学位論文

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Original Article

Relation between Prolonged Sedentary Bouts and Health-Related Quality of Life in Patients on Chronic Hemodialysis

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This study aimed to investigate the link between prolonged sedentary bouts and health-related quality of life (QOL) in patients on chronic hemodialysis (CHD). A total of 84 outpatients on CHD, aged 71.6±11.8 years, were enrolled in this cross-sectional study. Parameters for prolonged sedentary bouts [*i.e.*, ≧30 min (% and bout) and ≧60 min (% and bout)] were measured using a triaxial accelerometer. Health-related QOL (HRQOL) was evaluated by the Euro-QOL (EQ-5D). Clinical parameters were obtained from medical records. Relatively prolonged sedentary bouts (%) were 44.0±18.2 (≧30 min) and 29.8±16.5 (≧60 min) for total days. Prolonged sedentary bouts (bouts) were 6.2±2.7 (≧30 min) and 2.7±1.6 (≧60 min) for total days. EQ-5D scores were 0.728±0.220. All prolonged sedentary bout parameters were negatively correlated with EQ-5D scores, except for prolonged sedentary bouts (≧60 min) (min) and relatively prolonged sedentary bouts (%) on hemodialysis days. Multiple regression analysis showed that prolonged sedentary bout parameters were an important factor in EQ-5D scores even after adjusting for confounding factors for total and non-hemodialysis days. Our results suggested that prolonged sedentary bouts were closely associated with HRQOL in patients on CHD, especially on non-hemodialysis days.

Key words: prolonged sedentary bouts, hemodialysis, EQ-5D, QOL

The increasing number of patients on chronic hemodialysis (CHD) has become a public health challenge in Japan. The Japanese Society of Dialysis Therapy reported that over 300,000 patients are currently receiving CHD therapy (https://docs.jsdt.or.jp/overview/file/2019/pdf/01.pdf; accessed June 13, 2021). Therefore, appropriate maintenance is urgently required for CHD patients.

Sedentary behavior, defined as ≤1.5 metabolic equivalents (METs) during waking hours [1], is a recognized risk factor for health outcomes such as diseases including obesity and type 2 diabetes mellitus, as well as increased mortality rate [2-6]. We previously reported that sedentary behavior (%) was negatively correlated with health-related quality of life (HRQOL) in patients on CHD in a cross-sectional study [7]. In addition, sedentary behavior (%) was a determinant factor of mortality in CHD patients by longitudinal analysis [8].

Recently, it was reported that not only sedentary behavior (%), but also prolonged sedentary bouts, which reflect the quality of sedentary behavior, were

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associated with health outcomes [9-15]. However, there have been no reports on the relation between prolonged sedentary bouts and HRQOL in patients on CHD. Determining the effects of prolonged sedentary bouts on HRQOL will provide useful information regarding maintenance in patients on CHD.

Therefore, in this cross-sectional study, we evaluated the relation between prolonged sedentary bouts and HRQOL in patients on CHD.

Materials and Methods

Subjects. Among 208 outpatients who were treated for CHD from September 2013 to September 2019 at Innoshima General Hospital, Onomichi, Japan, a total of 84 outpatients (42 male and 42 females), aged 71.6±11.8 years, met the following criteria and were enrolled in this cross-sectional study: (1) they underwent measurements for prolonged sedentary bouts and HRQOL; and (2) they provided written informed consent. Ethical approval was obtained from the ethical committee of Innoshima General Hospital, Onomichi, Japan (H25-2-27, H26-1-23, H26-12-16, H27-12-25, H28-12-9, H29-12-4, H30-11-1, H31-2-25).

Prolonged sedentary bouts. Sedentary behavior including prolonged sedentary bouts and physical activity parameters were evaluated using a triaxial accelerometer (Active Style Pro: Hja-350it Omron, Kyoto, Japan), for which the validity and accuracy have been previously confirmed [16,17]. Subjects were asked to wear the activity meter except during sleeping and bathing [1,7,18]; total non-wearing time was defined as the periods when estimated physical activity intensity obtained from the triaxial accelerometer showed a value of 0 for more than 60 consecutive min. Total wearing time was defined as 24 h minus the non-wearing time. As prolonged sedentary bouts parameters, we used ≧30 min (% and bout), ≧60 min (% and bout) and total sedentary behavior (%). In addition, we measured light-intensity physical activity (LPA: 1.6-2.9 METs) (%) and moderate-to-vigorous intensity physical activity (MVPA: ≥3 METs) (%).

HRQOL. HRQOL was also evaluated using the EuroQOL (EQ-5D) Japanese version as previously described [19]. EQ-5D consists of five subscales with three levels collectively describing 3^5 (*i.e.*, 243) possible health combinations. The five subscales are (1) mobility, (2) self-care, (3) usual activities, (4) pain/discomfort, and (5) anxiety/depression.

Clinical parameters. We evaluated sex, age, height (cm), body weight (dry weight; kg), duration of hemodialysis (months), history of diabetes mellitus (yes/no), and blood examinations. Body mass index (BMI: kg/m^2) was calculated as follows: body weight (kg) / [height (m)]^2. Albumin (mg/dL), blood glucose (mg/dL), triglycerides (mg/dL) and HDL cholesterol (mg/dL) were measured by conventional laboratory methods. The geriatric nutritional risk index (GNRI), which reflects nutritional status, was calculated as follows: GNRI = 14.89 × serum albumin (g/dL) + 41.7 × BMI/22 [20].

Statistical analysis. All parameters are expressed as mean ± standard deviation (SD). Clinical parameters between subjects with shorter relatively prolonged sedentary bouts (≧30 min) (%) and with longer relative prolonged sedentary bouts (≧30 min) (%) were compared using unpaired *t* test, χ^2 test and Fisher's exact test. The relations between EQ-5D scores and clinical parameters were evaluated by simple correlation analysis. In addition, multiple regression analysis was used to evaluate the relation between prolonged sedentary bouts and HRQOL ($p<0.05$ was considered statistically significant). All statistical analyses were performed using JMP15 Pro 15.1.0 (SAS, Cary, NC, USA).

Results

Table 1 shows the clinical profiles of enrolled patients on CHD. On total days, prolonged sedentary bouts (≧30 min) (min) and prolonged sedentary bouts (≧60 min) (min) were 461.4±232.1 min and 317.4±198.8 min, respectively, and prolonged sedentary bouts (≧30 min) (bouts) and prolonged sedentary bouts (≧60 min) (bouts) were 6.2±2.7 bouts and 2.7±1.6 bouts, respectively. The EQ-5D score was 0.728±0.220 for total days. Thirty patients (40.5%) had a history of diabetes mellitus.

Next, we compared the clinical parameters between subjects with longer prolonged sedentary bouts and without shorter prolonged sedentary bouts (≧30 min) (%) (Table 2). There were significant differences of sex, age, height and body weight between the two groups. However, other clinical parameters did not show significant differences between the groups.

We also evaluated the relation between EQ-5D scores and physical activity, including sedentary behav-

Table 1 Clinical characteristics of patients on chronic hemodialysis (CHD)

	Mean ± SD	Minimum	Maximum
Men/Women	42/42		
Age (years)	71.6 ± 11.8	41.0	92.0
over 65 years	66 (78.6%)		
Height (cm)	154.9 ± 9.2	133.6	175.6
Body weight (dry weight) (kg)	53.5 ± 11.0	35.3	91.0
Body mass index (kg/m^2)	22.2 ± 3.6	16.5	31.5
Duration of hemodialysis (months)	79.4 ± 83.9	4.0	338.0
History of diabetes mellitus (%)	34 (40.5%)		
EQ-5D scores	0.728 ± 0.220	−0.062	1.000
Blood sample			
Albumin (g/mL)	3.8 ± 0.4	2.7	5.2
Blood glucose (mg/dL)	133.7 ± 41.2	82.0	286.0
Triglyceride (mg/dL)	112.3 ± 69.3	29.0	431.0
HDL cholesterol (mg/dL)	55.0 ± 17.1	19.1	108.7
GNRI	98.3 ± 10.2	77.1	137.1
Physical Activity (Total)			
Wear time (min/day)	1,010.5 ± 205.1	693.1	1,425.6
Sedentary behavior (min/day)	757.4 ± 249.0	259.1	1,320.4
Prolonged sedentary bouts (≧ 30 min) (min)	461.4 ± 232.1	33.6	1,014.4
Prolonged sedentary bouts (≧ 60 min) (min)	317.4 ± 198.8	0.0	786.4
Prolonged sedentary bouts (≧ 30 min) (bouts)	6.2 ± 2.7	0.6	13.7
Prolonged sedentary bouts (≧ 60 min) (bouts)	2.7 ± 1.6	0.0	7.0
LPA (min/day)	238.7 ± 107.9	40.9	482.0
MVPA (min/day)	17.6 ± 20.4	0.1	119.0
Relative sedentary behavior (%)	73.5 ± 13.6	32.2	95.4
Relative prolonged sedentary bouts (≧ 30 min) (%)	44.0 ± 18.2	4.7	83.0
Relative prolonged sedentary bouts (≧ 60 min) (%)	29.8 ± 16.5	0.0	69.6
Relative LPA (%)	24.8 ± 12.4	0.1	55.6
Relative MVPA (%)	2.0 ± 2.5	0.0	15.1
Physical Activity (Hemodialysis days)			
Wear time (min/day)	996.5 ± 223.4	632.3	1,440.0
Sedentary behavior (min/day)	760.4 ± 256.1	198.7	1,331.0
Prolonged sedentary bouts (≧ 30 min) (min)	479.7 ± 248.2	20.0	1,095.7
Prolonged sedentary bouts (≧ 60 min) (min)	353.3 ± 226.4	0.0	953.0
Prolonged sedentary bouts (≧ 30 min) (bouts)	5.9 ± 2.8	0.3	15.0
Prolonged sedentary bouts (≧ 60 min) (bouts)	2.8 ± 1.7	0.0	6.7
LPA (min/day)	222.2 ± 107.0	53.7	530.3
MVPA (min/day)	16.7 ± 18.1	0.0	101.0
Relative sedentary behavior (%)	74.9 ± 13.6	31.4	94.2
Relative prolonged sedentary bouts (≧ 30 min) (%)	46.5 ± 20.1	2.7	80.2
Relative prolonged sedentary bouts (≧ 60 min) (%)	34.0 ± 19.6	0.0	74.2
Relative LPA (%)	23.4 ± 12.6	0.1	56.3
Relative MVPA (%)	1.9 ± 2.4	0.0	15.9
Physical Activity (Non-hemodialysis days)			
Wear time (min/day)	1,020.7 ± 213.1	682.8	1,436.8
Sedentary behavior (min/day)	754.9 ± 261.3	304.5	1,312.5
Prolonged sedentary bouts (≧ 30 min) (min)	447.5 ± 245.4	43.8	960.3
Prolonged sedentary bouts (≧ 60 min) (min)	290.7 ± 212.0	0.0	862.0
Prolonged sedentary bouts (≧ 30 min) (bouts)	6.5 ± 3.0	0.8	14.8
Prolonged sedentary bouts (≧ 60 min) (bouts)	2.7 ± 1.7	0.0	7.8
LPA (min/day)	251.1 ± 121.3	31.3	584.0
MVPA (min/day)	18.1 ± 23.0	0.3	132.5
Relative sedentary behavior (%)	72.5 ± 14.6	32.8	96.5
Relative prolonged sedentary bouts (≧ 30 min) (%)	42.1 ± 19.3	5.2	87.9
Relative prolonged sedentary bouts (≧ 60 min) (%)	26.7 ± 17.6	0.0	79.1
Relative LPA (%)	25.8 ± 13.3	0.1	57.9
Relative MVPA (%)	2.0 ± 2.6	0.0	14.5

LPA, light intensity physical activity, 1.6 METs ≦ LPA <3.0 METs; MVPA, moderate-vigorous intensity physical activity, over 3.0 METs; GNRI, geriatric nutritional risk index.

Table 2 Comparison of clinical parameters at baseline between subjects with longer prolonged sedentary bouts and without shorter prolonged sedentary bouts (≧30 min) (%)

	Longer group	Shorter group	
	Mean ± SD	Mean ± SD	*P*
Number of subjects	n = 42	n = 42	
Men/Women	27/15	15/27	0.009
Age (years)	76.0 ± 9.5	67.2 ± 12.3	<0.001
over 65 years	37 (88.1%)	29 (69.0%)	0.061
Height (cm)	157.4 ± 9.1	152.4 ± 8.7	0.011
Body weight (dry weight) (kg)	56.2 ± 10.4	50.9 ± 11.0	0.025
Body mass index (kg/m^2)	22.6 ± 3.6	21.8 ± 3.6	0.296
Duration of hemodialysis (months)	69.0 ± 73.6	89.7 ± 92.8	0.262
History of diabetes mellitus (%)	21 (50.0%)	13 (30.1%)	0.075
EQ-5D scores	0.7 ± 0.2	0.8 ± 0.2	0.150
Blood sample			
Albumin (g/mL)	3.8 ± 0.4	3.8 ± 0.4	0.914
Blood glucose (mg/dL)	136.6 ± 38.8	130.9 ± 43.8	0.529
Triglyceride (mg/dL)	119.2 ± 76.7	105.5 ± 61.2	0.368
HDL cholesterol (mg/dL)	52.8 ± 16.1	57.2 ± 17.9	0.243
GNRI	99.0 ± 10.2	97.6 ± 10.3	0.527

GNRI, geriatric nutritional risk index.

ior parameters, by simple correlation analysis (Table 3). For total days and non-hemodialysis days, all sedentary behavior parameters were significantly and negatively correlated with HRQOL. Relative LPA (%) and MVPA (%) were positively correlated with EQ-5D scores. For hemodialysis days, prolonged sedentary bouts (≧30 min) (min), prolonged sedentary bouts (≧30 min and ≧60 min) (bouts) and relative sedentary behavior (%) were negatively correlated with EQ-5D scores. Relatively LPA (%) and relatively MVPA (%) were positively correlated with EQ-5D scores. However, other continuous parameters were not significantly correlated with EQ-5D scores.

Finally, we evaluated the relation between prolonged sedentary bout parameters and EQ-5D sores by multiple regression analysis (Table 4). We used EQ-5D scores as a dependent variable, and sex, duration of hemodialysis (months), age, history of diabetes mellitus, albumin and prolonged sedentary bout parameters as independent variables. For total days and non-hemodialysis days, prolonged sedentary bout parameters [*i.e.*, prolonged sedentary bouts (≧30 min and ≧60 min) (min) and prolonged sedentary bouts (≧30 min and ≧60 min) (bouts)] were determinant factors for EQ-5D scores, even after adjusting for confounding factors. However, for hemodialysis days, prolonged sedentary bout parameters, except prolonged sedentary bouts (≧30 min) (min), were not significantly associated with EQ-5D scores.

Discussion

In this study, we evaluated the relationship between prolonged sedentary bouts and HRQOL in patients on CHD, and found that prolonged sedentary bouts, especially on non-hemodialysis days, were an important factor in HRQOL.

Studies using a questionnaire or single-accelerometer to measure sedentary behavior found that sedentary behavior in CHD patients was significantly longer than that in patients without CHD [18,21,22]. In our previous report using a triaxial accelerometer, the rate of sedentary behavior in CHD patients was 74% [8]. As for the relation between sedentary behavior and HRQOL in patients on CHD, patients with longer sedentary behavior had lower HRQOL based on questionnaire results [21]. There was a negative relationship between sedentary behavior and HRQOL evaluated by EQ-5D in our previous report [8].

Prolonged sedentary bouts have been closely associated with onset of metabolic syndrome [11]. Schmid *et al.* reported that replacing 30 min of total sitting time

Table 3 Simple correlation analysis between EQ-5D scores and physical activity including sedentary behavior

	r	P
Physical Activity (Total days)		
Prolonged sedentary bouts (≧30 min) (min)	−0.397	<0.001
Prolonged sedentary bouts (≧60 min) (min)	−0.365	0.001
Prolonged sedentary bouts (≧30 min) (bouts)	−0.385	<0.001
Prolonged sedentary bouts (≧60 min) (bouts)	−0.335	0.002
Relative sedentary behavior (%)	−0.390	0.001
Relative prolonged sedentary bouts (≧30 min) (%)	−0.280	0.010
Relative prolonged sedentary bouts (≧60 min) (%)	−0.271	0.013
Relative LPA (%)	0.329	0.002
Relative MVPA (%)	0.397	<0.001
Body mass index (kg/m^2)	0.046	0.679
Blood sample		
Albumin (g/mL)	0.235	0.032
Blood glucose (mg/dL)	−0.091	0.411
GNRI	0.167	0.128
Physical Activity (Hemodialysis days)		
Prolonged sedentary bouts (≧30 min) (min)	−0.291	0.007
Prolonged sedentary bouts (≧60 min) (min)	−0.187	0.088
Prolonged sedentary bouts (≧30 min) (bouts)	−0.401	<0.001
Prolonged sedentary bouts (≧60 min) (bouts)	−0.229	0.036
Relative sedentary behavior (%)	−0.280	0.010
Relative prolonged sedentary bouts (≧30 min) (%)	−0.123	0.266
Relative prolonged sedentary bouts (≧60 min) (%)	−0.042	0.706
Relative LPA (%)	0.249	0.022
Relative MVPA (%)	0.419	<0.001
Physical Activity (Non-hemodialysis days)		
Prolonged sedentary bouts (≧30 min) (min)	−0.436	<0.001
Prolonged sedentary bouts (≧60 min) (min)	−0.448	<0.001
Prolonged sedentary bouts (≧30 min) (bouts)	−0.331	0.002
Prolonged sedentary bouts (≧60 min) (bouts)	−0.374	0.001
Relative sedentary behavior (%)	−0.371	0.001
Relative prolonged sedentary bouts (≧30 min) (%)	−0.366	0.001
Relative prolonged sedentary bouts (≧60 min) (%)	−0.407	<0.001
Relative LPA (%)	0.358	0.001

LPA, light intensity physical activity, 1.6 METs ≦ LPA <3.0 METs; MVPA, moderate-vigorous intensity physical activity, over 3.0 METs; GNRI, geriatric nutritional risk index.

with low-intensity physical exercise resulted in a 14.0% reduction in the risk of death [12]. Interruption of prolonged sedentary behavior has also been associated with a reduction in abdominal circumference [13], postprandial blood sugar [14] and mortality rate [9]. However, there are no reports on the relation between prolonged sedentary bouts and HRQOL in CHD patients.

In this study, we found a significant relationship between prolonged sedentary bouts and HRQOL in patients on CHD, especially on non-hemodialysis days. On hemodialysis days, CHD patients must lie still continuously for at least 4 h (https://onlinelibrary.wiley.com/doi/pdf/10.1111/1744-9987.12294; accessed June 13, 2021). Therefore, the effect of prolonged sedentary bouts on HRQOL on hemodialysis days was lower than on non-hemodialysis days. In addition, in patients on CHD, increasing physical activity, especially MVPA, is expected to be difficult. However, reducing prolonged sedentary bouts [≧30 min (% and bout), ≧60 min (% and bout)] on non-hemodialysis days might be easier for CHD patients in clinical practice. Therefore, a new strategy of reducing prolonged sedentary bouts, *e.g.*, encouraging standing every 30 min, could be useful for patients.

This study had some limitations. First, because it

Table 4 Relation between EQ-5D scores and clinical parameters by multiple regression analysis

	Total days			Hemodialysis days			Non-Hemodialysis days		
	β	p	VIF	β	p	VIF	β	p	VIF
Dependent variable: EQ-5D scores									
Independent variables									
Relative prolonged sedentary bouts (≧30 min) (%)	−0.281	**0.016**	1.246	−0.129	0.256	1.154	−0.373	**0.002**	1.313
Sex (men/women)	0.129	0.222	1.056	0.095	0.376	1.033	0.160	0.124	1.079
Duration of hemodialysis (months)	−0.223	**0.034**	1.026	−0.227	**0.039**	1.057	−0.193	0.058	1.021
Age (years)	−0.088	0.428	1.172	−0.144	0.199	1.127	−0.060	0.581	1.174
History of diabetes mellitus	0.035	0.739	1.077	0.076	0.481	1.044	−0.002	0.985	1.110
Albumin (g/mL)	0.193	0.067	1.041	0.196	0.071	1.042	0.184	0.073	1.041
	Adjusted $R^2=0.138$, $p=0.007$			Adjusted $R^2=0.086$, $p=0.043$			Adjusted $R^2=0.184$, $p=0.001$		
Dependent variable: EQ-5D scores									
Independent variables									
Relative prolonged sedentary bouts (≧60 min) (%)	−0.233	**0.042**	1.204	−0.025	0.823	1.129	−0.381	**0.001**	1.279
Sex (men/women)	0.102	0.333	1.033	0.086	0.425	1.028	0.135	0.186	1.048
Duration of hemodialysis (months)	−0.212	**0.045**	1.021	−0.209	0.059	1.058	−0.169	0.096	1.031
Age (years)	−0.107	0.336	1.155	−0.174	0.123	1.114	−0.068	0.519	1.147
History of diabetes mellitus	0.040	0.712	1.084	0.084	0.439	1.044	−0.013	0.899	1.124
Albumin (g/mL)	0.180	0.091	1.043	0.191	0.080	1.041	0.160	0.119	1.049
	Adjusted $R^2=0.119$, $p=0.014$			Adjusted $R^2=0.071$, $p=0.068$			Adjusted $R^2=0.192$, $p=0.001$		
Dependent variable: EQ-5D scores									
Independent variables									
Prolonged sedentary bouts (≧30 min) (bouts)	−0.396	**<0.001**	0.210	−0.399	**<0.001**	1.105	−0.334	**0.004**	1.253
Sex (men/women)	0.172	0.094	1.085	0.161	0.111	1.066	0.159	0.132	1.087
Duration of hemodialysis (months)	−0.197	**0.049**	1.020	−0.195	0.050	1.021	−0.200	0.052	1.020
Age (years)	−0.064	0.538	1.140	−0.097	0.337	1.084	−0.073	0.499	1.165
History of diabetes mellitus	0.036	0.720	1.056	0.060	0.544	1.041	0.035	0.733	1.066
Albumin (g/mL)	0.194	0.055	1.041	0.194	0.053	1.041	0.193	0.063	1.041
	Adjusted $R^2=0.210$, $p<0.001$			Adjusted $R^2=0.226$, $p<0.001$			Adjusted $R^2=0.166$, $p=0.003$		
Dependent variable: EQ-5D scores									
Independent variables									
Prolonged sedentary bouts (≧60 min) (bouts)	−0.307	**0.007**	1.217	−0.212	0.052	1.078	−0.353	**0.003**	1.341
Sex (men/women)	0.130	0.213	1.052	0.101	0.341	1.032	0.150	0.151	1.071
Duration of hemodialysis (months)	−0.190	0.066	1.022	−0.217	**0.042**	1.024	−0.163	0.114	1.038
Age (years)	−0.088	0.417	1.146	−0.136	0.209	1.082	−0.063	0.563	1.184
History of diabetes mellitus	0.025	0.810	1.084	0.064	0.548	1.049	0.000	0.998	1.117
Albumin (g/mL)	0.182	0.081	1.042	0.192	0.073	1.041	0.174	0.092	1.044
	Adjusted $R^2=0.154$, $p=0.004$			Adjusted $R^2=0.115$, $p=0.016$			Adjusted $R^2=0.171$, $p=0.002$		

$p<0.05$ indicated in bold.

had a cross-sectional rather than a longitudinal design, it was not possible to assess trends over time. Second, enrolled patients were from one hospital and were thought to be more health conscious than average CHD patients. Therefore, the results obtained may not apply to all CHD patients in Japan. Third, the mechanism underlying the link between prolonged sedentary bouts and HRQOL was not clearly elucidated. Fourth, only prolonged sedentary bouts (≧30 min) (bouts) was a significant factor for HRQOL on hemodialysis days. Although prolonged sedentary bouts (≧30 min and ≧60 min) (min) and prolonged sedentary bouts (≧60 min) (bouts) on hemodialysis days were higher than those on non-hemodialysis days, prolonged sedentary bouts (≧30 min) (bouts) on hemodialysis days were lower than those on non-hemodialysis days. These results may have affected the relation between prolonged sedentary bouts (≧30 min) (bouts) and HRQOL on hemodialysis days. Nevertheless, reducing prolonged sedentary bouts would clearly be beneficial to HRQOL in patients on CHD. Further prospective and large sample studies are urgently needed to investigate this subject in the future.

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References

1. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, Chastin SFM, Altenburg TM and Chinapaw MJM: Sedentary behavior research network (SBRN)-Terminology consensus project process and outcome. Int J Behav Nutr Phys Act (2017) 14: 75.
2. Owen N, Sparling PB, Healy GN, Dunstan DW and Matthews CE: Sedentary Behavior: Emerging evidence for a new health risk. Mayo Clin Proc (2010) 85: 1138–1141.
3. Buman MP, Hekler EB, Haskell WL, Pruitt L, Conway TL, Cain KL, Sallis JF, Saelens BE, Frank LD and King AC: Objective light-intensity physical activity associations with rated health in older adults. Am J Epidemiol (2010) 172: 1155–1165.
4. Dogra S and Stathokostas L: Sedentary behavior and physical activity are independent predictors of successful aging middle-aged and older adults. J Aging Res (2012): 1–8.
5. Honda T, Narazaki K, Chen T, Nishibuchi H, Noufuji Y, Matsuo E and Kumagai S: Association between tri-axial accelerometer-derived sedentary time and obesity in a Japanese community-dwelling older population. Research in Exercise Epidemiology (2014) 16: 24–33 (in Japanese).
6. Harvey JA, Chastin SF and Skelton DA: How Sedentary are older people? A systematic review of the amount of sedentary behavior. J Aging Phys Act (2015) 23: 471–487.
7. Hishii S, Miyatake N, Nishi H, Katayama A, Ujike K, Koumoto K and Hashimoto H: Relationship between sedentary behavior and health-related quality of life in patients on chronic hemodialysis. Acta Med Okayama (2018) 72: 395–400.
8. Hishii S, Miyatake N, Nishi H, Katayama A, Ujike K, Koumoto K, Suzuki H and Hashimoto H: Relationship between sedentary behavior and all-cause mortality in Japanese chronic hemodialysis patients: A prospective cohort study. Acta Med Okayama (2019) 73: 419–425.
9. Diaz KM, Howard VJ, Hutto B, Colabianchi N, Vena JE, Safford MM, Blair SN and Hooker SP: Patterns of sedentary behavior and mortality in U.S. Middle-aged and older adults: A national cohort study. Ann Intern Med (2017) 167: 465–475.
10. Biswas A, Oh PI, Faulkner GE, Bajaj RR, Silver MA, Mitchell MS and Alter DA: Sedentary time and its association with risk disease incidence, mortality, and hospitalization in adults. Ann Intern Med (2015) 162: 123–132.
11. Honda T, Chen S, Yonemoto K, Kishimoto H, Chen T, Narazaki K, Haeuchi Y and Kumagai S: Sedentary bout durations and metabolic syndrome among working adults: A prospective cohort study. BMC Publ Health (2016) 16: 888.
12. Schmid D, Ricci C, Baumeister SE and Leitzmann MF: Replacing Sedentary Time with Physical Activity in Relation to Mortality. Med Sci Sports Exerc (2016) 48: 1312–1319.
13. Júdice PB, Silva AM, Santos DA, Baptista F and Sardinha LB: Associations of breaks in sedentary time with abdominal obesity in Portuguese older adults. Age (Dordr) (2015) 37: 23.
14. Peddie MC, Bone JL, Rehrer NJ, Skeaf CM, Gray AR and Perry TL: Breaking prolonged sitting reduces postprandial glycemia in healthy, normal-weight adults: A randomized crossover trial. Am J Clin Nutr (2013) 98: 358–366.
15. Healy GN, Dunstan DW, Salmon J, Cerin E, Shaw JE, Zimmet PZ and Owen N: Breaks in sedentary time: beneficial associations with metabolic risk. Diabetes Care (2008) 31: 661–666.
16. Ohkawara K, Oshima Y, Hikihara Y, Ishikawa-Takata K, Tabata I and Tanaka S: Real-time estimation of daily physical activity intensity by a triaxial accelerometer and a gravity-removal classification algorithm. Br J Nutr (2011) 105: 1681–1691.
17. Oshima Y, Kawaguchi K, Tanaka S, Ohkawara K, Hikihara Y, Ishikawa-Takata K and Tabata I: Classifying household and locomotive activities using a triaxial accelerometer. Gait Posture (2010) 31: 370–374.
18. Shiota K and Hashimoto T: Promotion and support of physical activity in elderly patients on hemodialysis: a case study. J Phys Ther Sci (2016) 28: 1378–1383.
19. Japanese EuroQol Translation Team: The development of the Japanese EuroQol Instrument. Journal of Health and Society (1998) 8: 109–123 (in Japanese).
20. Bouillanne O, Gilles M, Dupont C, Coulombel I, Vincent JP, Nicolis I, Benazeth S, Cynober L and Aussel C: Geriatric nutrition risk index: a new index fot evaluating at-risk elderly medical patients. Am J Clin Nutr (2005) 82: 777–783.
21. O'Hare AM, Tawney K, Bacchetti P and Johansen KL: Decreased survival among sedentary patients undergoing dialysis: Results from the dialysis morbidity and mortality study wave 2. Am J Kidney Dis (2003) 41: 447–454.
22. Anderton N, Giri A, Wei G, Marcus R, Chen X, Bjordahl T, Habib A, Herrera J and Beddlhu S: Sedentary behavior in individuals with diabetic chronic kidney disease and maintenance hemodialysis. J Ren Nutr (2015) 25: 364–370.