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The effect of modifiable healthy practices on higher-level functional capacity decline among Japanese community dwellers

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ABSTRACT

This study aimed to clarify the effects of the accumulation of 8 modifiable practices related to health, including smoking, alcohol drinking, physical activity, sleeping hours, body mass index, dietary diversity, *ikigai* (life worth living), and health checkup status, on higher-level functional capacity decline among Japanese community dwellers. Data were derived from the National Institute for Longevity Sciences - Longitudinal Study of Aging. Subjects comprised 1269 men and women aged 40 to 79 years at baseline (1997–2000) who participated in a follow-up postal survey (2013). Higher-level functional capacity was measured using the Tokyo Metropolitan Institute of Gerontology Index of Competence (total score and 3 subscales: instrumental self-maintenance, intellectual activity, and social role). The odds ratio (OR) and 95% confidence interval (CI) for a decline in higher-level functional capacity in the follow-up study according to the total number of healthy practices were analyzed using the lowest category as a reference. Multivariate adjusted ORs (95% CIs) for the total score of higher-level functional capacity, which declined according to the total number of healthy practices (0–4, 5–6, 7–8 groups) were 1.00 (reference), 0.63 (0.44–0.92), and 0.54 (0.31–0.94). For the score of social role decline, multivariate adjusted ORs (95% CIs) were 1.00 (reference), 0.62 (0.40–0.97), and 0.46 (0.23–0.90), respectively (P for trend = 0.04). Having more modifiable healthy practices, especially in social roles, may protect against a decline in higher-level functional capacity among middle-aged and elderly community dwellers in Japan.

1. Introduction

In today's aging society, we face the serious concern of extending the healthy lifespan of the elderly. Higher level competencies, such as social role and instrumental self-maintenance, usually deteriorate before declines in basic activities of daily living (Koyano et al., 1991). To extend the healthy life expectancy, it is important to prevent a loss of higher-level competencies in later life.

Numerous factors affect disability (May et al., 2015), and a systematic analysis selected 67 risk factors of disease burden in 21 regions in the world (Lim et al., 2012). Some lifestyle-related factors, including smoking, alcohol drinking, low physical activity, and low fruit intake, were selected as major risk factors for disability in the more wealthy Asia Pacific region (Lim et al., 2012). Among these factors, higher physical activity or physical ability, such as handgrip strength or walking speed, were associated with higher levels of competence (Nakamoto et al., 2015; Sugiura et al., 2013). Although a few investigations have reported the negative effects of smoking, longer sleep duration, poor self-rated health, lower animal protein intake, personality traits, and lower social participation on higher levels of competence (Imai et al., 2014; Tomioka et al., 2015; Tsubota-Utsugi et al., 2014), the impact of other lifestyle-related factors on loss of higher levels of competence is not well understood. In addition, it is not clear whether an accumulation of healthy lifestyle-related factors within individuals, as measured by the total number of healthy practices, is associated with higher levels of competence.

In this study, we analyzed the effect of an accumulation of 8 selected practices, including smoking, alcohol drinking, physical activity, sleeping hours, body mass index (BMI), dietary diversity, *ikigai* (life

Abbreviations: BMI, body mass index; CI, confidence interval; NILS-LSA, National Institute for Longevity Sciences - Longitudinal Study of Aging; OR, odds ratio; QUANTIDD, Quantitative Index for Dietary Diversity; TMIG-IC, Tokyo Metropolitan Institute of Gerontology Index of Competence.

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worth living (Sone et al., 2008)), and health checkup status on higher-level functional capacity decline among Japanese community dwellers. We selected these 8 practices because they are modifiable health-related factors.

2. Methods

2.1. Study subjects

Data for this survey were collected as part of the National Institute for Longevity Sciences - Longitudinal Study of Aging (NILS-LSA). Participants in the NILS-LSA included randomly selected age- and sex-stratified individuals from the pool of non-institutionalized residents in the NILS neighborhood areas of Obu City and Higashiura Town in Aichi Prefecture, located in central Japan. The first wave (baseline study) of the NILS-LSA (1997–2000) comprised 2267 participants (1139 men, 1128 women; aged 40–79 years). Details of the NILS-LSA study have been reported elsewhere (Shimokata et al., 2000).

In August 2013, a self-administered questionnaire was sent by mail to assess health status. After excluding participants who died (identified through the Basic Resident Registry or information from families), questionnaires were sent to 1933 individuals out of the 2267 baseline participants. A total of 1462 respondents (76% collection rate) replied, including 171 participants in their 50s, 495 in their 60s, 444 in their 70s, and 352 in their 80s or 90s in 2013. Apart from the 1462 respondents, the breakdown of the 471 individuals who did not respond was as follows: death (24 deaths reported on returned questionnaire), withdrawal (1), address unknown (33) and no reply (413).

Of the 1462 respondents, we excluded subjects with lack of data in any of the following variables: higher-level functional capacity at baseline and/or follow-up survey ($n = 44$); lifestyle-related factors ($n = 68$); and potential cofounders at baseline ($n = 81$), including household annual income, education, and history of stroke, hyperlipidemia, diabetes, hypertension, heart disease, cancer, osteoporosis, rheumatoid arthritis, and dementia. Thus, 1269 subjects (624 men, 645 women) were available for analysis.

The study protocol was reviewed and approved by the Committees of Ethics of Human Research of the National Center for Geriatrics and Gerontology (No. 640-2). Written informed consent was obtained from all subjects during the baseline study. In the mailed survey in 2013, we explained that returning the self-administered questionnaire represented informed consent.

2.2. Higher-level functional capacity

Higher-level functional capacity was assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) at baseline and follow-up survey (Koyano et al., 1991). It is a multidimensional evaluation method consisting of 13 items with the following 3 subscales: instrumental self-maintenance (5 items), intellectual activity (4 items), and social role (4 items). Each response to each item is scored either 'yes' (able to do) for 1 point or 'no' (unable to do) for 0 points, with possible scores ranging from 0 to 13 points. A higher score reflects higher functional capability. According to a previous report (Fujiwara et al., 2003), we defined a decline in higher-level functional capacity as follows: 1) a decrease of ≥2 points in total score for higher-level functional capacity, 2) a decrease of ≥1 point in score for instrumental self-maintenance, 3) a decrease of ≥2 points in score for intellectual activity, or 4) a decrease of ≥2 points in score for social role.

2.3. Healthy practices

Information was gathered from physical examinations, dietary assessments, and self-administered questionnaires with reference to healthy practices, as proposed by Breslow and Breslow (1993), the Global Burden of Disease Study 2010, and studies focused on health checkups among Japanese (Seino et al., 2014; Suka et al., 2009). In addition, we added "*ikigai*" (life worth living (Sone et al., 2008)), that is, "one aspect of psychological well-being to judge one's life as meaningful and worth living" (Yamamoto-Mitani and Wallhagen, 2002) as a psychological factor. All health-related measurements were assessed in the baseline survey.

Ikigai (life worth living) was assessed in a self-reported questionnaire asking whether the subject has or does not have *ikigai* for at least one objective (work; connection with colleagues in work place; connection with family members; child/children or grandchildren; hobbies or sports; keeping company with friends while participating in hobbies; activities in a local area or a group activity; caring for another person; religion; or other). Health checkup status was assessed in a self-reported questionnaire asking whether the subject had a health checkup once a year or less than that (never/once in 2 or 3 years). Dietary diversity and alcohol intake were assessed using a 3-day (2 weekdays and 1 weekend day) dietary record (Imai et al., 2000) and determined using the Quantitative Index for Dietary Diversity (QUANTIDD) (Katanoda et al., 2006). The index ranges from 0 to 1. Lower scores indicate an unbalanced diet, and higher scores indicate an equal distribution of each food group.

BMI was calculated as weight in kilograms divided by the square of height in meters. Physical activity was assessed by the METs score (a multiple of the resting metabolic rate), obtained through participant interviews with trained interviewers using a semi-quantitative assessment method to assess participants' levels of habitual physical activity during leisure time and on the job, and their sleeping hours (Kozakai et al., 2012).

Follow-up time (year) was calculated by the length of time (days) that had elapsed since the day each subject participated in the baseline survey to 19 July 2013 (the deadline for the follow-up postal survey).

2.4. Statistical analysis

All statistical analyses were conducted using Statistical Analysis System software version 9.3 (SAS Institute, Cary, NC, USA). Each of the 8 lifestyle factors was categorized into 'unhealthy (0 points)' or 'healthy (1 point)' practices as follows: (1) smoking status: past/current or never; (2) alcohol drinking: ≥23 g ethanol per day or <23 g ethanol per day (Shimazu et al., 2012); (3) physical activity: below or above the median of METs * h per day, as follows: <32 or ≥32 METs * h per day; (4) sleeping hours: <6 or ≥8 h per day or ≥6 –<8 h per day; (5) BMI: <21.5 or ≥25 kg/m^2 or ≥21.5–<25 kg/m^2 according to dietary goals for the elderly of the Japanese dietary guidelines 2015 (Ministry of Health, Labor and Welfare, 2015); (6) dietary diversity: below or above the sex-stratified median of QUANTIDD, as follows: men: 0.50–0.88 ($n = 322$) or 0.88–0.95 ($n = 322$); women: 0.74–0.90 ($n = 333$) or 0.90–0.96 ($n = 333$); (7) *ikigai*: 'None or one' or 'Have at least 2 positive responses to specified items'; and (8) health checkup status: never checked/once in 2 or 3 years or once a year. The total number of healthy practices was obtained by adding the number of healthy practices. Subjects were classified into 3 groups by the total number of healthy practices, that is, 0 to 4, 5 to 6, and 7 to 8, as only a few subjects had a lower or higher total number of healthy practices.

Differences in proportions and continuous variables according to the total number of healthy practices were assessed using the chi-square test or Fisher's exact probability test (if statistical expectation was ≤5) and the general linear model, respectively.

Multiple logistic regression analysis was performed to estimate the odds ratio (OR) and 95% confidence interval (CI) for higher-level functional capacity decline (total score and 3 subscale scores) according to the total number of healthy practices. The lowest category was used as a reference. The adjustment variables (confounding variables) were age, sex, individual subscale scores at baseline, household annual income, education, and history of stroke, hyperlipidemia, diabetes,