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【Brief Communication】

Reliability and validity of the Sedentary Lifestyle Questionnaire for Japanese (SLQ-J)

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Introduction

In recent years, sedentary behavior has been recognized as a major lifestyle-related health risk. Sedentary behavior is defined as "any waking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents (METs) while in a sitting or reclining posture"[13)]. Sitting for long periods has been reported to increase the overall risk of mortality, type 2 diabetes, cardiovascular disease, and cancer, independent of engagement in moderate to high-intensity physical activities[2)]. Furthermore, researchers have found correlations between sedentary behaviors and mental health[15)]. In one international comparative study of 20 countries[1)], Japanese people were found to have the longest sitting time. This suggests the need for further data on the influence of sedentary behavior on the health of Japanese people in particular. However, there are rather few epidemiological studies[7,9,10)] on the influence of sedentary behavior on health outcomes among Japanese people. One possible reason for this is that there is no questionnaire for comprehensively measuring sedentary behavior in the Japanese population. Overall sedentary time can be assessed with either a single item questionnaire or a questionnaire that sums time of multiple domains of sedentary behavior. Such composite questionnaire would be useful for understanding the health risks of sedentary behavior in different domains and how these health effects are influenced by behavior changes. Indeed, such composite measures of overall sedentary time have been developed in other countries[3-5,8,12,14)]. However, in previous studies focusing on Japanese individuals, sedentary behavior was measured via questionnaires focusing on a single domain, such as screen time[7)] or workplace sitting time[9)], or using a single item that measured overall sedentary time[10)]. To our knowledge, there have been no studies conducted to confirm the validity and reliability of a questionnaire that evaluates overall sedentary time as the sum of multiple domains of sedentary behavior in Japanese people. Thus, in this study, we designed the Sedentary Lifestyle Questionnaire for Japanese (SLQ-J) to provide such a composite measure of overall sedentary time in the Japanese population, and examined its validity and reliability.

Methods

A. Participants

We recruited two groups of subjects: adults working full-time jobs (Adult Group), and elderly people aged 60 years or older (Older Adult Group). The Adult Group comprised 95 individuals aged 23 years or older

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who were employed by a major urban insurance company and who had responded to the questionnaire as well as had their sedentary behavior measured using an accelerometer. All subjects in this group worked on weekdays (i.e., 5 days/week), and did not work on the weekends (i.e., 2 days/week). The Older Adult Group was recruited through a leaflet or word of mouth; a total of 98 subjects were recruited, all of whom had responded to the questionnaire and had their sedentary behavior measured using an accelerometer. Eighty of these subjects from the Older Adult Group participated in the second questionnaire administration for measuring the test-retest reliability.

B. Study procedures

1. Reliability

The test-retest reliability was examined. The questionnaires were mailed to all members of the Older Adult Group, and were collected approximately 2 weeks later. Then, approximately one month after the initial collection, we repeated this process of mailing out and collecting the questionnaires.

2. Validity

We evaluated the criterion validity by measuring objective sedentary time using an accelerometer. In the Adult Group, questionnaires and accelerometers were distributed and collected through the subjects' company. In the Older Adult Group, the questionnaires and accelerometer were mailed and then collected approximately two weeks later.

C. Measures

1. Sedentary Lifestyle Questionnaire for Japanese (SLQ-J)

The SLQ-J is an original self-report questionnaire that measures overall sedentary time as a composite of multiple domains of sedentary behavior of Japanese people. The SLQ-J was designed by two exercise epidemiologists, who used previous studies as reference material[4,5]. A prototype of the SLQ-J was initially prepared, which was then revised and finalized by reflecting on the opinions of other physical fitness science researchers and experienced nurses and doctors. The SLQ-J asks about the time spent engaged in sedentary behaviors per week in the following six domains: (1) occupation, (2) transportation (car, train, etc.), (3) TV viewing, (4) computer use other than work, (5) reading (newspapers, magazines, etc.), and (6) other sedentary time. For all domains other than occupation, participants had to give the time separately for work days and non-work days (i.e., weekends). In the Adult Group, the total sedentary time per work day was calculated by summing the times in all domains and dividing by 5. The total sedentary time per non-work days was calculated by summing the corresponding sedentary times for all domains other than occupation and dividing by 2. Then, the times on work days and non-work days were summed and divided by 7 to calculate the average total sedentary time per day (hereafter, "average day"). In the Older Adult Group, 56% of subjects were unemployed and most of the subjects who were still employed worked less than 5 days per week. These subjects were considered to be working as less than full-time; thus, instead of distinguishing between work days and non-work days, we calculated only the total time spent on the average day for the Older Adult Group.

2. Accelerometer

Sedentary behavior was assessed using a triaxial accelerometer (Active Style Pro HJA-750C; Omron Healthcare Co., Ltd., Kyoto, Japan). The Active Style Pro has been confirmed to have high accuracy through the Doubly Labeled Water Method[11]. Subjects were instructed to wear the accelerometer from waking until they went to sleep; for study purposes, we deemed valid days as days on which subjects wore the accelerometer for 10 hours or longer. Only subjects with 5 valid weekdays and 2 valid weekends were included in the analysis. Accelerometers were distributed to 122 people, of whom 97 met the inclusion criteria for the Adult Group. We also presented accelerometers to a further 100 people who all met the inclusion cri-

teria for the Older Adult Group. In both groups, two individuals were not analyzed because they had incomplete questionnaires. The mean numbers of valid days in the Adult and Older Adult Groups were 19.0 and 9.3 days for weekdays and 6.5 and 3.9 days for weekends, respectively. The average time spent wearing the accelerometer per day was 931.9 ± 100.6 min and 958.0 ± 94.7 min for subjects in the Adult and Older Adult Groups, respectively. In this study, sedentary behavior was defined as any activity with an accelerometer-estimated intensity of ≤ 1.5 METs. We considered each minute wherein the activity intensity was ≤ 1.5 METs as sedentary time.

D. Statistical analysis

Test-retest reliability was examined using intraclass correlation coefficients (ICCs) and 95% confidence intervals (95% CIs). Reliability was classified as follows: "poor," ICC ≤ 0.40; "moderate," 0.41–0.60; "good," 0.61–0.80; or "excellent," ≥ 0.81. The difference in scores between test times was examined using the Wilcoxon signed-rank test. The criterion validity was verified by calculating Spearman's correlation coefficient between the SLQ-J and sedentary time measured using the accelerometer. We also calculated the difference in sedentary time as measured by the SLQ-J and the accelerometer using the Wilcoxon signed-rank test. In addition, Bland-Altman plots were used to examine trends in the underestimation or overestimation of total sedentary time as measured by the SLQ-J compared to the accelerometer. For the data analysis, we used SPSS Statistics 22.0 for Windows. Significance was considered to be $P < 0.05$.

E. Ethical considerations

Subjects were briefed regarding the purpose and methods of this study, protection of personal information protocols, data usage, etc. Subjects who consented to participation were included in the survey. The collected survey forms were managed using IDs that did not individually identify subjects. This study was conducted after obtaining the approval of the Ethical Review Committee of the Meiji Yasuda Life Foundation of Health and Welfare (Approval number: 28001, 28004).

Results

A. Subject characteristics

The subject characteristics are displayed in Table 1. In the Adult Group, there were slightly more females (66%), while in the Older Adult Group, the number of men and women were equal. In both groups, the majority of subjects were married, had received education beyond high school levels, and were not obese. Regarding economic status, most subjects answered "good."

B. Reliability

The results of the reliability assessment are shown in Table 2. Total sedentary time as measured by the SLQ-J exhibited good reliability (ICC = 0.71). Sedentary time for each of the specific domains also exhibited acceptable reliability, except for other sedentary time, which had poor reliability (0.27). Occupation

Table 1. Participant characteristics.

	Adults n = 95	Older adults n = 98
Age (year)	47.6 (9.2)	68.3 (5.2)
Gender (%)		
Male	34.0	51.0
Female	66.0	49.0
Employment status (%)		
Employed	100.0	43.9
Not employed	0.0	56.1
Marital status (%)		
Married	64.9	86.7
Unmarried	34.0	13.3
Education (year)	15.0 (1.8)	15.3 (2.1)
Economic status		
Very good	7.2	14.3
Good	47.4	76.5
Poor	36.1	9.2
Very poor	8.2	0.0
Body mass index (kg/m^2)	22.5 (2.7)	21.8 (2.8)

Values are mean (SD), except for categorical data.

Table 2. Results of the test-retest reliability for older adults.

Sitting time (min/day)	n	Test	Retest	*P*	ICC (95% CI)
		Median (IQR)	Median (IQR)		
Total sedentary time	76	312.9 (213.6)	322.1 (159.6)	0.59	0.71 (0.57 - 0.80)
Occupation	79	0.0 (68.6)	0.0 (85.7)	0.07	0.93 (0.89 - 0.95)
Transportation	80	12.9 (28.6)	12.9 (30.4)	0.27	0.76 (0.65 - 0.84)
TV viewing	80	158.6 (145.7)	167.1 (135.0)	0.10	0.77 (0.66 - 0.84)
Computer use	79	42.9 (58.6)	40.7 (77.1)	0.27	0.85 (0.78 - 0.90)
Reading	80	60.0 (60.0)	60.0 (45.0)	0.83	0.58 (0.42 - 0.71)
Other sedentary time	78	34.3 (42.9)	42.9 (53.0)	0.36	0.27 (0.06 - 0.47)

*P*s were for Wilcoxon signed-rank tests. ICC; intraclass correlation coefficient, IQR; interquartile range.

Table 3. Results of the criterion validity testing in adults and older adults.

Sitting time (min/day)	SLQ-J	Accelerometer	*P**	Spearman	
	Median (IQR)	Median (IQR)		Rho	*P*
Adults					
Average day	590.0 (196.4)	509.7 (112.2)	< 0.01	0.27	0.02
Work day	660.0 (201.0)	546.7 (122.9)	< 0.01	0.33	< 0.01
Non-work day	375.0 (312.5)	390.6 (145.6)	0.78	0.24	0.03
Older adults					
Average day	322.9 (208.9)	453.9 (152.9)	< 0.01	0.21	0.04

**P*s were for Wilcoxon signed-rank tests. IQR; interquartile range.

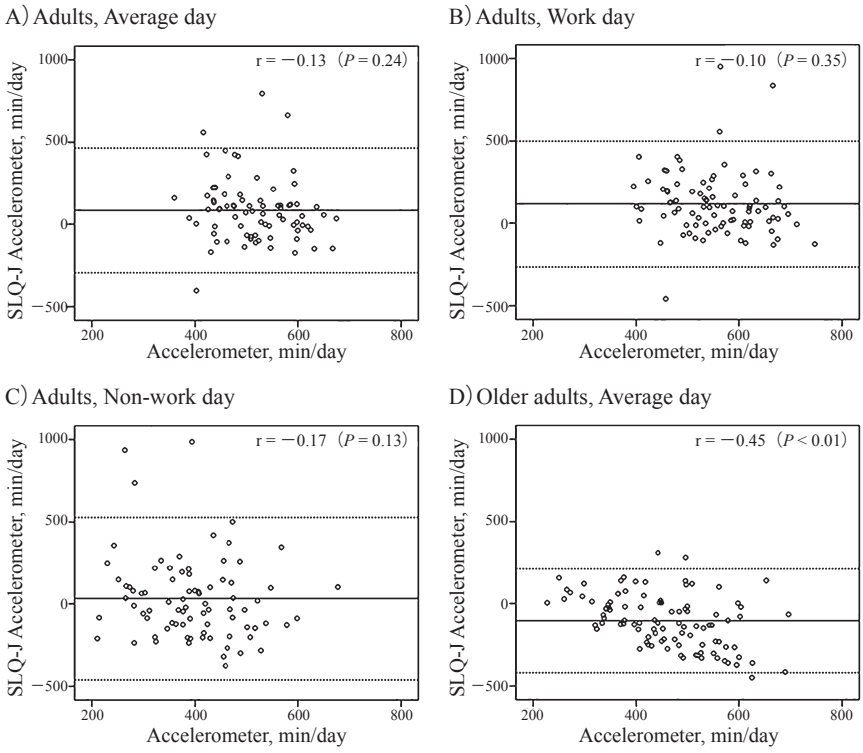

Figure 1. Bland-Altman plots illustrating agreement in total sedentary time between the accelerometer and the Sedentary Lifestyle Questionnaire for Japanese (SLQ-J).

and computer use both exhibited excellent reliability (ICC = 0.85–0.93), transportation and TV viewing exhibited good reliability (ICC = 0.76–0.77), and reading exhibited moderate reliability (ICC = 0.58).

C. Validity

The results of the validity assessment are shown in Table 3. When comparing the absolute value of total sedentary time between the SLQ-J and the accelerometer, we observed a significant difference between the average total sedentary time per day and the work day value in the Adult Group. Specifically, the SLQ-J showed overestimations for both the average day (+15.8%) and the work day (+20.7%) in comparison with the accelerometer. In contrast, the SLQ-J was significantly underestimated (−28.9%) for the average day in the Older Adult Group. Regarding the correlations between the total sedentary time as measured by the SLQ-J and the accelerometer, a significant correlation was observed for the average day (rho = 0.27), work day (rho = 0.33), and non-work day (rho = 0.24) in the Adult Group. We also observed a significant correlation in the Older Adult Group for the average day (rho = 0.21). The Bland-Altman plots are shown in Figure 1. In the Adult Group, we observed no systematic error for the average day, work day, or non-work day, but in the Older Adult Group, the total sedentary time as measured by the SLQ-J tended to be underestimated when the total sedentary time measured by the accelerometer was overlong (r = −0.45, $P < 0.01$).

Discussion

We designed the SLQ-J and examined its reliability and validity in Japanese adults and elderly people. The SLQ-J was found to have moderate-to-excellent reliability for most measurement domains, as well as acceptable validity. However, we also found that the SLQ-J tends to overestimate sedentary time by 16–21% in working adults and underestimates by 29% in the elderly. In elderly people in particular, when the sedentary times were long, the total sedentary time obtained by the SLQ-J tended to be underestimated.

According to previous research[3] verifying the reliability of a questionnaire for sedentary behavior (the SIT-Q-7d) in elderly subjects, the ICC for total sedentary behavior time was 0.68–0.80. Another study using a different questionnaire, the Sedentary Behavior Questionnaire, among adults found ICCs of 0.51–0.93[12]. The ICCs observed in this study were similar to those in these past studies, indicating that the SLQ-J had comparable reliability to the sedentary behavior surveys used in other countries. Notably, the ICC of the other sedentary time domain was only 0.27; this is perhaps because the test-retest period was 1 month in this study, whereas they are typically 1 to 2 weeks. However, in another study of elderly adults[3] wherein the test-retest period was 9 days, the ICC was 0.20 or less depending on the domain; this may reflect the limits of the self-report questionnaire format for elderly subjects.

In their review, Healy et al.[6] reported that correlation coefficients between composite measures of sedentary time and accelerometer-derived sedentary time were 0.15–0.32. Similarly, in this study, the correlation coefficients between the SLQ-J and accelerometer were 0.21–0.33. Therefore, the validity of the SLQ-J was deemed acceptable. In addition, Chau et al. examined the validity of a questionnaire (the Workforce Sitting Questionnaire; WSQ) developed for working people[4]. According to their report, the Spearman's rho between sedentary times as measured by the WSQ and an accelerometer was 0.29–0.34 on work days and 0.18–0.23 on non-work days. The results of our study were somewhat consistent with these past findings. Chau et al. also indicated that the WSQ's sitting time was overestimated in comparison to the accelerometer, as was the case in our study. Other previous studies have similarly reported that self-report questionnaires tend to overestimate sedentary times compared to accelerometers[14]. However, studies featuring older

adults have reported surveys that underestimated sitting time[8], while other surveys showed overestimations, as with the adults[3]. These differences might be explained in part by a bias inherent to self-reported questionnaires in general: namely, the fact that they rely on memory, which is naturally weaker in elderly individuals. Additionally, whether subjects are working might also have an impact. For instance, the study with the survey that overestimated sitting time[3] did not include unemployed people. However, the majority of subjects in study with the underestimating survey[8] were unemployed. The majority of the elderly people in our study were unemployed, so it is possible that the SLQ-J survey underestimated the sedentary times in comparison to the accelerometer for that reason. Based on this background, when using the absolute value of SLQ-J for evaluation, it is necessary to interpret the results in light of the age of subjects and whether they are employed. Particular attention is necessary for unemployed elderly subjects.

We were unable to examine the test-retest reliability in adults during this study. However, according to a prior study[3] examining the reliability in both adults and elderly, adults tend to show even greater reliability than the elderly. Given that the test-retest reliability of the SLQ-J was confirmed in elderly people, it is highly likely that it will be confirmed in adults as well. Nevertheless, further examination is necessary. Note that the subjects of this study belonged to a relatively high socioeconomic status group. Thus, whether the reliability and validity will be verified in lower socioeconomic groups as well should be examined in a future study.

Conclusion

We confirmed that SLQ-J had generally favorable reliability and acceptable validity. However, the absolute values for sedentary times were overestimated in working adults, while they were underestimated among elderly subjects (especially when the sedentary time was long), including those who were unemployed. The SLQ-J can be considered a useful questionnaire for epidemiological studies targeting Japanese, so long as the characteristics of survey targets are carefully considered.

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