Table 1
Baseline characteristics by sleep duration in 13,629 participants aged 40–79 years.

	Sleep duration (h/day)					*p* Value[b]
	⩽5	6	7	8	⩾9	
No. of subjects	453	1831	4291	5265	1789	
Mean age (years) (SD[a])	57.5 (9.7)	56.3 (9.6)	56.2 (9.3)	58.4 (9.1)	61.9 (8.5)	<.0001
Women (%)	70.0	66.3	58.4	51.2	45.6	<.0001
Mean weight (kg) (SD)	56.9 (10.1)	57.6 (9.2)	58.7 (9.3)	58.8 (9.4)	58.5 (10.0)	<.0001
Mean BMI (kg/m^2) (SD)	23.6 (3.3)	23.6 (3.0)	23.7 (3.0)	23.7 (3.0)	23.7 (3.6)	NS
Mean weight change (kg) (SD)	0.7 (5.7)	0.8 (5.0)	1.0 (5.4)	1.1 (5.8)	1.8 (7.4)	<.0001
Education (%)						
Junior high school or less	48.9	42.8	46.2	56.7	69.7	<.0001
High school	40.7	43.9	42.4	35.7	25.9	
College/university or higher	10.5	13.3	11.4	7.6	4.4	
Job status (%)						
Employed	54.8	58.8	65.6	63.4	58.3	<.0001
No occupation or housewife	45.2	41.2	34.4	36.6	41.7	
Smoking status (%)						
Never smoker	63.7	62.9	60.6	53.1	49.0	<.0001
Past smoker	12.3	12.2	12.6	15.1	18.1	
Current smoker <20	10.8	11.4	9.3	12.8	15.3	
Current smoker ⩾20	13.1	13.5	17.5	19.0	17.7	
Alcohol drinking (%)						
Never drinker	48.7	48.4	48.6	50.6	54.1	<.0001
Past drinker	6.3	5.7	4.8	6.7	6.8	
Current drinker	45.0	45.9	46.7	42.8	39.2	
Time spent walking (%)						
⩾1 h/day	42.5	45.2	45.9	47.4	50.2	0.0054
<1 h/day	57.5	54.8	54.1	52.6	49.8	
Sports and physical exercise (%)						
⩾5 h/week	8.2	5.3	5.8	6.9	8.5	0.0083
3–4 h/week	6.1	6.5	6.2	6.2	7.0	
1–2 h/week	13.9	16.2	16.2	16.8	15.0	
<1 h/week	71.8	72.0	71.8	70.1	69.5	
Marital status (%)						
Married	77.1	83.4	86.7	86.6	84.2	<.0001
Unmarried	22.9	16.6	13.3	13.4	15.8	
Menopause status (%)						
Premenopausal	25.6	30.0	28.0	18.0	8.6	<.0001
Postmenopausal	74.4	70.0	72.0	82.0	91.3	
Coffee consumption (%)						
⩾5 cups/day	6.8	5.2	3.2	3.1	1.7	<.0001
3–4 cups/day	7.8	9.5	9.5	7.6	5.4	
1–2 cups/day	27.8	34.6	36.8	34.1	29.1	
<1 cup/day	57.6	50.7	50.6	55.3	63.8	
Self-rated health (%)						
Good	56.7	69.0	71.6	71.4	67.9	<.0001
Not good	43.3	31.0	28.5	28.6	32.1	
Mean energy consumption/day (kcal) (SD)	1405.2 (528.9)	1488.7 (550.8)	1554.3 (565.4)	1595.8 (598.4)	1572.4 (600.3)	<.0001

[a] BMI, body mass index; SD, standard deviation; NS, not significant.
[b] *p* Values were calculated by chi-squared test (categorical variables), or ANOVA (continuous variables).

short sleepers and 1.06 (0.88–1.27) in long sleepers (*p* for trend = 0.5539). Similarly, the multivariate OR1 for obesity was 0.96 (0.59–1.57) in short sleepers and 1.06 (0.82–1.37) in long sleepers (*p* for trend = 0.3267). After stratification by BMI, only obese long sleepers also had a significantly increased risk of ⩾5 kg weight gain (OR: 1.41, 95%CI: 1.04–1.92).

4. Discussion

The present results indicate that the association between sleep duration, ⩾5 kg weight gain and obesity showed no significant association over a long period in Japanese subjects recruited from the community. After stratification by BMI, obese long sleepers showed a significantly increased risk of ⩾5 kg weight gain (OR: 1.36, 95%CI: 1.09–1.70).

The mean age in the long sleep category was oldest and the proportion of women in the short sleep category was highest in the sleep duration categories, but the association between sleep duration, ⩾5 kg weight gain, and obesity also showed no significant associations after stratification by the age categories (<65 years or ⩾65 years) and sexes (data not shown).

There is a possibility that the long sleep category would have included participants who were bedridden due to physical limitation. Short sleep is associated with poor self-rated health [23]. Therefore, we conducted additional analysis after excluding participants who had functional limitation, poor self-rated health, or history of disease in order to eliminate any bias due to these effects. However, only obese long sleepers also showed a significantly increased risk of weight gain (OR: 1.41, 95%CI: 1.04–1.92).

These results were different from those of previous studies conducted in Japan [13–15]. However, the participants of those studies had been recruited from among individuals undergoing health checkups. Also, the previous studies had examined the short-term effect of sleep duration on obesity, whereas, the present study examined the long-term effect. On the other hand, the present results were also different from those of previous studies that had examined the long-term effects of sleep duration on weight gain

Please cite this article in press as: Nagai M et al. Association between sleep duration, weight gain, and obesity for long period. Sleep Med (2012), http://dx.doi.org/10.1016/j.sleep.2012.09.024

Table 2
The association between sleep duration, ⩾5 kg weight gain, and obesity.

	Sleep duration					
	⩽5	6	7	8	⩾9	*p* for trend[a]
⩾5 kg weight gain						
Total number	453	1,831	4,291	5,265	1,789	
Case	95	355	876	1113	468	
Crude	1.03(0.82–1.31)	0.94(0.82–1.08)	1.00 (reference)	1.05(0.95–1.15)	1.38(1.21–1.57)	<.0001
Age-sex adjusted ORs	0.98(0.77–1.25)	0.93(0.81–1.07)	1.00 (reference)	0.94(0.85–1.04)	1.07(0.93–1.22)	0.2032
Multivariate ORs1[b]	0.93(0.73–1.19)	0.95(0.82–1.09)	1.00 (reference)	0.94(0.84–1.04)	1.05(0.91–1.20)	0.3087
Multivariate ORs2[c]	0.93(0.73–1.20)	0.95(0.82–1.09)	1.00 (reference)	0.94(0.84–1.04)	1.05(0.91–1.20)	0.3093
Stratified analyses (BMI)						
<25 kg/m^2	0.99(0.72–1.35)	0.94(0.78–1.12)	1.00 (reference)	0.93(0.81–1.06)	0.91(0.76–1.08)	0.6236
⩾25 kg/m^2	0.86(0.58–1.29)	0.96(0.76–1.23)	1.00 (reference)	0.95(0.80–1.13)	1.36(1.09–1.70)	0.0145
Obesity[d]						
Total number	311	1,329	3,038	3,724	1,256	
Case	44	177	413	539	162	
Crude	1.05(0.75–1.47)	0.98(0.81–1.18)	1.00 (reference)	1.08(0.94–1.24)	0.94(0.78–1.14)	0.9454
Age-sex adjusted ORs	1.07(0.76–1.49)	0.98(0.81–1.18)	1.00 (reference)	1.12(0.98–1.29)	1.05(0.86–1.29)	0.3125
Multivariate ORs1	1.08(0.77–1.52)	0.99(0.82–1.20)	1.00 (reference)	1.12(0.97–1.29)	1.06(0.86–1.30)	0.3712
Multivariate ORs2	1.08(0.77–1.51)	0.99(0.81–1.19)	1.00 (reference)	1.12(0.97–1.29)	1.06(0.86–1.29)	0.3655

[a] *p* for trend values were calculated by sleep duration as a continuous variable.
[b] Multivariate ORs1 was adjusted for sex (men or women); age (continuous); body mass index (<18.5, 18.5–24.9, 25.0–29.9, or ⩾30.0 kg/m^2); education (junior high school or less, high school, or college/university or higher); smoking status (never smoker, past smoker, current smoker consuming 1–19 cigarettes per day, or current smoker consuming at least 20 cigarettes per day); alcohol drinking (never drinker, past drinker, or current drinker); time spent walking/day (less than 1 h, or 1 h or longer); job status (employed, or no occupation or housewife); marital status (married or unmarried); menopause (premenopausal or postmenopausal); coffee (never or occasionally, 1–2 cups/day, 3–4 cups/day, ⩾5 cups/day); self-rated health (good or not good).
[c] Multivariate ORs2 was further adjusted multivariate ORs1 for energy consumption/day (tertile category).
[d] Analyses of obesity excluded the 3971 participants who was obesity from the 13,629 participants.

Table 3
The association between sleep duration, 5 kg weight gain, and obesity in healthy participants aged 40–79 years.

	Sleep duration					
	⩽5	6	7	8	⩾9	*p* for trend[a]
5 kg weight gain						
Total number	228	1185	2830	3305	1031	
Case	41	222	522	652	251	
Multivariate ORs1[b]	0.88(0.61–1.26)	1.01(0.85–1.21)	1.00 (reference)	0.95(0.83–1.09)	1.06(0.88–1.27)	0.5539
Stratified analyses (BMI)						
<25 kg/m^2	1.00(0.64–1.56)	1.07(0.86–1.33)	1.00 (reference)	0.90(0.76–1.07)	0.91(0.73–1.15)	0.2253
⩾25 kg/m^2	0.71(0.38–1.33)	0.92(0.68–1.26)	1.00 (reference)	1.06(0.85–1.32)	1.41(1.04–1.92)	0.0073
Obesity[c]						
Total number	160	852	2,041	2362	747	
Case	20	123	282	341	101	
Multivariate ORs1	0.96(0.59–1.57)	1.09(0.87–1.38)	1.00 (reference)	1.08(0.90–1.28)	1.06(0.82–1.37)	0.3267

[a] *p* for trend values were calculated by sleep duration as a continuous variable.
[b] Multivariate ORs1 was adjusted for sex (men or women); age (continuous); body mass index (<18.5, 18.5–24.9, 25.0–29.9, or ⩾30.0 kg/m^2); education (junior high school or less, high school, or college/university or higher); smoking status (never smoker, past smoker, current smoker consuming 1–19 cigarettes per day, or current smoker consuming at least 20 cigarettes per day); alcohol drinking (never drinker, past drinker, or current drinker); time spent walking/day (less than 1 h, or 1 h or longer); sports and physical exercise time/week (less than 1 h, 1–2 h, 3–4 h, or 5 h or longer); job status (employed, or no occupation or housewife); marital status (married or unmarried); menopause (premenopausal or postmenopausal); coffee consumption (never or occasionally, 1–2 cups/day, 3–4 cups/day, ⩾5 cups/day).
[c] Analyses of obesity excluded the 2417 participants who was obesity from the 8579 participants.

and obesity [16,17]. This may have been due to differences in long-term BMI or weight change trends between Japanese and Americans; the former show a decreasing long-term trend for BMI [18], and the latter an increasing long-term trend for weight increases [16]. Over short periods, short sleep is also a risk factor for obesity in Japanese [13–15]. Thus, after short sleepers have increased weight, they might show a weight reduction in the long term. Therefore, the present study found no association between short sleep and the risk of weight gain and obesity. However, we were unable to demonstrate whether our study participants exhibited such weight changes during the observation period because we only had data for their weight at the baseline and the end of follow up.

The biological mechanism responsible for the association between short sleep, weight gain, and obesity has mainly been considered attributable to a decreased leptin level and an increased ghrelin level with shorter sleep duration [24–26]. Appetite increases as the level of the satiety-promoting hormone falls and that of the appetite-promoting hormone increases. Thus, short sleep induces an increase of daily energy consumption and, thereby, weight gain. However, although we did not obtain data on leptin and ghrelin levels, daily energy consumption was lowest in short sleepers. The proportion of women in the short sleep category was higher than that in the long sleep category, but the above trend was also observed after separation of the sexes (data not shown). Manini et al. and St-Onge et al. demonstrated no association between sleep duration and energy expenditure as measured using doubly labeled water [27,28]. Therefore, the lack of association between short sleep, weight gain, and obesity in the present study might have been attributable to the lack of a relationship between short sleep duration and

Please cite this article in press as: Nagai M et al. Association between sleep duration, weight gain, and obesity for long period. Sleep Med (2012), http://dx.doi.org/10.1016/j.sleep.2012.09.024

increased energy consumption. However, although the Nurses' Health Study also showed that daily energy consumption was lowest in short sleepers [16], lack of sleep duration was associated with a risk of ⩾15 kg weight gain. The association between changes in hormone levels, increasing daily energy consumption, weight gain, and obesity due to short sleep duration might be related to not only the above mechanism, but also other unknown mechanisms.

A major strength of the present study was that it was the first to have investigated the long-term association between sleep duration, weight gain, and obesity in an Asian general population showing different long-term trends of weight change from Western populations [16,18]. Asians have a lower prevalence of obesity and a shorter mean sleep duration than Westerners [1,5]. To exclude the effects of physical condition on sleep duration, weight gain, and obesity, we repeated our analyses after excluding participants who had functional limitation or history of disease.

On the other hand, several limitations should also be considered. First, we had no information about sleep quality, the timing of sleep, the use of sleep medication, the presence of sleeping disorders, rotating shift work, or night work that can influence sleep duration and thereby affect the risk of weight gain and obesity. Although we had no information about rotating shift work and night work, since 18.2% of our participants were housewives, 32.6% farmers, and 14.8% retired, such details would have been unlikely to have changed the results. Second, the assessment of weight was done only at the baseline and at the end of follow-up. We had no information about the trends of weight change during the follow-up period. Third, we used self-reported weight, height, and BMI. There is a systematic bias in self-reported weight and height. Because of this bias, there is possibility that we observed no association between short sleep duration, weight gain, and obesity. However, we demonstrated a high correlation and appropriate agreement between self-reported values and measured values (weight: $r = 0.96$, height: $r = 0.93$, BMI: $r = 0.88$).

In conclusion, the present study showed that only obese long sleepers have a significantly increased risk of ⩾5 kg weight gain in the long term among Japanese recruited from the community. Short sleep did not carry a risk of weight gain and obesity. Further research is needed to clarify the long-term association between sleep duration, weight gain, and obesity in Asian populations.

Conflict of Interest

This was not an industry supported study. The authors declare that they have no conflicts of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: **http://dx.doi.org/10.1016/j.sleep.2012.09.024.**

Acknowledgments

This study was supported by a Health Sciences Research Grant for Health Services (H22-Junkankitou (Seisyu)-Ippan-012, H23-Junkankitou (Seisyu)-Ippan-005, H23-Junkankitou (Seisyu)-Wakate-015), Ministry of Health, Labour and Welfare, Japan. Masato Nagai is a recipient of a Research Fellowships of the Japan Society for the Promotion of Science for Young Scientists.

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Please cite this article in press as: Nagai M et al. Association between sleep duration, weight gain, and obesity for long period. Sleep Med (2012), http://dx.doi.org/10.1016/j.sleep.2012.09.024

[学会発表]

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睡眠時間と総死亡・死因別死亡リスク：大崎国保コホート研究（口演）．
第48回宮城県公衆衛生学会学術総会，仙台，2012年．

1 睡眠時間と総死亡・死因別死亡リスク：大崎国保コホート研究

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【要旨】大崎保健所管内に在住する国保加入者49,256名を1995年から2008年まで追跡し、睡眠時間と総死亡・死因別死亡リスクとの関連を身体機能および主観的健康度別に検討した。その結果、長時間睡眠時間と総死亡および死因別死亡リスクの関連は身体機能や主観的健康度の差によって関連に違いは見られなかった。

【目的】睡眠時間と総死亡および死因別死亡リスクに関して、多くの先行研究が行われており、長時間睡眠と総死亡および死因別死亡リスクとの関連が報告されている。しかし、その関連が身体機能や主観的健康度別で異なるか検討されている先行研究はない。

【方法】大崎市保健所管内に居住する40歳から79歳の国民健康保険加入者54,996名のうち、追跡開始以前の異動者、睡眠時間未回答者、極端な睡眠時間の回答者（3時間以下または13時間以上）を除外した49,256名を解析した。自己回答の睡眠時間を6時間以下、7、8、9、10時間以上にわけ、コックス比例ハザードモデルにより、7時間群を基準とした他の群のハザード比(HR)および95%信頼区間(CIs)求めた。また、身体機能に制限がある者・ない者、主観的健康度の良い者・悪い者別に関連を検討した。

【結果】49,256名を平均10年間追跡した結果、8,447例の死亡（循環器疾患死亡2,549例、がん死亡2,764例、その他の死亡3,134例）が確認された。7時間睡眠と比較し、10時間以上の睡眠時間の群において、総死亡、循環器疾患死亡、虚血性心疾患死亡、脳卒中死亡、がん死亡、その他の死亡のHR（95% CI）はそれぞれ1.37（1.27-1.47）、1.49（1.30-1.71）、1.41（1.04-1.92）、1.51（1.24-1.85）、1.10（0.96-1.25）、1.53（1.36-1.73）となった。脳卒中死亡において身体機能制限者(P for interaction=0.04)および主観的健康度（P for interaction=0.046）が悪い者でHRが上昇したが、それ以外の死因別死亡リスクにおいて身体機能と主観的健康度の違いによる関連の差は見られなかった。

【考察】長時間睡眠と総死亡および死因別死亡リスクの関連は、脳卒中死亡リスクを除き、身体機能および主観的健康度の違いにより差はみられなかった。長時間睡眠と総死亡および循環器疾患死亡リスクとの関連は、身体機能および主観的健康度の差によるものではないことが考えられる。

2. 柿崎真沙子，菅原由美，丹治史也，渡邊生恵，深尾　彰，辻　一郎．
自覚的ストレスと自殺リスクに関する前向きコホート研究：宮城県コホート研究（口演）．
第 23 回日本疫学会学術総会，大阪，2013 年．

O-07

自覚的ストレスと自殺リスクに関する前向きコホート研究：宮城県コホート研究

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キーワード：自殺、前向きコホート研究、自覚的ストレス

【背景】自覚的ストレスは、ストレス脆弱性の 1 つの指標と考えられており、全死亡リスクや心疾患死亡リスクとの関連が報告されている。しかしながら自殺リスクとの関連を検討した研究は少ない。
【目的】日本人の一般地域住民を対象に、自覚的ストレスの強さとその後の自殺死亡リスクとの関連を検討する。
【方法】1990 年 6 月から 8 月に、宮城県内 14 町村に在住する 40 歳から 64 歳の住民全員 51,921 名に生活習慣に関する質問票を配布した。47,605 名（92%）から有効回答が得られ、追跡開始以前に異動した者、心疾患、がん、脳卒中の既往者、自覚的ストレスの質問に未回答の者を除外した 44,332 名（男性：21,210 人、女性：23,122 人）を解析対象とした。1990 年から 2008 年までの 18 年間の追跡により、145 例の自殺者を確認した。自覚的ストレスは、低い、中等度、高い、の 3 分類とし、自覚的ストレスが低い群を基準した際の他の群の自殺リスクのハザード比と 95 %信頼区間を Cox 比例ハザードモデルにて算出した。また多変量解析の補正項目は年齢、教育歴、疾患既往歴、婚姻状況、飲酒、喫煙、歩行時間、Body Mass Index、緑茶摂取頻度、睡眠時間、生きがい、Eysenck Personality Questionnaire-Revised (EPQ-R) における神経症傾向、非協調性傾向とした。
【結果】自覚的ストレスが低い群と比較し、中等度群での多変量補正相対危険度は 1.80（95 %信頼区間：0.93-3.48）、高い群では 2.24（同：1.10-4.56）となった。傾向性の P 値は 0.03 で、自覚的ストレスが高いほど自殺リスクは増加した。
　また、男女別、疾患既往歴の有無、職業の有無、神経症傾向および非協調性傾向の高低にわけ層別化解析を行ったが、全体での解析と同様に自覚的ストレスが高い群において自殺リスクが増加する傾向が示された。
　ベースライン時の年齢を 55 歳未満と以上に分けて層別化解析を行った結果、55 歳未満の者でのみ、自覚的ストレスの強さと自殺リスクとの関連が見られた。55 歳未満では自覚的ストレスが中等度の者で多変量補正相対危険度が 5.46（95 %信頼区間：1.33-22.43）、高い者で 6.55（同：1.54-27.84）となり、傾向性の P 値は 0.01 となった。55 歳以上では自覚的ストレスが中等度の者で多変量補正相対危険度が 0.84（95 %信頼区間：0.38-1.84）、高い者で 1.10（同：0.42-2.87）、傾向性の P 値は 0.78 であり、55 歳以上では自覚的ストレスの強さは自殺リスクと関連しなかった。

3. 渡邉　崇，遠又靖丈，本藏賢治，周　婉婷，菅原由美，柿崎真沙子，辻　一郎．健診受診が医療費に与える影響—propensity score matched cohort による解析—（口演）．
第 23 回日本疫学会学術総会，大阪，2013 年．

O-38

健診受診が医療費に与える影響－ propensity score matched cohort による解析－

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キーワード：健康診査、医療費、propensity score

【背景】健康診査（健診）の受診は死亡リスクを減じることが示唆されているが、個人レベルでの将来の医療費に与える影響は明らかではない。【目的】propensity score(PS) matched cohort を用い、老人保健法下で実施されていた基本健診の受診が将来の医療費に与える影響を推定する。【方法】大崎国保コホート参加者のうち、動脈硬化性疾患やがんの既往があった者、医療費データ欠損者などを除外した 31,413 人をもとに、1995 年の基本健診受診の有無を予測する PS を推定し、1：1 の PS matched cohort を編成した。PS の推定には性・年齢・飲酒喫煙・運動習慣・家族歴・社会心理的要因・1995 年の医療費などを用いた。主解析で検討する医療費は 1996 年から最大 12 年にわたる観察期間中の 1 年あたり医療費とし、年あたり医療費が集団の上位 10 %より高額にあたるリスク（高額医療費リスク）を健診受診の有無で比較した。積算医療費を観察期間で除することで中途死亡者の医療費が過大に評価される可能性を考慮し、副次解析では 12 年間生存して追跡を満了した 21,105 人を対象に matched cohort を再作成し、積算医療費における高額医療費リスクの解析を実施した。【結果】10,170 対のペアからなる matched cohort が編成され、バランスは良好であった。観察 1 年あたり医療費が高額となるリスクは健診受診群で有意に小さかった（受診者の高額医療費オッズ比 0.89; 95 %信頼区間 0.82 – 0.98）。ただし、主解析 cohort で高額医療消費群とされた者の過半数が中途死亡者であり、全期間生存例のみによる副次的解析では、両群の高額医療費リスクに有意な差は認められなかった（オッズ比 0.97; 95 %信頼区間　0.87-1.09）。【考察】死亡例・中途観察打ち切り例も対象とした観察 1 年あたり医療費の解析では、健診受診群で将来の高額医療費リスクが有意に低下した。しかし長期に生存した者に限った検討では有意差は認められず、主解析の結果は死亡リスクの減少を異なる形で捉えている可能性がある。医療費を検討する際には、観察 1 年あたりか積算か、また死亡例・追跡打ち切り例をどう取り扱うかにより結果が異なることが示された。【結論】健診受診者では、死亡リスク減少により将来の高額医療費リスクが低下する可能性が示唆された。

4. Chou WT, Tomata Y, Watanabe T, Sugawara Y, Kakizaki M, Tsuji I.
Relationships between changes in time spent walking since middle age and incident disability: the Ohsaki Cohort 2006 Study（口演）.
第 23 回日本疫学会学術総会，大阪，2013 年.

O-47

Relationships between changes in time spent walking since middle age and incident disability: the Ohsaki Cohort 2006 Study

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キーワード：walk、disability、cohort

Background: In comparison with the adults who remain sedentary, those who maintain or increase their physical activity have lower mortality. However, the association between physical activity across the lifespan and incident disability has not been documented.

Objective: To examine the relationships between changes in time spent walking since middle age and incident disability, using data of a population-based cohort study in Japan.

Methods: We conducted a prospective cohort study in 7,177 (men: 3,202, women: 3,975) Japanese individuals aged ≥65 years in 2006. Information on time spent walking was collected via two questionnaire surveys held in 1994 and 2006. Information on mobility limitation status and other lifestyle factors was collected in 2006 survey. Participants were categorized to 4 groups as: "remained sedentary" (<30 minutes in both 1994 and 2006 surveys), "became active" (<30 minutes in 1994 survey and ≥30 minutes in 2006 survey), "remained active" (≥30 minutes in both 1994 and 2006 surveys) and "became inactive" (≥30 minutes in 1994 survey and <30 minutes in 2006 survey). Primary outcome was define as incident disability, which was retrieved from the public Long-term Care Insurance database. We followed the subjects up for 5 years. Cox proportional hazards regression analysis was used to investigate the association between changes in time spent walking and the risk of incident disability.

Results: The 5-year incidence of functional disability was 9.9% (712 cases). Compared with those remained sedentary, the multiple-adjusted hazard ratios (95% confidenc intervals) were 0.69 (0.49-0.98) among those became active and 0.64 (0.50-0.82) among those remained active. The results did not alter after further adjusting for weight loss for more than 5 kg between 1994 and 2006 surveys, or focusing on those aged more than 75 years old.

Conclusion: Increase in time spent walking among the sedentary adults was significantl associated with a lower risk of incident disability.

厚生労働科学研究費補助金（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
「生活習慣病対策が医療費・介護保険給付費に及ぼす効果に関する研究」
（H23－循環器等（生習）－若手－015）

平成24年度総括・分担研究報告書（平成25年3月）

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