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## Accurate weight gain perception may inhibit weight loss compared to inaccurate weight gain perception among Japanese adults

Shota Endo , Takeyasu Kakamu , Hideaki Kasuga, Yusuke Masuishi , Tomoo Hidaka  and Tetsuhito Fukushima

Department of Hygiene and Preventive Medicine, Fukushima Medical University School of Medicine, Fukushima, Japan

### ABSTRACT

The study investigates the association between weight gain perception and weight change over time among Japanese adults. Data were from specific health checkups held in 2013, 2014, and 2015 by National Health Insurance in Fukushima Prefecture, Japan. We included 3677 participants who gained more than 3.0kg between 2013 and 2014. Weight gain perception was asked in 2014 using a questionnaire. The participants who perceived their weight gain of more than 3kg were categorized in the accurate group and those who did not were in the inaccurate group. Multiple linear regression models were used to assess associations between weight gain perception in 2014 and weight change between 2014 and 2015. The models were adjusted for gender, age, weight in 2014, regular physical exercise, daily physical activity, and medication. Results showed that the accurate group ( $\beta=0.217$ ; 95% confidence interval=0.037, 0.397;  $P=0.018$ ) had significantly less weight loss than those in the inaccurate group. We concluded that accurate weight gain perception was associated with an increased risk of future weight gain among Japanese adults.

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### KEYWORDS

Weight perception; weight gain; Japanese

## Introduction

Inaccurate weight status perception refers to when a person's subjective perception of their own weight status, such as 'overweight', 'underweight', or 'about the right weight', differs from objective weight status (Robinson et al., 2017). This inaccurate perception has been reported to be associated with lack of interest in or attempts at weight loss and physical activity (Duncan et al., 2011; Gregory et al., 2008; Hwang et al., 2015). In addition, the diagnosis of overweight and obesity by health-care professionals might lead to correct weight status perceptions and healthy weight control practices (Yaemsiri et al., 2011). Some studies have pointed out an increasing proportion of inaccurate weight status perception, especially underestimation of weight status among people with obesity or overweight, as a threat to healthy weight control (Johnson et al., 2008; Johnson-Taylor et al., 2008; Salcedo et al., 2010).

**CONTACT** Shota Endo  [shota-e@fmu.ac.jp](mailto:shota-e@fmu.ac.jp)  Fukushima 960-1295, Japan

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However, recent cohort studies have shown that self-perception of being overweight predicted future weight gain among overweight adolescents (Sonnevile et al., 2016) and adults who were overweight or of normal weight (Robinson et al., 2015). The association between self-perception of being overweight and future weight gain is explained by overeating related to weight stigma internalization (Robinson et al., 2015; Romano et al., 2018). These findings have shown health policy-makers that informing people of their overweight status might have adverse effects (Robinson et al., 2017).

While these previous studies focused on weight status perception, there are a few studies on the perception of weight gain. For example, in cross-sectional studies, Rahman and Berenson (2012) examined the relationship between the perception of weight gain over a 6-month period and race/ethnicity, and Toga et al. (2018) examined the relationship between the perception of weight gain over a 1-year period and actual weight. However, the number of studies investigating the relationship between weight gain perception and weight change over time remains few. Importantly, body weight had gained dynamically and longitudinally (Drøyvold et al., 2006; Ho et al., 2015; Matsushita et al., 2008; Stenholm et al., 2015) and the gain was found to be a risk factor for high mortality (Cheng et al., 2015; Shimazu et al., 2009). Clarification of the relationship between weight gain perception and weight change over time may help health policy-makers and physicians decide whether to inform those who gained weight of their weight gain.

The purpose of the current study, therefore, is to reveal for the first time the association between weight gain perception and weight change over time among adults. We hypothesized that accurate weight gain perception is associated with more weight gain over time than inaccurate perception.

## **Materials and methods**

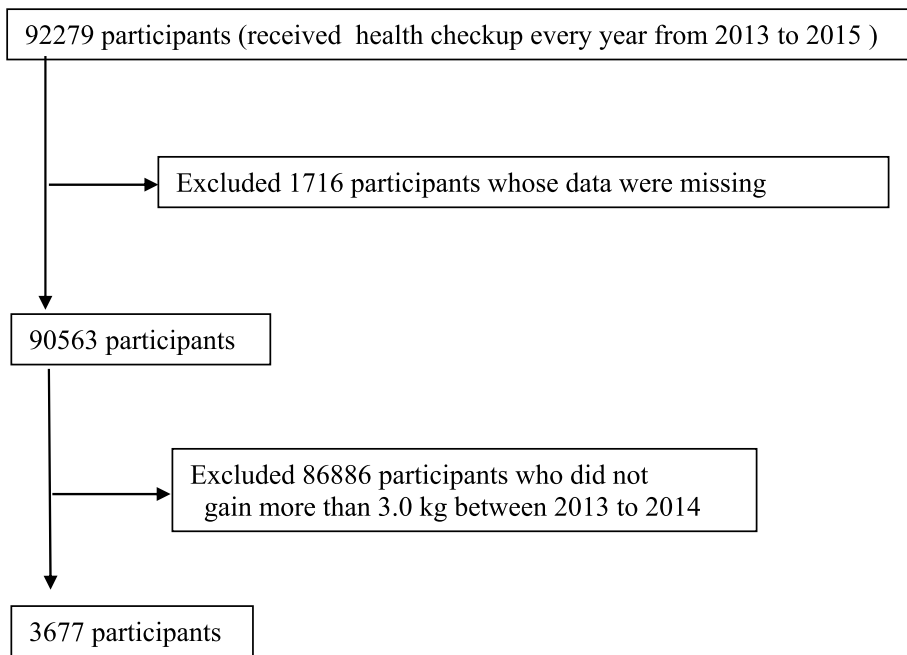
### ***Study design and participants***

In this retrospective cohort study, the subjects comprised 92 279 residents, aged 40 to 72 years in 2013, who had undergone annual health checkups from fiscal year (FY) 2013 (April 2013 to March 2014) to FY 2015 in Fukushima Prefecture, Japan, by the National Health Insurance Organization (NHIO). We used the health checkup data on age, gender, weight (kg), perception of a 3-kg weight change in 1 year, regular physical exercise, daily physical activity, and medications used for hypertension, diabetes, and dyslipidemia.

The flow chart of selecting study subjects are shown in [Figure 1](#). First, 1716 individuals with missing data were excluded. Second, to focus on weight gain, of the 90 563 remaining participants, 3677 who had gained more than 3.0 kg between FY 2013 and FY 2014 remained as study subjects.

### ***Measurements***

In the checkups, trained staff measured weight to the nearest 0.1 kg. A self-administered questionnaire (AMDA International Medical Information Center,



**Figure 1.** Flow chart of the exclusion of the study participants.

2008), which was recommended for specific health examination by the Japanese government (Ministry of Health, Labour and Welfare, 2013), included questions regarding perception of a 3-kg weight change in 1year, regular physical exercise, daily physical activity, and medications used for hypertension, diabetes, and dyslipidemia. Perception of a 3-kg weight change in 1year was assessed by asking ‘Did you gain or lose over 3kg during the past year?’, with two response options (yes and no). Regular physical exercise was assessed by asking ‘Have you been exercising regularly for over 30 min at a time, during which you sweat lightly, two or more times weekly, for over a year?’, with two response options (yes and no). Daily physical activity was assessed by asking ‘In your daily life do you walk or do equivalent PA for more than one hour a day?’, with two response options (yes and no).

### **Definition of weight gain perception**

Definition of weight gain perception followed the previous study (Toga et al., 2018). Weight change perception was assessed by asking whether they had more than 3-kg body weight change during the previous year, with two response options, Yes and No in FY 2014. In this study, we selected study subjects who had gained more than 3kg between FY 2013 and FY 2014. The study subjects who answered ‘No’ were categorized into the inaccurate group, as they did not recognize weight gain of more than 3kg. The participants who answered ‘Yes’ to the question were categorized into the accurate group.

## Statistical analyses

Data were analyzed using SPSS ver. 23. Median and interquartile range (IQR) were calculated for age and weight. Changes in weight between FY 2013 and FY 2014 and between FY 2014 and FY 2015 were calculated. We classified the subjects into the following age groups: 40–49, 50–59, 60–69, and  $\geq 70$  years. Descriptive statistics for gender, age groups, regular physical exercise, daily physical activity, and medication were calculated using frequencies and proportions.

To assess the relationships between weight gain perception and age, age group, weight, change in weight, regular physical exercise, daily physical activity, and medication, we conducted the Mann-Whitney U test for continuous variables and chi-square test for categorical variables. Multiple linear regression analysis was performed to assess the change in weight between FY 2014 and FY 2015 as the dependent variable, as well as the independent contributions of weight gain perception, age, gender, weight in FY 2014, regular physical exercise, daily physical activity, and medication. P-values below 0.05 were regarded as statistically significant.

## Ethics

This study was approved by the Ethics Committees of Fukushima Medical University (Application No. 2974).

## Results

The descriptive statistics for our subjects who gained more than 3kg between FY 2013 and FY 2014 are shown in Table 1. Of the 3677 subjects, 1998 (54.3%) were included in the inaccurate group. The median age was 64.0 years (IQR: 57.0–67.0) in the accurate group and 65.0 years (IQR: 60.0–69.0) in the inaccurate group. Between the accurate and

**Table 1.** Sample description in 2013 and 2014 by weight gain perception.

Median (25th–75th percentiles) or n (%)	Accurate group (N=1679)	Inaccurate group (N=1998)	P-value <sup>a</sup>
Gender			<0.001
Male	841 (50.1)	1128 (56.5)	
Female	838 (49.9)	870 (43.5)	
Age (years)	64.0 (57.0–67.0)	65.0 (60.0–69.0)	<0.001
Age group			<0.001
40–49	217 (12.9)	164 (8.2)	
50–59	328 (19.5)	303 (15.2)	
60–69	871 (51.9)	1055 (52.8)	
$\geq 70$	263 (15.7)	476 (23.8)	
Weight in 2013 (kg)	61.3 (54.0–70.5)	59.0 (52.2–66.7)	<0.001
Weight in 2014 (kg)	65.6 (58.3–75.2)	63.0 (56.1–70.625)	<0.001
Weight change (kg) <sup>b</sup>	3.9 (3.4–5.0)	3.5 (3.2–4.2)	<0.001
Regular physical exercise	556 (33.1)	710 (35.5)	0.124
Daily physical activity	576 (34.3)	806 (40.3)	<0.001
Medication			
Hypertension	693 (41.3)	849 (42.5)	0.456
Diabetes	182 (10.8)	188 (9.4)	0.151
Dyslipidemia	449 (26.7)	476 (23.8)	0.042

a: P-value of chi-square test for categorical variables and of Mann-Whitney U test for continuous variables

b: Weight change between 2013 and 2014

**Table 2.** Weight change between 2014 and 2015 by weight gain perception.

Median (25th–75th percentiles)	Accurate group (N=1679)	Inaccurate group (N=1998)	<i>P</i> -value <sup>a</sup>
Weight in 2015 (kg)	65.1 (57.3–74.2)	62.4 (55.2–70.0)	<0.001
Weight change (kg) <sup>b</sup>	–0.50 (–2.1–1.0)	–0.70 (–2.0–0.6)	0.032

a: *P*-value of Mann-Whitney U test

b: Weight change between 2014 and 2015

inaccurate groups, we found significant differences in gender, age, weight in FY 2013 and 2014, change in weight between FY 2013 and FY 2014, daily physical activity, and medication for dyslipidemia. The median weight in the inaccurate group was less than that in the accurate group in both FY 2013 and FY 2014. The accurate group had a significantly higher proportion of female than the inaccurate group.

Table 2 shows weight in FY 2015 and weight change between FY 2014 and FY 2015. The median weight change between 2014 and 2015 was –0.50kg (IQR: –2.1–1.0) in the accurate group and –0.70kg (IQR: –2.0–0.6) in the inaccurate group. When comparing the accurate and inaccurate groups, we found significant differences in weight in FY 2015 and change in weight between FY 2014 and FY 2015. Table 3 shows the results of multiple linear regression analyses. In fully adjusted models including weight in FY 2014, gender, age group, and medications, the accurate group exhibited a higher weight gain than the inaccurate group ( $\beta=0.217$ ; 95% confidence interval=0.037, 0.397;  $P=0.018$ ).

## Discussion

In this retrospective cohort study, we investigated the association between weight gain perception and change in weight over time in Japanese adults. To our knowledge, this is the first study to document such an association. Our hypothesis that

**Table 3.** Estimates of association of weight gain perception and weight change between 2014 and 2015 (N=3677).

	Weight-adjusted	Covariate-adjusted
Weight gain perception		
Inaccurate group	Ref.	Ref.
Accurate group	0.185 (0.008, 0.362) <sup>**</sup>	0.217 (0.037, 0.397) <sup>**</sup>
Gender		
Male		Ref.
Female		–0.307 (–511, –0.103) <sup>**</sup>
Age group		
40–49		Ref.
50–59		0.043 (–0.305, 0.390)
60–69		–0.039 (–0.355, 0.277)
≥70		–0.101 (–0.466, 0.263) <sup>**</sup>
Weight in 2014	–0.025 (–0.032, –0.018) <sup>**</sup>	–0.033 (–0.041, –0.024) <sup>**</sup>
Regular physical exercise <sup>a</sup>		–0.002 (–0.211, 0.207)
Daily physical activity <sup>b</sup>		–0.051 (–0.254, 0.153)
Medication		
Hypertension		0.139 (–0.054, 0.331)
Diabetes		0.092 (–0.207, 0.390)
Dyslipidemia		–0.045 (–0.259, 0.169)

Data are presented as regression coefficients (95% confidence intervals).

<sup>\*\*</sup>*P*-value < 0.05

accurate weight gain perception is a predictor of more weight gain over time than the inaccurate perception among adults was not supported. However, the subjects who accurately perceived a weight gain of more than 3kg in the previous 1 year, did not lost more than weight in the following year (on average, 0.217kg) compared with those who did not perceive the weight gain.

Our results regarding the association between accurate weight gain perception and weight change over time among adults are in line with the findings of a previous study of overweight US adolescents (Sonneville et al., 2016). In that study, adolescents with overweight or obesity who accurately perceived themselves to be obese or overweight gained more weight (Sonneville et al., 2016). However, the present and previous studies are different in some aspects. First, our focus was on the perception of weight gain, not the perception of weight status. Our results may help health policy-makers and physicians better understand the negative effects of self-perception of weight gain on weight change. Second, the median age of participants in our study was higher than those in the previous study (Sonneville et al., 2016). Therefore, our findings will be more applicable to ageing populations. Third, the follow-up period in our study was shorter than that in previous studies. Weight status perception might not be constant throughout a follow-up period of more than 10years, as an ideal weight changes with a change in the actual weight (Maynard et al., 2006; Naghshizadian et al., 2014). In a short follow-up period, such as that in the present study, participants may not change their weight perception.

In the current study, approximately half of the participants did not accurately perceive their weight gain of more than 3kg over the previous one year. This proportion is higher than that of a past study, where 40% of those who gained more than 3kg in 1 year did not among Japanese adults who had taken annual health checkups for 2 years. (Toga et al., 2018). The participants in our study were those who had undergone annual health checkups every year for 3 years. Thus, the present study might have shown a higher prevalence rate of inaccurate weight gain perception compared to the previous study.

We observed weight reduction between 2014 and 2015 in both the accurate and inaccurate groups in the current study. This might be due to the regression toward the mean phenomenon, which refers to the tendency for subjects with extreme scores on a variable at first measurement to have less extreme scores on the same variable at a later measurement (Bland & Altman, 1994; Davis, 1976). In our study, as the participants were those who had gained more than 3.0kg between 2013 and 2014, an overall tendency for weight loss was observed between 2014 and 2015.

One recent study of US adults showed that there was a cross-sectional relationship between perceiving their weight status as 'overweight' and a tendency to overeat (Romano et al., 2018). In addition, overeating mediated the prospective association between perceiving oneself as being overweight and weight gain over time (Robinson et al., 2015). The same might be said about the association between weight gain perception and weight change over time.

Our results showed that female have a higher proportion of accurate group than male, similar to the previous study (Toga et al., 2018). This might be a result from gender difference in ideal body size. Females prefer smaller body sizes than males (Townsend et al., 2014), and tend to overestimate their body weight (Wardle et al., 2006). Future studies should be designed to examine the associations between weight gain perception and ideal body size.

The present study has some limitations. First, weight fluctuation, meaning repeated weight loss and regain, within 1 year was not taken into account, although body weight fluctuates even within a week (Orsama et al., 2014). In our study, we used data measured when the participants had their annual health checkup. Second, as our retrospective cohort study was short-term, the long-term relationship between weight gain perception and weight change remains unknown. Third, our data were a little dated, with the most recent data being from 2015. Further investigation that includes more recent data is needed. Despite some limitations, our study extended previous studies by revealing that accurate weight gain perception would lead to less weight loss over time among Japanese adults. The results of the current study may indicate that informing people of their weight gain probably has no beneficial effect on their weight reduction. Public-health policy makers and physicians may need to think carefully when approaching people about weight reduction, as they may gain more weight.

In conclusion, the present study showed that, among Japanese adults who gained more than 3.0kg in 1 year, those who accurately perceived their weight gain went on to less weight reduction in the following year than those who did not accurately perceive their gain. Our findings suggest the need for public-health policy makers and physicians to pay attention to weight status perception, and in particular to weight gain perception. Additional research is needed to explore the long-term effects and mechanisms of these findings.

## Disclosure statement

The authors declared no conflict of interest.

## ORCID

Shota Endo  <http://orcid.org/0000-0002-7459-6092>

Takeyasu Kakamu  <http://orcid.org/0000-0001-6920-8457>

Yusuke Masuishi  <http://orcid.org/0000-0002-4761-0813>

Tomoo Hidaka  <http://orcid.org/0000-0003-2987-4804>

## Author contributions

SE conceived the research question, analyzed the data, and wrote the initial draft of the manuscript. TK and TF contributed to interpretation of data and assisted in the preparation of the manuscript. All other authors contributed to data interpretation and critically reviewed the manuscript. All authors approved the final version of the manuscript.

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