	258± 262	236± 234	406± 309	**	–	–	**

All items are expressed as activity scores per week except IPAQ sitting time. Sitting time is expressed as minutes per week. When the Kruskal-Wallis test results reached statistical significance, the Steel-Dwass test was used as a post hoc test. –: not significant. OA: osteoarthritis. \* $p < 0.05$ ; \*\* $p < 0.01$

#### IPAQ sitting time.

In the present study, criterion-related validity was tested by examining the correlations between the SQUASH and the IPAQ. In some studies, pedometers have been used for criterion validity of activity scales. We did not use pedometers, however, because they do not measure aquatic sports, and result in a relatively high noncompliance rate of device wearing in older adults<sup>16</sup>). Furthermore, the SQUASH measures activity over an average week throughout the past month, while pedometers are generally only worn for a week<sup>15</sup>).

Our findings show that the SQUASH had high discriminant validity when compared with the IPAQ in older adults. The IPAQ (short version) is intended to measure the intensity of physical activity, while the SQUASH measures both the intensity and type of activity. The SQUASH is composed of culturally sensitive activity items that could detect differences in activity levels among older adults with relatively low physical activity levels. The sex differences in activity level noted in our study were in line with a national survey of activity among Japanese adults and seniors, which found that women spent far more time on household activities than men (4.25 and 0.5 hours per day, respectively<sup>25</sup>).

No differences emerged when household activity levels of women with OA were compared with those of asymptomatic women, indicating that women with OA maintained high levels of household activity. Household activities include

carrying shopping bags, lifting pots and pans, and standing while cooking. These activities may aggravate osteoarthritis<sup>26, 27</sup>). Such individuals require support in performing these household activities in order to prevent further joint deterioration.

Walking, cycling, and sports scores in OA women were significantly lower than those in asymptomatic groups. This suggests that pain and limited range of motion make it difficult for individuals with OA to be active for leisure. Maintaining low impact exercise is important for slowing the progression of OA<sup>28, 29</sup>). Further research is necessary to examine the association between OA progression and activity levels that match appropriate amounts of exercise.

Since the SQUASH has excellent discriminant validity in detecting activity level differences between asymptomatic older adults and women with OA, it can be used to monitor changes in activity levels. Because the SQUASH does not evaluate solely the intensity or amount of an activity, but also classifies its content in detail<sup>17, 19</sup>), the scale is effective in evaluating less active older adults. The SQUASH can also be used to identify OA patients that engage in intense household activities. Appropriate social services should be provided to reduce intense household activity in order to mitigate the heavy loads on the knees or hips.

This study has several limitations worth noting. The sample size was not large enough to prevent type 2 errors

for some items, and differences in activity levels among the asymptomatic and OA groups may not have been detected. In addition, the OA group was selected from three hospitals in Japan, and included only women; they may not represent the activity level of all individuals with knee or hip OA across Japan. Nevertheless, this study showed the SQUASH to possess high discriminant validity in older adults, and the discrepancies in patterns of activity between men and women were in agreement with a national survey<sup>25</sup>). Lastly, this study did not differentiate between mild/moderate/severe OA. Further research is needed to see whether the SQUASH can distinguish physical activity between patients with different OA severities.

In conclusion, the current study examined the test-retest reliability, criterion-related validity, and discriminant validity of the Japanese version of the SQUASH in older adults. The results showed the SQUASH to be a reliable and valid instrument for use among older Japanese adults as well as a useful tool to discriminate between women with knee or hip OA. The SQUASH is a practical, easy-to-administer scale that may be used to assess physical activity for individuals with OA and to monitor changes in physical activity.

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#### REFERENCES

- Pisters MF, Veenhof C, van Dijk GM, et al.: The course of limitations in activities over 5 years in patients with knee and hip osteoarthritis with moderate functional limitations: risk factors for future functional decline. *Osteoarthritis Cartilage*, 2012, 20: 503–510. [Medline] [CrossRef]
- Dawson J, Fitzpatrick R, Murray D, et al.: Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg Br*, 1998, 80: 63–69. [Medline] [CrossRef]
- Bellamy N, Buchanan WW, Goldsmith CH, et al.: Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol*, 1988, 15: 1833–1840. [Medline]
- Dawson J, Fitzpatrick R, Murray D, et al.: Comparison of measures to assess outcomes in total hip replacement surgery. *Qual Health Care*, 1996, 5: 81–88. [Medline] [CrossRef]
- Ministry of Health: Labour and Welfare: Guideline of Health-enhancing Physical Activity in 2013. <http://www.mhlw.go.jp/stf/houdou/2r985200002xple.html>. (Accessed Jul. 2, 2014)
- Terwee CB, Bouwmeester W, van Elstrand SL, et al.: Instruments to assess physical activity in patients with osteoarthritis of the hip or knee: a systematic review of measurement properties. *Osteoarthritis Cartilage*, 2011, 19: 620–633. [Medline] [CrossRef]
- Amstutz HC, Thomas BJ, Jinnah R, et al.: Treatment of primary osteoarthritis of the hip. A comparison of total joint and surface replacement arthroplasty. *J Bone Joint Surg Am*, 1984, 66: 228–241. [Medline]
- Baecke JA, Burema J, Frijters JE: A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr*, 1982, 36: 936–942. [Medline]
- Craig CL, Marshall AL, Sjöström M, et al.: International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*, 2003, 35: 1381–1395. [Medline] [CrossRef]
- Murase N, Katamura T, Ueda C, et al.: Reliability and validity of the Japanese version of the International Physical Activity Questionnaire (IPAQ). *Kousei no Shihyou*, 2002, 49: 1–9. (in Japanese).
- Ono R, Hirata S, Yamada M, et al.: Reliability and validity of the Baecke physical activity questionnaire in adult women with hip disorders. *BMC Musculoskelet Disord*, 2007, 8: 61. [Medline] [CrossRef]
- Tomioka K, Iwamoto J, Saeki K, et al.: Reliability and validity of the International Physical Activity Questionnaire (IPAQ) in elderly adults: the Fujiwara-kyo Study. *J Epidemiol*, 2011, 21: 459–465. [Medline] [CrossRef]
- Lim KI, Hwnagbo G, Nam HC, et al.: Comparison of the effects on dynamic balance ability of warming up in water versus on the ground. *J Phys Ther Sci*, 2014, 26: 575–578. [Medline] [CrossRef]
- Hale LA, Waters D, Herbison P: A randomized controlled trial to investigate the effects of water-based exercise to improve falls risk and physical function in older adults with lower-extremity osteoarthritis. *Arch Phys Med Rehabil*, 2012, 93: 27–34. [Medline] [CrossRef]
- Baker G, Gray SR, Wright A, et al. Scottish Physical Activity Research Collaboration (SPARColl): The effect of a pedometer-based community walking intervention “Walking for Wellbeing in the West” on physical activity levels and health outcomes: a 12-week randomized controlled trial. *Int J Behav Nutr Phys Act*, 2008, 5: 44. [Medline] [CrossRef]
- Kochersberger G, McConnell E, Kuchibhatla MN, et al.: The reliability, validity, and stability of a measure of physical activity in the elderly. *Arch Phys Med Rehabil*, 1996, 77: 793–795. [Medline] [CrossRef]
- Wendel-Vos GC, Schuit AJ, Saris WH, et al.: Reproducibility and relative validity of the short questionnaire to assess health-enhancing physical activity. *J Clin Epidemiol*, 2003, 56: 1163–1169. [Medline] [CrossRef]
- 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. [Medline] [CrossRef]
- Wagenmakers R, van den Akker-Scheek I, Groothoff JW, et al.: Reliability and validity of the short questionnaire to assess health-enhancing physical activity (SQUASH) in patients after total hip arthroplasty. *BMC Musculoskelet Disord*, 2008, 9: 141. [Medline] [CrossRef]
- Bossen D, Veenhof C, Dekker J, et al.: The usability and preliminary effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis. *BMC Med Inform Decis Mak*, 2013, 13: 61. [Medline] [CrossRef]
- Jingushi S, Ohfuji S, Sofue M, et al.: Multiinstitutional epidemiological study regarding osteoarthritis of the hip in Japan. *J Orthop Sci*, 2010, 15: 626–631. [Medline] [CrossRef]
- Sudo A, Miyamoto N, Horikawa K, et al.: Prevalence and risk factors for knee osteoarthritis in elderly Japanese men and women. *J Orthop Sci*, 2008, 13: 413–418. [Medline] [CrossRef]
- Jacobs DR Jr, Ainsworth BE, Hartman TJ, et al.: A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exerc*, 1993, 25: 81–91. [Medline] [CrossRef]
- Naal FD, Impellizzeri FM, Leunig M: Which is the best activity rating scale for patients undergoing total joint arthroplasty? *Clin Orthop Relat Res*, 2009, 467: 958–965. [Medline] [CrossRef]
- Kobayashi T, Morofuji E, Watanabe Y: National survey on schedule of a daily life in Japan. The NHK Monthly Report on Broadcast Research, 2011, 2–21. (in Japanese).
- Sulsky SI, Carlton L, Bochmann F, et al.: Epidemiological evidence for work load as a risk factor for osteoarthritis of the hip: a systematic review. *PLoS ONE*, 2012, 7: e31521. [Medline] [CrossRef]
- Wang Y, Simpson JA, Wluka AE, et al.: Is physical activity a risk factor for primary knee or hip replacement due to osteoarthritis? A prospective cohort study. *J Rheumatol*, 2011, 38: 350–357. [Medline] [CrossRef]
- Ageberg E, Engström G, Gerhardsson de Verdier M, et al.: Effect of leisure time physical activity on severe knee or hip osteoarthritis leading to total joint replacement: a population-based prospective cohort study. *BMC Musculoskelet Disord*, 2012, 13: 73. [Medline] [CrossRef]
- Koyama Y, Miyashita M, Irie S, et al.: A study of disease management activities of hip osteoarthritis patients under conservative treatment. *J Orthop Nurs*, 2008, 12: 75–83. [CrossRef]