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Risk for physical inactivity due to inadequate health literacy among middle-aged Japanese adults: a cross-sectional study†

Original article

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Abstract: **Objective:** We assessed the risk for physical inactivity due to inadequate health literacy using multivariable analysis in a large middle-aged population.
Methods: This cross-sectional mail survey using a self-administered questionnaire was conducted in 2020 and included 33,902 community residents aged 40–64 years from 5 cities in Osaka Prefecture, Japan. Of these, 12,446 (36.7%) agreed to participate in the survey. After exclusion of those with regular visits to medical institutions and those with missing data, the analysis included 3742 participants. Health literacy was measured by the communicative and critical health literacy (CCHL) scale, and participants were classified into 3 groups (low, medium, and high health literacy groups) by the tertiles of the CCHL scale score. Physical inactivity was defined as not completing at least 150 min of moderate-intensity physical activity throughout the week.
Results: After adjustment for age, gender, education level, occupation, economic status, living alone, and stages of health behavior change, the multivariable-adjusted odds ratios (ORs) for physical inactivity were 1.36 (95% confidence interval [CI]: 1.16–1.59, $P < 0.001$) in the medium health literacy group and 1.70 (95% CI: 1.36–2.11, $P < 0.001$) in the low health literacy group compared with the high health literacy group.
Conclusions: This large-scale study provides compelling evidence that those with inadequate health literacy are at higher risk for physical inactivity among middle-aged adults.

Keywords: *health literacy • middle-aged adults • physical inactivity • Japan • risk*

1. Introduction

Physical activity is proven to help prevent and manage non-communicable diseases (NCDs) such as hypertension, type 2 diabetes, cardiovascular disease, and several cancers.[1] It also can improve mental health, quality of life, and well-being.[1] Even though physical inactivity increases the risk of NCDs and mortality,[2,3] current global estimates show that nearly one-third of adults worldwide, approximately 1.8 billion people, did

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not meet the recommended levels of physical activity in 2022.[4] The highest rates of physical inactivity were observed in the high-income Asia Pacific region and South Asia.[4] Furthermore, as countries develop economically, levels of physical inactivity increase and can be as high as 70% due to increased use of technology for work and recreation and increased sedentary behavior.[4] Addressing the problem of physical inactivity is crucial to promoting overall well-being and ensuring a healthier future for individuals and communities.[5]

In recent years, health disinformation is widespread, especially on the Internet and social networking services,[6–8], and increased attention is being paid to people's health literacy.[9] The World Health Organization defines health literacy as "the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways which promote and maintain good health."[10] Previous studies on health literacy and health promotion reported that people with inadequate health literacy may be unable to accurately understand and utilize health information, and that inadequate health literacy is a barrier to participation in cancer screening and health checkups.[11–15] However, few studies have assessed whether inadequate health literacy increases the risk for physical inactivity, and no large-scale studies have assessed this risk using multivariable analysis in middle-aged adults, an important target population for promoting physical activity. Therefore, we assessed the risk for physical inactivity due to inadequate health literacy using multivariable analysis in a large middle-aged population.

2. Methods

2.1. Study design and participants

A cross-sectional mail survey using a self-administered questionnaire was conducted in 2020. The questionnaire was mailed to each participant, who was requested to complete the questionnaire themselves and return it using a reply envelope. The time necessary to complete the questionnaire was approximately 10 min. The return period of the questionnaire was set at approximately 1 month. To improve the response rate, a reminder postcard was mailed 1 week after the self-administered questionnaire was mailed to participants. The full details of this study have been previously described.[15]

This convenience sample involved 33,902 community residents, aged 40–64 years, from 5 cities in Osaka Prefecture, Japan. Of these, 12,446 (36.7%) agreed to participate in the mail survey. To control for the effects of elements of medical history, such as hypertension, diabetes, dyslipidemia, cardiovascular disease, respiratory disease, and musculoskeletal disease, and of interventions from their primary care physicians, we excluded the 8174 who reported regular visits to medical institutions. We also excluded 530 with missing data. Finally, a total of 3742 aged 40–64 years were included in the analysis.

2.2. Measurements

2.2.1. Health literacy

Nutbeam[16] proposed a health literacy model comprising 3 levels: (1) functional health literacy—sufficient basic skills in reading and writing; (2) communicative health literacy—skill in applying new information; and (3) critical health literacy—skill in critically analyzing information with respect to life events and situations. In this study, health literacy was measured by the communicative and critical health literacy (CCHL) scale.[17] This scale measures health literacy beyond the functional level, focusing on the ability to access, understand, and utilize health information; the reliability and validity of this scale have been previously confirmed.[17] Participants were asked whether they could do the following: (1) obtain health-related information from various sources; (2) extract the required information; (3) understand and communicate the information obtained; (4) assess the reliability of the information; and (5) make decisions based on the information, specifically in the context of health-related issues. We rated each item on a 5-point Likert scale: 1 (strongly disagree), 2 (disagree a little), 3 (neither disagree nor agree), 4 (agree a little), and 5 (strongly agree). The scores of the 5 items were summed and divided by the number of items in the scale to yield a scale score (theoretical range, 1–5). The Cronbach alpha of the scale in this study was 0.88.

2.2.2. Sociodemographic factors and stages of health behavior change

Sociodemographic factors such as age, gender, education level, occupation, economic status, and living alone, and stages of health behavior change have been reported to be associated with physical inactivity.[18–21] Therefore, the following information was obtained as potential confounding factors: age, gender (male or female), education level (9–12 years or >12 years), occupation (presence or absence), economic status (very good, good, average, poor, or very poor), living alone (yes or no), and stages of health behavior change.[22]

2.2.3. Physical inactivity

Physical inactivity was defined as not completing at least 150 min of moderate-intensity physical activity throughout the week.[1,23]

2.3. Statistical analyses

In the study, participants were classified into 3 groups (low, medium, and high health literacy groups) by the tertiles of the CCHL scale score: low health literacy group with 1.0–3.0 points, medium health literacy group with 3.1–3.9 points, and high health literacy group with 4.0–5.0 points.[15] Additionally, age was categorized into 3 groups: 40–49 years, 50–59 years, and 60–64 years. Economic status was categorized into 3 groups: very good and good, average, and poor and very poor. Stages of health behavior change were categorized into the non-precontemplation stage and the precontemplation stage.

Dichotomous and categorical data were calculated as numbers (%). Continuous data with a normal distribution were calculated as mean ± standard deviation (SD). In addition, differences in physical inactivity according to health literacy groups and other factors were determined using independent samples chi-squared tests.

To assess the risk for physical inactivity due to inadequate health literacy using multivariable analysis, logistic regression model was used. The multivariable-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for physical inactivity according to health literacy groups were estimated by a logistic regression model. Age, gender, education level, occupation, economic status, living alone, and stages of health behavior change were included in the same model. Moreover, we performed age-stratified analysis.

All data were analyzed using SPSS statistical software version 26 (IBM SPSS Japan, Tokyo, Japan). All reported *P*-values were 2-tailed, and values <0.05 were considered statistically significant (alpha level = 0.05).

2.4. Ethical considerations

The study protocol was written in accordance with the Declaration of Helsinki and was approved by the Institutional Review Boards of Osaka Prefecture University (date of approval 5 October 2020; approval no. 2020–28). Informed consent was obtained from all participants who were included in this study.

3. Results

3.1. Demographic information

Table 1 shows the descriptive statistics of health literacy, sociodemographic factors, stages of health behavior change, and physical inactivity among 3742 middle-aged Japanese adults. The mean ± SD of age was 53.2 ± 6.7 years, and the male-to-female ratio was approximately 1:1. The mean ± SD of the CCHL scale was 3.5 ± 0.8 points, and 70% of the participants were physically inactive.

Variables	*n* (%) or Mean ± SD
*Health literacy**	
High health literacy group	1281 (34.2)
Medium health literacy group	1473 (39.4)
Low health literacy group	988 (26.4)
Mean CCHL scale score (points)	3.5 ± 0.8
Age (years)	
60–64	859 (23.0)
50–59	1657 (44.3)
40–49	1226 (32.8)
Mean age (years)	53.2 ± 6.7
Gender	
Male	1718 (45.9)
Female	2024 (54.1)
Education level	
>12 years	1747 (46.7)
9–12 years	1995 (53.3)
Occupation	
Presence	3202 (85.6)
Absence	540 (14.4)
Economic status	
Very good and good	680 (18.2)
Average	829 (22.2)
Poor and very poor	2233 (59.7)
Living alone	
No	3244 (86.7)
Yes	498 (13.3)
Stages of health behavior change	
Non-precontemplation stage	2496 (66.7)
Precontemplation stage	1246 (33.3)
Physical inactivity	2621 (70.0)

Note: CCHL, communicative and critical health literacy; SD, standard deviation.
*Participants were classified into 3 groups (low, medium, and high health literacy groups) by the tertiles of the CCHL scale score: low health literacy group with 1.0–3.0 points, medium health literacy group with 3.1–3.9 points, and high health literacy group with 4.0–5.0 points.

Table 1. Descriptive statistics of health literacy, sociodemographic factors, stages of health behavior change, and physical inactivity among 3742 middle-aged Japanese adults.

3.2. Proportion of physical inactivity according to health literacy, sociodemographic factors, and stages of health behavior change

Table 2 shows the differences in physical inactivity according to health literacy, sociodemographic factors, and stages of health behavior change among 3742 middle-aged Japanese adults. The proportions of physical inactivity were 64.5% in the high health literacy group, 71.9% in the medium health literacy group, and 74.5% in the low health literacy group ($P < 0.001$). Additionally,

Variables	Percentage (%) of physical inactivity	*P*
Health literacy		<0.001
High health literacy group	64.5	
Medium health literacy group	71.9	
Low health literacy group	74.5	
Age (years)		<0.001
60–64	64.1	
50–59	70.6	
40–49	73.4	
Gender		<0.001
Male	66.2	
Female	73.3	
Education level		0.794
>12 years	69.8	
9–12 years	70.2	
Occupation		0.021
Presence	69.3	
Absence	74.3	
Economic status		<0.001
Very good and good	62.5	
Average	68.4	
Poor and very poor	73.0	
Living alone		0.474
No	70.3	
Yes	68.7	
Stages of health behavior change		0.315
Non-precontemplation stage	69.5	
Precontemplation stage	71.1	

Note: Dichotomous and categorical data were analyzed with chi-squared tests and shown.

Table 2. Differences in physical inactivity according to health literacy, sociodemographic factors, and stages of health behavior change among 3742 middle-aged Japanese adults.

Variables	Multivariable-adjusted OR (95% CI) for physical inactivity	*P*
Health literacy		
High health literacy group	1.0 (reference)	
Medium health literacy group	1.36 (1.16–1.59)	<0.001
Low health literacy group	1.70 (1.36–2.11)	<0.001
Covariates in the same model		
Age (years)		
60–64	1.0 (reference)	
50–59	1.39 (1.16–1.67)	<0.001
40–49	1.63 (1.34–1.98)	<0.001
Gender		
Male	1.0 (reference)	
Female	1.55 (1.34–1.80)	<0.001
Education level		
>12 years	1.0 (reference)	
9–12 years	0.95 (0.82–1.10)	0.472
Occupation		
Presence	1.0 (reference)	
Absence	1.30 (1.05–1.61)	0.016
Economic status		
Very good and good	1.0 (reference)	
Average	1.22 (0.98–1.52)	0.077
Poor and very poor	1.52 (1.26–1.84)	<0.001
Living alone		
No	1.0 (reference)	
Yes	0.95 (0.77–1.17)	0.616
Stages of health behavior change		
Non-precontemplation stage	1.0 (reference)	
Precontemplation stage	1.05 (0.90–1.22)	0.548

Note: A logistic regression model was used to estimate the multivariable-adjusted ORs and 95% CIs for physical inactivity according to health literacy. Health literacy, age, gender, education level, occupation, economic status, living alone, and stages of health behavior change were included in the same model; CIs, confidence intervals; ORs, odds ratios.

Table 3. Risk for physical inactivity due to inadequate health literacy among 3742 middle-aged Japanese adults.

the proportions of physical inactivity differed significantly by age (60–64 years: 64.1%, 50–59 years: 70.6%, 40–49 years: 73.4%, $P < 0.001$), gender (male: 66.2%, female: 73.3%, $P < 0.001$), occupation (presence: 69.3%, absence: 74.3%, $P = 0.021$), and economic status (very good and good: 62.5%, average: 68.4%, poor and very poor: 73.0%, $P < 0.001$).

3.3. Risk for physical inactivity due to inadequate health literacy

Table 3 shows the risk for physical inactivity due to inadequate health literacy among 3742 middle-aged Japanese adults. After adjustment for age, gender, education level, occupation, economic status, living alone, and stages of health behavior change, the multivariable-adjusted ORs for physical inactivity were 1.36 (95% CI: 1.16–1.59, $P < 0.001$) in the medium health literacy group and 1.70 (95% CI: 1.36–2.11, $P < 0.001$) in the low health literacy group compared with the high health literacy group. Regarding the covariates in the same model, age, gender, occupation, and economic status were significantly associated with physical inactivity.

Variables	*n* (%)	Percentage (%) of physical inactivity	Multivariable-adjusted OR (95% CI) for physical inactivity	*P*
60–64 years				
High health literacy group	289 (7.7)	58.1	1.0 (reference)	
Medium health literacy group	327 (8.7)	64.8	1.25 (0.90–1.75)	0.188
Low health literacy group	243 (6.5)	70.4	1.57 (1.08–2.28)	0.019
50–59 years				
High health literacy group	565 (15.1)	64.4	1.0 (reference)	
Medium health literacy group	669 (17.9)	73.2	1.46 (1.14–1.87)	0.003
Low health literacy group	423 (11.3)	74.7	1.57 (1.18–2.10)	0.002
40–49 years				
High health literacy group	427 (11.4)	68.9	1.0 (reference)	
Medium health literacy group	477 (12.7)	74.8	1.35 (1.01–1.81)	0.041
Low health literacy group	322 (8.6)	77.3	1.55 (1.10–2.19)	0.012

Note: Logistic regression models were used to estimate the multivariable-adjusted ORs and 95% CIs for physical inactivity according to health literacy. Health literacy, gender, education level, occupation, economic status, living alone, and stages of health behavior change were included in the same model; CIs, confidence intervals; ORs, odds ratios.

Table 4. Risk for physical inactivity due to inadequate health literacy among 3742 middle-aged Japanese adults: age-stratified analysis.

3.4. Risk for physical inactivity due to inadequate health literacy: Age-stratified analysis

The results of the age-stratified analysis are shown in Table 4. In 60–64 years, after adjustment for gender, education level, occupation, economic status, living alone, and stages of health behavior change, the multivariable-adjusted ORs for physical inactivity were 1.25 (95% CI: 0.90–1.75, $P = 0.188$) in the medium health literacy group and 1.57 (95% CI: 1.08–2.28, $P = 0.019$) in the low health literacy group compared with the high health literacy group. In 50–59 years, the multivariable-adjusted ORs for physical inactivity were 1.46 (95% CI: 1.14–1.87, $P = 0.003$) in the medium health literacy group and 1.57 (95% CI: 1.18–2.10, $P = 0.002$) in the low health literacy group compared with the high health literacy group. In 40–49 years, the multivariable-adjusted ORs for physical inactivity were 1.35 (95% CI: 1.01–1.81, $P = 0.041$) in the medium health literacy group and 1.55 (95% CI: 1.10–2.19, $P = 0.012$) in the low health literacy group compared with the high health literacy group.

4. Discussion

This large-scale study provides compelling evidence that those with inadequate health literacy are at higher risk for physical inactivity among middle-aged adults. Our main findings were that the proportions of physical inactivity differed by 10% between the low health literacy group (74.5%) and the high health literacy group (64.5%), and that the multivariable-adjusted ORs for physical inactivity were 1.36 (95% CI: 1.16–1.59) in the medium health literacy group and 1.70 (95% CI: 1.36–2.11) in the low health literacy group when compared with the high health literacy group after adjustment for confounding factors. Furthermore, these results were similar for each age group (40–49 years, 50–59 years, and 60–64 years).

Physical activity promotes both mental and physical health in people of all ages.[24] Nevertheless, today, nearly one-third of adults worldwide do not meet the recommended levels of physical activity.[4] In addition, as countries develop economically, levels of physical inactivity increase,[4] and Japan has a very high proportion of those without physical activity.[25] This affects not only individuals' health over their life course, but also places a financial burden on health services and society as a whole.[24] Understanding the factors contributing to physical inactivity is important in determining appropriate interventions to address physical inactivity. Although health literacy, age, gender, occupation, and economic status were significantly associated with physical inactivity in this study, low health literacy had the highest OR for physical inactivity, indicating that health literacy is potentially the key to developing effective interventions to address physical inactivity.

Health literacy is understood as the ability to access, understand, appraise, and utilize health information to make health decisions throughout their life,[26] and people with inadequate health literacy may be unable to adequately access, understand, appraise, and utilize information about physical activity. In the U.S., the National Action Plan to Improve Health Literacy has2 main principles: (1) that everyone has the right to health

information that helps them make informed decisions, and (2) that health services should be delivered in ways that are understandable and beneficial to health, longevity, and quality of life.[27] Additionally, the U.S. Department of Health and Human Services has developed and published guidelines called "A Guide for Creating Easy-to-Understand Materials" and "Health Literacy Online: A Guide for Simplifying the User Experience" for the development of materials aimed at inadequate health literacy populations.[28,29] Moreover, videos convey information better than text,[30] and a randomized controlled study reported that existing quality-controlled YouTube videos improved health literacy.[31] Therefore, we believe that accurate information about physical activity must be delivered in ways that are easy for those with inadequate health literacy to access, understand, and utilize. In addition, it would be necessary to develop content-distribution platforms that enable people with inadequate health literacy to continuously access accurate and easy-to-understand information about physical activity.

4.1. Strengths and limitations

An important strength of this study is that we examined a large sample of middle-aged adults. On the contrary, this study had some limitations. First, a cross-sectional design cannot prove causality; therefore, a prospective study is necessary to confirm our findings. Second, because the response rate was 36.7%, we cannot exclude the possibility of selection bias in which people with relatively high health literacy were selected. Finally, in our study, data for physical activity were assessed by self-report; therefore, physical activity may not have been accurately reported.

5. Conclusions

In conclusion, this large-scale study provides compelling evidence that those with inadequate health literacy are at higher risk for physical inactivity among middle-aged adults. The present findings support the conclusion that health literacy is an important factor of physical inactivity among middle-aged adults, indicating that health literacy is potentially the key to developing effective interventions to address physical inactivity. In the future, there are 2 suggestions for further research. First, longitudinal studies are needed to clarify the causal relationship between inadequate health literacy and physical inactivity among middle-aged adults. Second, it is necessary to develop health literacy-focused interventions to verify the effect on promoting physical activity.

Authors contributions

NS participated in the study design and data collection, analyzed the data, interpreted the data, and wrote the manuscript. AM participated in the study design and data collection, analyzed the data, interpreted the data, and edited the manuscript.

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Ethical approval

The study protocol was written in accordance with the Declaration of Helsinki and was approved by the Institutional Review Boards of Osaka Prefecture University (date of approval 5 October 2020; approval no. 2020–28).

Conflicts of interest

All contributing authors declare no conflicts of interest.

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