博 士 論 文

Nutrient and food intake of underweight Japanese young women: association of factors related to thinness and diet

（日本人やせ若年女性における栄養素・食品摂取量: やせの背景要因と食事との関連）

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CONTENTS

LIST OF ABBREVIATIONS

BMI	Body mass index
CI	Confidence interval
DFT	Desire for thinness
DHQ	Self-administered diet history questionnaire
EAT-26	Eating attitude test 26
MEQ	Media exposure questionnaire
MET	Metabolic equivalent
NKQ	Nutrition knowledge questionnaire
PCA	Principal component analysis
OR	Odds ratio
SATAQ-3	Socio-cultural attitude towards appearance-3
WHO	World Health Organization
UK	United Kingdom

LIST OF TABLES

CHAPTER 1

CHAPTER 2

CHAPTER 3

LIST OF FIGURES

CHAPTER 2

CHAPTER 3

CONCLUSION

LIST OF PUBLICATIONS

A part of this thesis is based on the following paper.

- Mori N, Asakura K, Sasaki S. Differential dietary habits among 570 young underweight Japanese women with and without a desire for thinness: a comparison with normal weight counterparts. *Asia Pac J Clin Nutr* 2016; 25(1):97-107

ABSTRACT

Objective: The aim of this study was to examine the effect of factors associated with thinness on dietary intake among underweight Japanese young women.

Methods: The literature search was carried out to identify the associated factors with thinness conducted to date. Among many other factors associated with thinness, a desire for thinness (DFT) was chosen as high percentage of Japanese young women was reported to have a DFT regardless of their weight category. Based on the results obtained by considering the effect of a DFT on dietary intake, a new hypothesis arose from the finding that unfavorable dietary behavior may also be caused by lack of nutrition knowledge. The effect of nutrition knowledge on dietary intake, media exposure, and thin-ideal internalization on dietary intake was examined among 685 young Japanese women. Media exposure was reported to function as a behavior conditioning source, on the other hand, exposure to thin-ideal images causes disordered eating.

Results: Underweight women with a DFT tended to avoid staple foods such as cereal and rice. A DFT was associated with unfavorable diet even in underweight population. Nutrition knowledge, and media exposure was both positively associated with favorable diet among not underweight subjects. However, no clear associations were found among underweight individuals. In both groups, there was no evident association between thin-ideal

internalization and dietary intake.

Conclusion: The present study have identified that the effect of nutrition knowledge and media exposure on dietary intake between underweight and not underweight individuals was different. Nutrition education only focused on increasing nutrition knowledge is probably insufficient to modify dietary behavior among underweight women. To improve the quality of nutrition education among underweight women, further research on other aspects, such as recognition of nutrition and health, or difference of behavioral change based on their knowledge are needed. Linkage of research, theory, and practice is probably the key for overcoming underweight problems among Japanese young women.

Keywords: Underweight; Desire for thinness; Nutrition knowledge; Mass media exposure; Thin-ideal internalization; Young Japanese women.

INTRODUCTION

Background

Obesity is becoming a major public health problem worldwide, and Japan is no exception for certain populations (1, 2). At the same time, Japanese young women who are underweight increased dramatically in the past decades (3-5). Underweight is defined as those with body mass index (BMI) of under 18.5 kg/m^2 according to the current WHO classification. The National Health and Nutrition Survey of Japan conducted in 2013, showed the highest percentage of underweight women (12.3%) in the past decade (6). Among those, as much as 21.5% of women aged 20-29 y is reported to be underweight in Japan (6). In this doctoral thesis, young women are referring to women aged around 20s. The term “thinness” is used to describe the underweight condition especially among women.

It has been stated that women in their 20s has a stronger desire to be slim than in the other age groups (7). Based on this, the Japanese government is aiming to reduce the prevalence of underweight women aged 20-29 to 15% by the year of 2010 under the health promotion measure called “Healthy Japan 21” (8). “Healthy Japan 21” has been implemented since 2000 to reduce the number of deaths in the prime of their life, prolong healthy years of life, and improve people’s quality of life in order to become a vigorous society in which all citizens can live in good health both physically and mentally. However, at the time of 2010, the prevalence of underweight women aged 20-29 actually increased to 24.4%. In the second term of “Healthy Japan 21, the goal for the underweight was amended to 20% (6).

This public health issue becomes more problematic as being underweight is said to be associated with unfavorable pregnancy outcomes in women of childbearing age (9). The

number of low birth weight newborn (<2500 kg) is reported to be increasing since 1975 and reached 9.6% in 2012 (10). Underweight also raises susceptibility to various negative health impacts, such as nutritional deficiency (11), and osteoporosis (12). However, comprehensive measure against thinness is yet to be introduced.

In this thesis, the author identified the several factors associated with thinness which may have mediated by one's dietary intake. Among those, author focused on a DFT (desire for thinness) as it has been reported that as much as 51.7% of underweight and 88.8% of normal weight young women had a DFT (13), and these percentages are much higher than in other countries (14, 15). Having considered the effect of a DFT on dietary intake among underweight young women in Chapter 2, the author hypothesized that unfavorable dietary behavior may be caused by lack of nutrition knowledge. A study conducted among professional ballet dancers revealed that those with disordered eating displayed lower level of nutrition knowledge (16). In addition, Japanese government is currently promoting "*shokuiku*" which defined as "Acquisition of knowledge about food and nutrition and ability to make appropriate food choices through various experiences related to food, in order to develop people with the ability to practice a healthy diet" (17). The target is also set on underweight women as it has been stated in the "Basic Law on *Shokuiku*" itself (18). However, no study was conducted the association between nutrition knowledge and dietary intake in underweight Japanese women. Additionally, in recent years, mass media has been recognized as a behavior conditional source. An Italian study has concluded that mass media exposure provided a beneficial role towards healthy eating behavior (19). On the other hand, media with thin-ideal images are reported to cause body dissatisfaction, thin-ideal internalization, and disordered eating (20-22). Therefore in Chapter 3, the author have examined the effect of nutrition knowledge, media exposure and thin-ideal internalization on dietary intake between different BMI categories to suggest possible measures against

underweight epidemic among Japanese young women.

Aims of the present study and structure of this thesis

This study has two main aims; as follows: to identify the dietary characteristics of underweight Japanese young women with or without a DFT (Aim 1); to examine the effect of nutrition knowledge on dietary intake (Aim 2-1); to examine the effect of media exposure (Aim 2-2); and finally to examine the effect of thin-ideal internalization on dietary intake (Aim 2-3) among Japanese young women of different BMI categories.

The structure of this thesis is as follows:

1) In Chapter 1, the author provides a review on factors associated with thinness and dietary intake.

2) In Chapter 2, the author identifies the dietary characteristics of underweight Japanese young women with or without a DFT in reference to normal weight individuals (Aim 1).

3) In Chapter 3, the author examines the effect of nutrition knowledge (Aim 2-1), the effect of mass media exposure (Aim 2-2), and thin-ideal internalization through the media (Aim 2-3) on dietary intake among underweight Japanese young women between those who are underweight and not underweight.

CHAPTER 1

Factors associated with thinness: A review

1.1 Overview

Underweight young women have increased dramatically in the past decades among Japanese population (3-5). Underweight is defined as those with body mass index (BMI) of under 18.5 kg/m^2 according to the current WHO classification. Japanese government is aiming to lower the number of underweight women to 20% under the "Healthy Japan 21" (6), as underweight is reported to cause unfavorable pregnancy outcomes in women of childbearing age (9). Underweight also raises susceptibility to various negative health impacts, such as nutritional deficiency (11), and osteoporosis (12). However, no comprehensive measure was implemented to combat against this public health issue.

The author searched the PubMed database to identify epidemiological studies reporting various factors associated with thinness which may also influence dietary intake using the following keywords, thinness, underweight, leanness, weight loss, and diet. Several factors have been identified including a DFT (13), body dissatisfaction (23), weight loss behaviors (24), parental and friend's endorsement (25, 26), menstrual disturbances (27), thin-ideal internalization (28, 29). Among these factors, DFT was chosen as it has been reported that as much as 51.7% of underweight and 88.8% of normal weight young women had a DFT (13), and these percentages are much higher than in other countries (14, 15).

Having considered the effect of a DFT on dietary intake among underweight young women in Chapter 2, the author hypothesized that unfavorable dietary behavior may be caused by lack of nutrition knowledge. A study conducted among professional ballet dancers revealed that those with disordered eating displayed lower level of nutrition knowledge (16). In addition, Japanese government is currently promoting "*shokuiku*" which defined as "Acquisition of knowledge about food and nutrition and ability to make appropriate food choices through various experiences related to food, in order to develop people with the ability to practice a healthy diet" (17). The target is also set on underweight

women as it has been stated in the "Basic Law on *Shokuiku*" itself (18). However, no study was conducted the association between nutrition knowledge and dietary intake in underweight Japanese women. From these reasons, a review on the relationship between nutrition knowledge and dietary intake was conducted.

Additionally, in recent years, mass media has been recognized as a behavior conditional source. An Italian study has concluded that mass media exposure provided a beneficial role towards healthy eating behavior (19). On the other hand, media with thin-ideal images are reported to cause body dissatisfaction, thin-ideal internalization, and disordered eating (20-22). Therefore, the review on the relationship between mass media exposure, and thin-ideal internalization through media and dietary intake were conducted.

Since body weight change occurs when an imbalance between the energy content of food eaten and energy expended by the body to maintain life and to perform physical work (30), monitoring of one's dietary intake is one of the key solutions for the underweight epidemic.

1.2 Method of the review

The current review was conducted to discuss the 1) the relationship between a DFT and dietary intake, 2) the relationship between nutrition knowledge and dietary intake, 3) the relationship between mass media exposure and dietary intake, and 4) the relationship between thin-ideal internalization through media and dietary intake.

PubMed database was used as a search engine, and search was conducted up to September 2015. Other databases such as Japan Medical Abstract Society and Google Scholar were also used to identify studies conducted in Japan. This is because numbers of nutritional or psychological studies are only published in Japanese languages. However, all searched articles were published in the form of university based bulletin which was not

peer-reviewed.

The terms used in individual article search were following; 1) “underweight”, “thinness”, “leanness”, “desire for thinness”, “dietary intake”, “food intake”, “food consumption” and “eating behavior”, 2) “nutrition knowledge”, “food knowledge”, “dietary intake”, “food intake”, “food consumption”, and “eating behavior”, 3) “media exposure”, “media use”, “mass media”, “dietary intake”, “food intake”, “food consumption”, and “dietary behavior”, and 4) “media”, “dietary intake”, “food intake” “food consumption”, eating behavior”, and “thin-ideal internalization”.

1.3 The relationship between a DFT and dietary intake

Studies have suggested that a DFT is associated with weight loss behaviors (13) and disordered eating habits (31-33).

A total of 3 studies identified, out of those 1 was conducted within Japan (13), and others were carried out outside of Japan (14, 15). According to the previous studies investigated the prevalence of young female with a DFT (13), Japan is being a highest of which 51.7% of underweight and 88.8% of normal weight students had a DFT (13). In other population, 47.9% of Spanish female university students expressed a desire to lose weight, despite the majority having a BMI within the normal range (14), 62% of Chinese women had a desire to be thin and 29.8% had a history of weight loss behavior (15).

Although the studies published on the influence of a DFT towards specific dietary behavior is sparse, a study conducted in Spain indicated somehow favorable aspects of diet. Those with a DFT showed the lower consumption of sweet confectionaries compared to those who did not have a DFT (14).

To date, possibly due to the number of underweight individuals in other part of the world, studies documented the dietary characteristics of underweight subjects are limited.

Further, specific dietary characteristics that are influenced by a DFT have not been discussed fully.

Since majority of Japanese young women said to have a DFT (13), there is a need for investigating the influence of a DFT on dietary behavior in young Japanese women.

1.4 The relationship between nutrition knowledge and dietary intake

A number of studies examined the association between nutrition knowledge and dietary intake, and indicated that nutrition knowledge is one of the factors that can influence dietary intake (34-54).

A total of 21 studies identified, were carried out outside of Japan among community populations **(Table 1-1)**. The article search was conducted up to September 2015 and most of them were written in English. Studies have shown significant positive relationships between nutrition knowledge and certain food intake, such as fruits (38-42, 44, 49-52), vegetables (37-42, 44, 50-52, 55), cereal (40, 47, 48, 51), noodles (38, 51), fish (38, 39), meat (47, 52), dairy products (47, 48, 51), eggs (52), beans (40, 47, 52), and nuts (40, 52). The negative association have seen in high fat or fried foods (38, 40, 41), snacks (38), confectioneries (37, 38, 41), sugary soft drinks (37-39), beans (39), red meat (40, 46), processed meat (40), egg based noodle (40), margarine (40), sunflower oil, potatoes (40), milk (40), and fruits (47). Furthermore, an increased intake of certain nutrient such as protein (35), fiber (50), iron (36), vitamin E (51), and magnesium (51) were found to be associated with higher nutritional knowledge. Whereas decreased intake of energy (39), carbohydrates (35), fat (35), saturated fats (39), monosaturated fats from animal origin (48), and sodium (53) were associated with higher nutrition knowledge. Focusing on the young group of women, a Belgian study has found a positive association between nutrition knowledge and vegetable and fruit intake (44). Similarly, a study done in Croatia among

medical students has also shown that higher nutrition knowledge level is associated with higher intake of fish, and vegetables, and associated with lower intake of legumes and soft drinks (39).

Up to our knowledge, there is no such documentation among Japanese population which examined the association between nutrition knowledge and dietary intake, though understanding such relationships are crucial in order to implement effective nutrition education initiatives against thinness or other health outcomes. In addition, a systematic review published in 2014 documented that despite the wide implementation of nutrition education initiatives, only a small number of studies have evaluated the nutrition knowledge level both in the general communities or specific populations (15). The evidence is demanding in not only in Japan, but also in other part of the world. Therefore, it is essential to evaluate the relationship between nutrition knowledge and dietary intake.

1.5 The relationship between mass media exposure and dietary intake

In recent years, mass media exposure is started to be recognized as a behavior conditional source. Mass media is defined as channels that carry mass communication; mass communication is any form of communication transmitted through a medium channel that simultaneously reaches the large number of people (56).

A total of 3 studies were identified through the article search (19, 34, 57). A study conducted in Italy has concluded that mass media exposure provided a beneficial role towards healthy eating behavior, in this case adherence to Mediterranean diet. Another Austrian study also indicated that newspaper articles, and the internet and booklets acted as a source of nutrition information, and were positively associated with daily fruits and vegetables consumption among adolescents (57).

Clearly the studies discussed the relationship between mass media exposure and dietary

intake is limited both in Japan and worldwide.

1.6 The relationship between thin-ideal internalization through media and dietary intake

Certain types of media with thin-ideal images are reported to cause body dissatisfaction, thin-ideal media internalization and disordered eating (20-22). In particular, Internet, watching soap operas, music program on TV, and magazines were positively related with disordered eating (21, 22, 58, 59). The main focus of this section will be to review the relationship between thin-ideal internalization through media and dietary intake.

A total of 18 articles were identified through the search (20-22, 26, 28, 58-70) **(Table 1-2).** Except for some studies conducted in Asian countries, they are mostly from North America and Europe.

The thin-ideal internalization is defined as individual cognition of societal norms of size and appearance, to the point of modifying one's behavior to approximate these standards (71). Western media are said to be saturated with images promoting thinness, and media-influences on eating behaviors have been a focus of psychological research for a long time (21). Because of that, many of the studies have been conducted in western society. The internalization of thin-ideal media is recognized as one of the important sociocultural factor for developing a DFT or disordered eating is thin-ideal internalization through the media (21, 22, 26, 62, 65).

The most common form of questionnaire to assess the level of internalization through mass media is Socio-cultural Attitudes towards Appearance-3 (SATAQ-3) (20, 21, 26, 61, 62, 65). The SATAQ-3 is a 30-item questionnaire assessing four dimensions of media influence on body image, including information, pressures, internalization-general, and internalization-athletic. For the assessment of eating behavior, Eating Attitude Test-26

(EAT-26) is commonly used (26, 58, 59, 64). EAT-26 is widely used in clinical purposes, as it is used to find out whether the person has an eating disorder that needs professional attention.

To our knowledge, no study has approached to specific dietary intake caused by thin-ideal internalization through media. Since the main focus was to identify whether the person has an eating disorder, specific dietary characteristics of individuals with thin-ideal internalization is not clear. In addition, there is no study conducted among Japanese population. In order to develop a preventive approach against thinness, such evidence is needed.

1.7 Conclusion

A DFT was associated with a DFT showed the lower consumption of sweet confectionaries compared to those who did not have a DFT (14). Those with a DFT showed the lower consumption of sweet confectionaries compared to those who did not have a DFT (14). However, due to the limited number of underweight individuals in other part of the world, studies documented the dietary characteristics of underweight subjects are limited. Further, specific dietary characteristics that are influenced by a DFT have not been discussed fully. Since majority of Japanese young women said to have a DFT (13), there is a need for investigating the influence of a DFT on dietary behavior in young Japanese women.

Most of the studies examined the association between nutrition knowledge and dietary intake reported the favorable aspects of diet (34-54). However, there is no such documentation among Japanese population which examined the association between nutrition knowledge and dietary intake, though understanding such relationships are crucial in order to implement effective nutrition education initiatives against thinness or other

health outcomes.

It has been also reported that mass media exposure acts as behavior conditioning source, as it was related with good dietary behavior (19, 57). Another Austrian study also indicated that newspaper articles, and the internet and booklets acted as a source of nutrition information, and were positively associated with daily fruits and vegetables consumption among adolescents (57). Clearly the studies discussed the relationship between mass media exposure and dietary intake is limited both in Japan and worldwide.

On the other hand, certain types of media with thin-ideal images are reported to cause body dissatisfaction, thin-ideal media internalization and disordered eating (20-22).

To conclude, 1) limited number of studies discussed the influence of having a DFT towards dietary behavior, 2) there is no documentation among young Japanese population which examined the association between nutrition knowledge and dietary intake, 3) no study was conducted in Japan whether mass media acts as behavior conditioning source, thus favorable diet, 4) no study has approached to specific dietary intake caused by thin-ideal internalization through media among healthy population.

Table 1-1. Epidemiological studies on association between nutrition knowledge and dietary intake.

No.	Authors	Year	Country	Study design	Subject	Data / Measures	Positive associations	Negative associations
1	Oldewage-Theron W, et al. (35)	2015	S. Africa	cross-sectional	98 (48M, 50M); 14-18y adolescents	24-hour-recall questionnaires, FFQ, nutrition knowledge questionnaire	Protein	carbohydrates, fat
2	Leonard AJ, et al. (36)	2014	Australia	cross-sectional	107 (F); 18-35y	Nutrition knowledge questionnaire, FFQ, ferritin biomarker	iron intake	
3	Bonaccio M, et al. (34)	2013	Italy	cross-sectional	744 (mean age 52.1y)	Italian EPIC / FFQ, nutrition knowledge questionnaires	Mediterranean dietary pattern	(obesity)
4	Williams L, et al. (37)	2012	Australia	cross-sectional	523 (F); mother	Dietary behavior, nutrition knowledge questions	vegetables, chocolate/ lollies and lower soft drinks	
5	Grosso G, et al. (38)	2012	Italy	cross-sectional	445; 4-16y children and young adolescents	Food consumption frequency, nutrition knowledge questionnaire	pasta, fish, vegetables and fruits	Sweets, snacks, fried foods, and sugary drinks.
6	Jovanovic GK, et al. (39)	2011	Croatia	cross-sectional	390 (120M, 270F); medical students	Nutrition knowledge questionnaire, FFQ	intake of fish (p=0.0027, p=0.001) and vegetables (P=0.019, p=0.001) in fiber group of both gender and fruit in females (p=0.038, p=0.007)	overall examined nutrition knowledge and daily energy intake (p=0.019, p=0.001), energy density of the diet (p=0.038, p=0.001), saturated fats (p=0.036, p<0.001), and legumes (p=0.027, p=0.001) and soft drinks (p=0.001, p<0.001) for both gender in high-fiber groups
7	Dickson-Spillmann M, et al. (40)	2011	Switzerland	cross-sectional	1043 (420M, 623F); mean age 53±16y	Nutrition knowledge questions, qualitative consumer interview, food consumption frequencies	vegetable, water, fruit, cereals, lentils, unsalted nuts and light sodas	sausages, egg-based pasta, chips, croquets, red meat, margarine, boiled potatoes, low-fat milk and full-fat milk (p<0.01)
8	Gambaro A, et al. (41)	2011	Uruguay	cross-sectional	270 (83M, 187F); mean age 37.3±13.1y	FFQ	fruits, vegetables, and low-fat products	high-fat and high-sugar foods
9	Dissen AR, et al. (42)	2011	US	cross-sectional	279 (131M, 148M); university students	Fruit-vegetable-fiber-dietary fat screener	vegetable and fruit in males	
10	Venter IM, et al. (43)	2010	S. Africa	cross-sectional	168 (17-18y adolescents)	Dietary fat knowledge questionnaire		low dietary fat knowledge was associated with high fat intake
11	De Vriendt T, et al. (44)	2009	Belgium	cross-sectional	630 (F); young and middle-aged women	Nutrition knowledge questionnaire, 2-day food record	vegetable and fruit	
12	Kresic G, at al. (45)	2009	Croatia	cross-sectional	1005 (264M, 741F); university students	Nutrition knowledge questionnaire, FFQ	adherence to dietary recommendations (p<0.001)	

(continued)

13	Tsartsali PK, et al. (46)	2009	Greece	cross-sectional	200 (97M, 103F); 15-17y adolescents	Mediterranean dietary pattern knowledge questionnaire, FFQ	Mediterranean dietary pattern was associated with vegetable consumption	meat consumption
14	Sharma SV, at al. (47)	2008	US	cross-sectional	963 (373M, 590F); 18-60y	Qué Sabrosa Vida community nutrition initiative / FFQ, Knowledge of recommended servings of food items (telephone survey)	intake of grains, dairy products, meats, beans and water	fruits and non-starchy vegetables
15	Dallongeville et al. (48)	2001	France	cross-sectional	361 (M); middle-aged men	3-day dietary record, nutrition quiz with food habits and nutrient intake	olive oil, cheese and cereal	sunflower oil, dry vegetables, fat and monosaturated fat from animal origin
16	Wardle J, et al. (49)	2000	UK	cross-sectional	1039 (455M, 584F); mean age 51.5y	Dietary instrument for nutrition education	vegetables (P<0.001), fruit (P<0.001) and fat (p<0.001) and healthy eating	
17	Lee CJ, at al. (51)	1998	US	cross-sectional	1539 (285M, 1234F); elderly	24 hour recall, questions on diet knowledge, attitudes, and practice	number of servings of grains/cereals/breads/pasta/milk/cheese, and fruits and vegetables; vitamin E, Mg	
18	Harnack L, at al. (50)	1997	US	cross-sectional	10286 (M, F); over 18y	1992 National Health Interview Survey Cancer Epidemiology Supplement / knowledge, beliefs, and attitudes and FFQ	vegetables, fruit and fiber	energy from fat
19	Guthrie J, et al. (52)	1995	US	cross-sectional	2960 (F); mean age 49y	24 hour recall, 2-days dietary record	USDA food guide servings recommendations, vegetables, fruits, dairy products, meat poultry, dried beans, eggs and nuts	
20	Trexler ML, et al. (53)	1993	US	cross-sectional	600 (14-18y adolescents)	Nutrition knowledge questionnaire, 24 hour dietary recall	sodium knowledge was significantly associated with lower sodium intake	
21	Kristal AR, et al. (54)	1990	US	cross-sectional	97 (F); mean age 51.5±4.3y	FFQ, 8 days of food diaries, 18-item questionnaire on fat-related diet behavior	low-fat diets, fats from foods and preservatives and knowledge that processed foods can cause cancer and percentage of energy consumed from fats	

Abbreviations: S. Africa; South Africa, US; United States, UK; United Kingdom, M; male, F; female, y; years, FFQ; food frequency questionnaire, EPIC; European Prospective Investigation into Cancer and Nutrition, Mg; magnesium, USDA; United States Department of Agriculture

*PubMed database was searched to September 2015 using following terms: ("nutrition knowledge", "food knowledge", "dietary intake", "food intake", "food consumption", and "eating behavior").

Table 1-2. Epidemiological studies on relationship between thin-ideal internalization through media, a desire for thinness and eating behavior.

No.	Authors	Year	Country	Study design	Subject	Data / Measures	Findings
1	Tod D, et al. (26)	2013	UK	cross-sectional	353 men and women	Drive for Leanness Scale, the Socio-cultural Attitudes Towards Appearance-3 (SATAQ-3), Eating Attitude Test-26 (EAT-26)	Drive for leanness was significantly correlated with athletic internalization, pressure to attain an ideal physique, exercise frequently, and dieting
2	Zeeni N, et al. (60)	2013	Cyprus, Lebanon	cross-sectional	200 from each country	DEBQ, Perceived Sociocultural Influences on Body Image and Body Change Questionnaire	Lebanese students were more likely to engage in emotional and external eating and their body image was impacted to a larger extent by socio-cultural agents such as media influence, socio-cultural influence correlated positively with external eating in Cypriot sample.
3	Reina SA, et al. (61)	2013	US	cross-sectional	90 adolescents (48% female)	Perceived Sociocultural Pressures Scale, SATAQ-3, MBSRQ-AS	Media pressure was related to more eating in the absence of hunger.
4	Chang FC, et al. (62)	2013	Taiwan	cross-sectional	2992 high school students	Media exposure questions, SATAQ-3, multidimensional body-self relations questionnaire	Female had higher levels of thin-ideal media exposure; media pressure to be thin, thin-ideal internalization, body dissatisfaction, and disordered eating behaviors than males.
5	Luevorasirikul K, at al. (63)	2012	UK	cross-sectional	393 undergrad students (mean age 19y)	Combination of original and adapted tools	Women were more likely to perceive negative body image, socio-cultural influences, friends, family and the media have an impact on body image concern especially in women.
6	Bair CE, et al. (21)	2012	US	cross-sectional	421 female undergrad student	EDI-2, SATAQ-3	Appearance-oriented Internet and TV use were associated with eating pathology, the association between media-focused Internet use and body dissatisfaction was mediated by thin-ideal internalization.
7	Mask L, et al. (28)	2011	Canada	intervention	138 undergrad women	Autonomous regulation of eating behaviors (AREB), trait body dissatisfaction, body image concerns, and eating-related intentions	Trait body dissatisfaction predicted more negative affect and size dissatisfaction following exposure to thin-ideal video among women displayed less AREB, and predicted greater intentions to monitor food intake and limit unhealthy foods than women displayed more AREB.
8	Nouri M, et al (20)	2011	US	cross-sectional	287 college females (154 Asian Americans, 133 European Americans)	Media exposure questions, SATAQ-3	Asian Americans may be employing unhealthy weight control behaviors and may prone to developing eating disorders at rates similar to European Americans.
9	Mousa TY, et al. (64)	2010	Jordan	cross-sectional	326 adolescent girls (10-16y)	EAT-26, Body shape questionnaire, Eating habits questionnaire	Negative eating attitudes were associated with body image dissatisfaction; mass media messages were associated with preoccupation with the body image.
10	Calado M, et al (58).	2010	Spain	cross-sectional	1165 secondary students (14-16y)	EAT-26, mass media influence, body dissatisfaction etc.	Both male and female students with disordered eating showed increased exposure to TV and magazine sections related to body image, disordered eating was associated with higher TV and magazine exposure to dieting, fashion and sport sections.

(continued)

11	Anschutz D, et al (22).	2009	Netherlands	cross-sectional	245 girls (7-9y)	Multidimensional media influence scale	Watching soaps and music television was associated with higher thin ideal internalization, which in turn was associated with higher body dissatisfaction and restrained eating.
12	McNicholas F, et al. (66)	2009	Ireland	cross-sectional	3031 students (mean 14.7) and 56 parents	EAT-26, EDI-3	71.4% adolescents felt adversely affected by media portrayal of body weight and shape, significant correlation between media impact and high EAT scores and EDI scores.
13	Ahern AL, et al. (67)	2008	UK	cross-sectional	99 female undergrad students	Weight based implicit association test (IAT), self-reported measure of body dissatisfaction	IAT score were associated with drive for thinness, the relationship between drive for thinness and IAT was stronger in participants who report the media is an important source of information about fashion and being attractive.
14	Anschutz D, et al. (65)	2008	Netherlands	cross-sectional	163 female students	SATAQ-3, Eating disorder inventory symptom checklist (EDI-SC), DEBQ	Higher susceptibility for thin ideal media was directly related to higher score on all eating styles, and indirectly related to higher restrained and emotional eating though elevated levels of body dissatisfaction.
15	Lam CKM, et al. (59)	2007	Hong Kong	cross-sectional	2382 students	EAT-26, body weight satisfaction, exposure to mass media et.	Strong association were found between disordered eating and other health-compromising behaviors, exposure to entertainment, beauty and youth magazines was positively related to disordered eating.
16	Monro FJ, et al. (68)	2006	Australia	cross-sectional	68 female university students (15-37y)	Self-objectification questionnaire, amount of food consumed in a classic taste test procedure	No difference was found between high and low self-objectifier's total food intake.
17	Xie B, et al. (70)	2006	China	cross-sectional	6863 middle and high school student and their parents	Exposure to Western media, attitude towards physical appearance, dietary behaviors	Girls were more often considered themselves either relatively heavy or too heavy than boys, girls who were frequently exposed to media from Japan, Korean, Hong Kong and Taiwan, and placed high values on their physical appearance were more likely to be dissatisfied with their body weight, which in turn were more likely to restrict consumption of certain foods etc.
18	McCabe MP, et al. (69)	2005	Australia	cross-sectional	indigenous Australians (25M, 25F) and non-indigenous Australians (25M, 25F)	Body image and body change inventory	Girls were more likely to be dissatisfied with their weight and engage in strategies to lose weight.

Abbreviations: UK; United Kingdom, US; United States, M; male, F; female, y; years, SATAQ-3; Socio-cultural Attitudes towards Appearance-3, EAT-26; Eating Attitude Test-26, DEBQ; Dutch Eating Behavior Questionnaire, MBSRQ-AS; The Multidimensional Body-Self Relations Questionnaire Appearance Scales, EDI-3; Eating Disorder Inventory-3

* PubMed database was searched to September 2015 using following terms: ("media", "dietary intake", "food intake" "food consumption", eating behavior", and "thin-ideal internalization").

CHAPTER 2

Differential dietary habits among young underweight Japanese women with and without a desire for thinness: a comparison with normal weight counterparts

2.1 Introduction

As already discussed in Chapter 1, underweight has increased rapidly among Japanese young women (3-5). Although the Japanese government has renewed a national health campaign called “Healthy Japan 21,” which aims to lower the prevalence of underweight women aged 20-29 y to 20% (72), the targeting program has yet to be introduced.

A strong desire for thinness (DFT) is linked to weight loss behaviors (13) and consequent eating disorders (15, 31, 32). Several studies indicated that underweight is associated with low intake of energy (73), protein, micronutrients (74), and DFT is associated with lower consumption of sweet confectioneries. However, the study conducted to examine the influence of a DFT on dietary behavior in young underweight women is limited. Also, a clear understanding of this influence is prerequisite to effective nutritional education against thinness among Japanese young women.

Here, we aimed to identify the dietary behaviors of underweight female university students, particularly those with a DFT despite being underweight.

2.2 Methods

2.2.1 Study population.

The study was based on data obtained in 2005 through a self-administered questionnaire survey known as “Dietetic Courses Study II” among dietetic students (n = 4,679) from 54 institutions (universities, junior colleges, and technical schools) in 33 of 47 prefectures of Japan. The survey has been described in detail elsewhere (75-78). Briefly, dietetic students who newly entered school in April 2005 completed a set of two questionnaires on dietary habits and lifestyle behaviors in the previous month. The students were distributed the questionnaires at their course guidance or very first lectures, and asked to complete them retrospectively. The completed questionnaires were then closely reviewed by well-trained

staff, most of whom were registered dietitians. The staff clarified any unclear responses with the student as necessary.

A total of 4,426 students (4,197 women and 229 men) participated in the survey and completed both questionnaires. For the present study, we selected 3634 female subjects aged 18-20 y after exclusion of the following: 1) overweight or obese subjects (BMI ≥ 25), whose diet may differ from non-obese individuals (n = 298); 2) all students at one institution at which the questionnaire was completed in May 2005, as this was inconsistent with other institutions (n = 101); 3) subjects with missing information on the variables used in this study (n = 141); and 4) subjects with an energy intake less than 500 or more than 4000 kcal/day, as these were considered to be under- or over-reporters, respectively (n = 23). **(Figure 2-1)**

The study was conducted in accordance with the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the ethics committee of the National Institute of Health and Nutrition, Japan. Informed consent was obtained from all subjects prior to the study.

2.2.2 Dietary assessment.

Dietary habits of the preceding month were assessed using a previously validated, diet history questionnaire (DHQ) (79-83). Its structure and method of calculating dietary intake have been described elsewhere (79-83). The DHQ is a structured 16-page questionnaire on the frequency and portion size of foods commonly consumed in Japan, and on habitual dietary behaviors and cooking methods (81, 83). Estimated daily intake of foods (147 items in total), energy and selected nutrients was calculated using an ad hoc computer algorithm developed specially for DHQ (81, 83). The DHQ has been widely used throughout Japan and its validity with respect to commonly studied nutrition factors has

been confirmed (79-83).

2.2.3 Socio-demographic and lifestyle variables

Socio-demographic and lifestyle factors in the preceding month were obtained from a 12-page questionnaire, except for body weight and height, which were both included in the DHQ. Subjects reported their self-perceived weight status (categorized as thin, about right or heavy), presence of a DFT (with or without), history of weight loss attempts (yes or no), dietary consciousness (“pay attention to own diet”, “do not pay attention at all,” or “neither of these”), residential status (“living with family or others” or “living alone”), and residential area. Residential area was divided into six regions of Japan as well as into three municipality levels. To better understand particular dietary and other related behaviors, the questionnaire also asked about the frequency of eating breakfast (“three or fewer times a week” or “four or more times a week”); frequency of watching TV while having dinner (“none”, “once a week”, “twice a week”, “three times a week”, “four times a week”, “five times a week”); monitoring of fat and sugary food intake (“no monitoring at all”, “will start within six months”, “a little”, “routinely in the past six months”, “always in the past six months”); intentionality with regard to food choices (“no intentionality at all”, “will start within six months”, “a little”, “routinely in the past six months”, “always in the past six months”); self-perceived eating speed (fast, slow, and normal); alcohol intake in the past month (“yes”, “none” and “intentionally not consumed”); and frequency of eating out (“none”, “once a month”, “2-3 times a month”, “once a week”, “2-3 times a week”, “4-6 times a week”, “once a day” and “more than twice a day”). In addition, the subjects also reported hours of sleep, and the frequency and intensity of different types of physical activity. For those whose recorded duration of activities totaled less than 24 hours, unrecorded hours were assumed to be sedentary activities, while for over-reporters, the

total duration of activity was proportionally adjusted to equal 24. Metabolic equivalent hours (METs*hour) were calculated by assigning activities with a metabolic equivalent value in accordance with a previous paper (i.e. 1.0 for sleeping, 1.3 for sedentary activity, 3.5 for walking, 6.0 for moderate-intensity activity, and 8.0 for high-intensity activity) 33 (84). The total number of hours spent on each activity was then multiplied by the metabolic equivalent value assigned for each activity.

2.2.4 Statistical analysis.

Subjects were divided into three groups, a normal weight group, an underweight with a DFT group, and an underweight without a DFT group. First, mean differences in nutrition and food intake among the groups were examined by one-way analysis of variance (ANOVA). The post hoc test (Dunnett's test) was also performed if the overall p value was < 0.05. Subjects were divided into quintile according to their nutrient intake, and multivariate adjusted odds ratios and 95% confidence intervals for being underweight with or without DFT compared to normal subjects were calculated by logistic regression analysis, in which the lowest intake quintile was used as a reference. In the logistic regression analysis, the normal weight subjects were set as reference, including both those with and without a DFT, as this particular group had an optimum energy intake regardless of the existence of a DFT. Due to the lack of information on possible confounders from previous studies, it was estimated with a significance level of < 0.05 from ANOVA. Based on that, we added eating speed as covariate which was significantly different between five groups, to the multivariate model to derive multivariate adjusted ORs. Confounding was self-perceived weight status, history of weight loss attempts, and monitoring for fat intake and sugary foods were not included in the model as these variables are closely related with a DFT.

For food intake, crude and multivariate adjusted odds ratios (ORs) and 95% confidence intervals (CI) were calculated by quintile of selected food intake. In line with nutrition intake, eating speed was added as covariate based on the criteria explained above.

All statistical analyses are performed using SAS program version 9.4 (SAS Institute Inc., Cary, NC, USA). All reported p values of < 0.05 were considered statistically significant.

2.3 Results

Socio-demographic and lifestyle characteristics of the subjects are described in **Table 2-1**. Mean values of the normal weight subjects were aged 18.1 years, height 157.8 cm, weight 52.2 kg, and BMI 20.9 kg/m^2. A total of 84% of all 3634 women who were classified in either the normal or underweight categories had a DFT and 81.8% of normal weight women considered themselves “heavy”. Further, 40.5% of all 570 underweight women had a DFT. Underweight students with a DFT had an erroneous self-perceived weight status image, with 51.5% considering themselves “heavy” and 37.7% had made an unnecessary weight loss attempt in the past month. Among other socio-demographic and lifestyle characteristics, “Always monitoring fat intake and sugary foods in the past 6 months” showed a highest percentage, 29.0% and 21.2% respectively, among underweight subjects with a DFT. The eating speed among three groups was also significantly different (< 0.0001), as normal weight subject being the fastest eater. Other variables such as geographical region, municipality levels, residential status, physical activity levels, frequency of breakfast consumption, frequency of TV watching during dinner, intentionality regarding the food choice, dietary consciousness, frequency of eating out, and sleep hours did not show clear difference between three groups.

Table 2-2 shows nutrient and food intake in each group, and compares mean intakes by

ANOVA. Dunnett's test revealed that underweight women without a DFT had the lowest intake of total fats, saturated fats, monounsaturated fats, polyunsaturated fats and n-6 fatty acids among all groups, but the highest intake of carbohydrates. Moreover, underweight women without a DFT showed a significantly low intake of western-style confectionaries, including ice creams. In contrast, underweight women with a DFT showed the lowest intake of cereals and rice, but the highest intake of western-style confectionaries such as candies, which were categorized as western-style confectionaries.

Table 2-3 describes the odds ratios (OR) and 95% confidence intervals (CI) for being underweight with or without a DFT by selected nutrients and food consumption. The normal weight group was used as reference. Since the crude and adjusted ORs showed consistent results, only adjusted ORs are described. Although no significant difference on nutrient intake were noted, decreased cereal (p for trend = 0.03) and rice (p for trend = 0.03) intake was significantly associated with a higher prevalence of underweight with DFT. On the other hand, opposite trend, namely increased cereal (p for trend = 0.004) and rice (p for trend = 0.02) intake, was significantly related with underweight without a DFT. The OR showing the relationship between being underweight with a DFT and intake of western-style confectionaries was also more than 1 in all intake quintiles, but the trend was not significant. In contrast, underweight subjects without a DFT tended to show a decreased intake of total fats (p for trend = 0.002), saturated fats (p for trend = 0.004), monounsaturated fats (p for trend = 0.0004), polyunsaturated fats (p for trend = 0.02), n-6 fatty acids (p for trend = 0.02) and increased intake of carbohydrates (p for trend = 0.0007). For food groups, fats and oils (p for trend = 0.02) and western-style confectionaries (p for trend = 0.05), including candies (p for trend = 0.002) and ice creams (p for trend = 0.0002) showed decreased consumptions across the quintiles.

2.4 Discussion

In this study, we found that 40.5% of underweight women had a desire to be thin and more than a half of them had an erroneous self-perceived weight status image. On adjustment for eating speed, underweight women with a DFT tended to avoid staple foods such as cereal and rice. Conversely, underweight women without a DFT showed completely different dietary habits, with high consumption of cereals and rice and low consumption of western-style confectionaries such as candies and ice creams, and fats and oil across quintiles. **(Figure 2-2)**

The issue of underweight women is prevalent in Japanese society, possibly due to strong social pressure or established social norms towards thinness, as previous study have suggested that Japanese women living in Japan may be even more sensitive to social pressures to be thin (85).

One of the strength of our study was that we were able to include a substantial number of underweight subjects, and made the very first study to identify the dietary characteristics of young underweight women with and without a DFT.

To date, only one study has reported the prevalence of underweight women who have a DFT, at 51.7% (13). Our study found a somewhat lower percentage. This inconsistency may be due to the difference in sample selection, as the previous study recruited subjects from only 1 of 47 prefectures in Japan. Other finding reported that 62.0% of Chinese women wanted to be slim to look beautiful (15). This percentage is substantially lower than that in a previous Japanese study (13) in young women (88.8%) and our present finding (85%), which includes overweight individuals. Thus, the phenomenon of young women desiring to become slim appears much more prevalent in Japan.

In this study, women with a DFT reported lower consumption of cereal and rice. It might be caused by introduction of a “Low-carbohydrate diet” by Dr. Robert Atkins, as the

Japanese translated edition was published in 2000. **Figure 2-3** shows the annual number of articles matched on Mainichi and Yomiuri Newspapers when searched with a keyword "low-carbohydrate diet" until 2005. There were no matched articles before 2001. Also, **Figure 2-4** shows the annual number of articles on 10 different monthly women lifestyle magazines searched with the same keyword. No keyword match was found before 2001. Another reason could be due to lack of nutrition knowledge as previous study conducted among UK dancers found that those were on disordered eating displayed lower nutrition knowledge (16). However, the detail of this disordered eating is not known since this study employed the questionnaire called Eating Attitude Test-26 (EAT-26) (26, 58, 59, 64), which is used to identify whether the person have an eating disorder that needs special attention. Similarly, internalization of thin-ideal media is also found to be one of the important sociocultural factors for developing a DFT or disordered eating (21, 22, 26, 62, 65). Then again, specific dietary characteristics are unknown due to same reason.

Underweight women with a DFT were more likely than the other two groups to monitor fat intake and sugary food in the past six months **(Table 2-1)**. The most recent DRIs for Japanese, adopted in 2015, suggest a desirable fat intake as a percentage of energy of 20% to 30% (86). However, in our study, the highest fat intake was observed among underweight subjects with a DFT, at 30.7% on average, and the lowest was in underweight subjects without a DFT, 29.0%. In other words, underweight women without a DFT are likely to follow the healthiest diet of all groups with regards to fat intake.

Although previous studies have reported that being underweight is linked to low intake of protein and micronutrients (73, 74), our results did not show any clear difference versus normal weight group. In our study, underweight women without a DFT were on relatively healthy diet, with a relatively low consumption of western-style confectionaries, and fats and oil. This differed from those with a DFT, indicating that having a DFT may be the key

element in disordered eating among young underweight Japanese women, regardless of a thin body. These findings might provide clues about thinness-related dietary and behavioral factors for use in studies aimed at preventing obesity.

Several limitations of this study can be noted. First, we recruited female dietetic students utilizing our research network, and thus did not adopt a random sampling method. To minimize the influence of the nutritional education given at each institution, the survey was conducted within two weeks after the course commenced. The National Health and Nutrition Survey conducted in 2005 reported that average BMI for 15- to 19-year-old females was 21.0, which is the same as our sample when overweight individuals are included (87). In contrast, a 2009 survey of eating attitudes among university students by the Cabinet Office of Japan found that 12.9% of girls ate out at least once a day, which is more than double the 6.4% in our subjects. These data suggest that our subjects share some similarities with national data. Nevertheless, our students may have had healthier lifestyles and been more health conscious than the general population at the same age. In addition, there is a possibility that the current population may have some hidden cases of eating disorders, as the diagnostic criteria of anorexia nervosa in Japan (established by the study group of the Ministry of Health, Labour and Welfare) include “having erroneous self-perceived weight and/or body image” as an item (88). However, since the prevalence of anorexia nervosa was ranged between from 0.025% to 0.2% in Japan (89), the number of subjects with eating disorder in the present study may not be so large. Also, careful assessment for the quality of dietary intakes is important for young underweight women both with and without eating disorder.

Second, all self-reported dietary assessments are subject to measurement error and under- or over-reporting of dietary intake (90, 91). We attempted to minimize these possibilities by adopting a previously validated DHQ (79-83). In addition, completed

questionnaires were closely reviewed by well-trained staff and unclear responses were confirmed with the student.

Third, all the variables used in this study were based on self-reporting, which might have been biased. For instance, BMI was calculated using the self-reported weight and height, which can be underestimated. Our underweight students were selected using the calculated BMI, and the reported associations might be weakened or strengthened if weight and height were measured anthropometrically. However, as we targeted new students who had entered the institution only two weeks before the survey, it is likely that they knew their latest weight and height from the school medical check-up.

Fourth, in the logistic regression analysis, we avoided analytical and interpretive complexity by using the normal weight subjects as reference, including those both with and without a DFT. Further, the proportion of normal weight subjects who regarded themselves as of “normal weight” was only 17.2%. Thus, these subjects may not have been representative of a normal weight group, and their use as reference group might have confounded the results, because it might have included subjects with the same or similar unfavorable dietary behavior to that observed in the underweight subjects. Nevertheless, this statistical procedure is the best available method that we could come up with and we found significantly different dietary characteristics between the underweight subjects with and without a DFT even using this reference group.

Fifth, because this particular data set was obtained in 2005, our results might not represent the current situation in Japan. However, the rate of underweight women in their 20s has continued to rise, from 21.9% in 2005 to 29% in 2009 (72), indicating that the severity of this serious health issue among Japanese young women and need for intervention continue to increase.

Finally, as the study is the first to identify the dietary characteristics of young

underweight women, there may be other potential confounders may need to be taking into account.

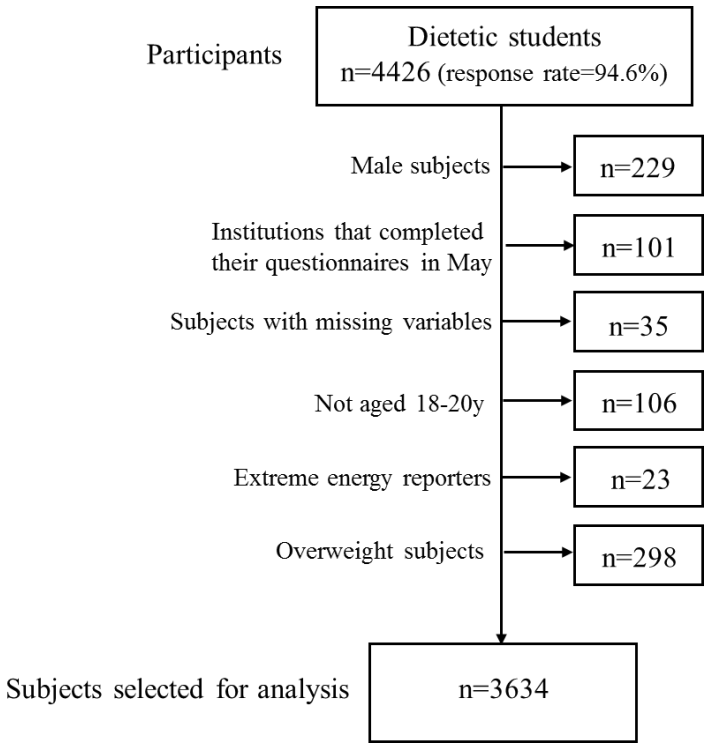


Figure 2-1. Flow chart of subjects.

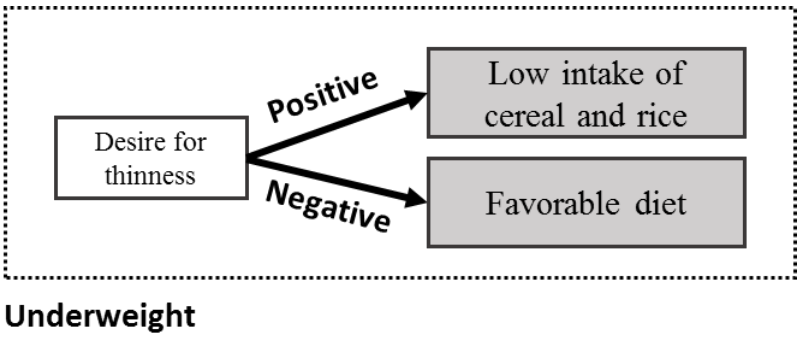
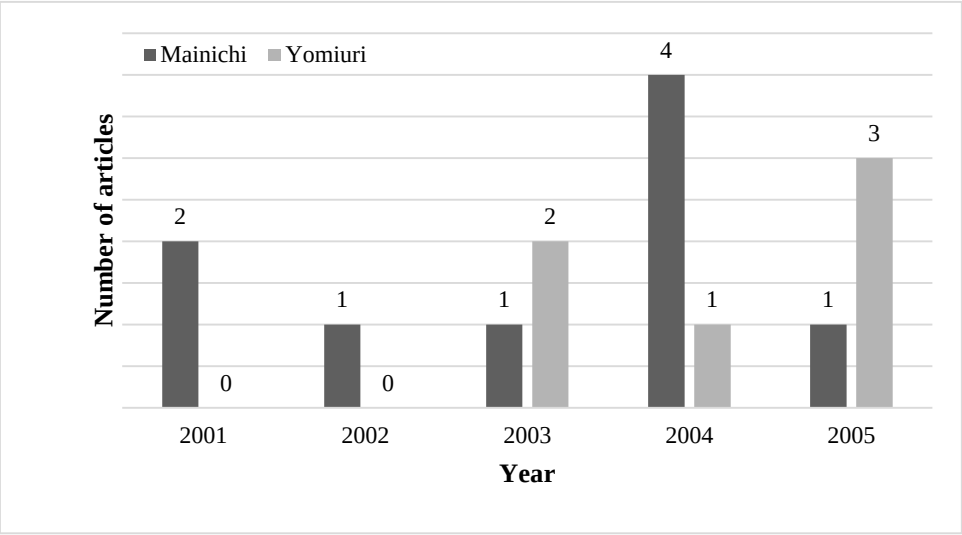
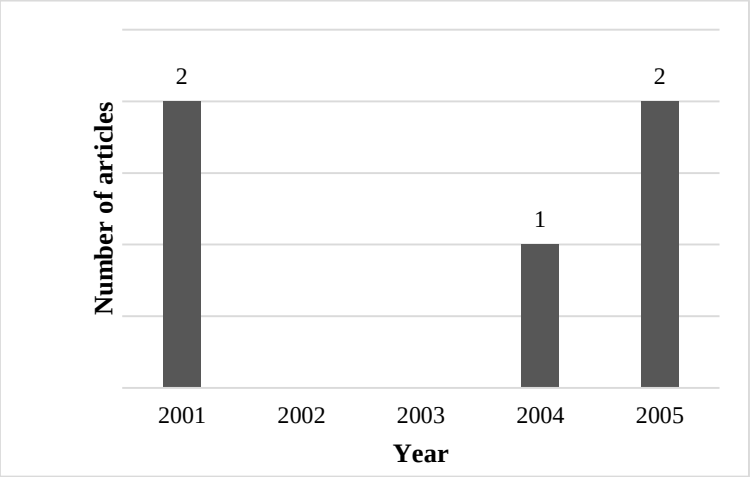


Figure 2-2. Summary flow diagram of the study.



† Number of articles was searched with a keyword “low-carbohydrate diet” using Mainichi and Yomiuri past newspapers online database.
‡ Total number of articles was not possible to identify.

Figure 2-3. Annual number of articles on Mainichi and Yomiuri newspapers searched with low-carbohydrate diet between 2001 and 2005.



† Number of articles was searched with a keyword “low-carbohydrate diet” using Web OYA-bunko magazine database. From the available data, 10 women lifestyle monthly magazine which are likely to be read by the targeted population were selected.
‡ Total number of articles was not possible to identify.

Figure 2-4. Annual number of articles on 10 monthly women lifestyle magazines searched with low-carbohydrate diet between 2001 and 2005.

Table 2-1. Basic characteristics of 3634 Japanese young women

	Normal weight† (n=3064)	Underweight without a desire for thinness† (n=339)	Underweight with a desire for thinness† (n=231)	p‡
	Mean ± SD or n (%)	Mean ± SD or n (%)	Mean ± SD or n (%)	
Age	18.1±0.3	18.1±0.4	18.1±0.3	0.83
18 years	2769 (90.4)	307 (90.6)	209 (90.5)	0.12
19 years	273 (8.9)	25 (7.4)	20 (8.7)	
20 years	22 (0.7)	7 (2.1)	2 (0.9)	
Height (cm)	157.8±5.3	158.5±5.3	158.8±5.3*	0.005
Weight (kg)	52.2±5.2	43.8±3.5*	45.2±3.3*	<.0001
BMI (kg/m^2)	20.9±1.6	17.4±0.9*	17.9±0.5*	<.0001
Region				0.98
Hokkaido and Tohoku	300 (9.8)	27 (8.0)	24 (10.4)	
Kanto	1060 (34.6)	121 (35.7)	77 (33.3)	
Hokuriku and Tokai	416 (13.6)	47 (13.9)	34 (14.7)	
Kinki	620 (20.2)	74 (21.8)	46 (19.9)	
Chugoku and Shikoku	321 (10.5)	32 (9.4)	27 (11.7)	
Kyusyu	346 (11.3)	38 (11.2)	23 (10.0)	
Municipality level				0.28
Ward	608 (19.9)	77 (22.7)	35 (15.2)	
City	2009 (65.6)	216 (63.7)	162 (70.1)	
Town or village	446 (14.6)	46 (13.6)	34 (14.7)	
Residential status				0.54
Living with family	2790 (91.1)	303 (89.4)	205 (88.7)	
Living alone	170 (5.6)	24 (7.1)	18 (7.8)	
Living in a dormitory	103 (3.4)	12 (3.5)	8 (3.5)	
Self-perceived weight status				<.0001
Thin	31 (1.0)	135 (39.8)	10 (4.3)	
About right	525 (17.1)	197 (58.1)	102 (44.2)	
Heavy	31 (81.8)	7 (2.1)	119 (51.5)	
History of weight loss behavior				<.0001
No	1919 (62.6)	317 (93.5)	144 (62.3)	
Yes	1145 (37.4)	22 (6.5)	87 (37.7)	
Physical activity (METs: hours/week)	32.1±4.5	31.8±5.0	32.2±4.7	0.52
Monitoring of fat intake				
No intention at all	68 (2.2)	36 (10.6)	9 (3.9)	<.0001
Will start within 6 months	274 (9.0)	27 (8.0)	14 (6.1)	
A little	1556 (50.8)	161 (47.5)	111 (48.1)	
Routinely in the past 6 months	514 (16.8)	23 (6.8)	30 (13.0)	
Always in the past 6 months	651 (21.3)	92 (27.1)	67 (29.0)	
Monitoring of sugary foods				0.005
No intention at all	148 (4.8)	32 (9.4)	16 (6.9)	
Will start within 6 months	397 (13.0)	43 (12.7)	25 (10.8)	
A little	1479 (48.4)	151 (44.5)	114 (49.4)	
Routinely in the past 6 months	492 (16.1)	43 (12.7)	27 (11.7)	
Always in the past 6 months	542 (17.7)	70 (20.7)	49 (21.2)	
Eating speed				<.0001
Fast	1176 (38.4)	75 (22.1)	62 (26.8)	
Normal	871 (28.5)	111 (32.7)	74 (32.0)	
Slow	1014 (33.1)	153 (45.1)	95 (41.1)	
Alcohol intake in past month				0.05
Yes	632 (20.6)	53 (15.6)	52 (22.5)	
None	2430 (79.3)	286 (84.4)	178 (77.1)	
Intentional abstinence	2 (0.1)	0 (0.0)	1 (0.4)	

(continued)

Breakfast				0.13
3 or fewer times/week	513 (16.8)	46 (13.6)	46 (19.9)	
4 or more times/week	2550 (83.3)	293 (86.4)	185 (80.1)	
Watching TV during dinner				0.33
2 or fewer times/week	609 (19.2)	77 (22.7)	41 (17.9)	
3 or more times/week	2448 (80.1)	262 (77.3)	188 (82.1)	
Intentionality regarding food choice				0.28
No intention at all	226 (7.4)	22 (6.5)	22 (9.5)	
Will start within 6 months	593 (19.4)	58 (17.1)	30 (13.0)	
A little	1205 (39.4)	140 (41.3)	89 (38.5)	
Routinely in the past 6 months	411 (13.4)	43 (12.7)	33 (14.3)	
Always in the past 6 months	628 (20.5)	76 (22.4)	57 (24.7)	
Dietary consciousness				0.12
Conscious	1870 (61.1)	217 (64.0)	138 (59.7)	
Neither	669 (21.8)	54 (15.9)	53 (22.9)	
Not conscious	523 (17.1)	68 (20.1)	40 (17.3)	
Frequency of eating out				0.5
None	57 (1.9)	10 (3.0)	2 (0.9)	
Once a month	158 (5.2)	23 (6.8)	11 (4.8)	
2-3 times a month	742 (24.2)	85 (25.1)	58 (25.1)	
Once a week	635 (20.7)	69 (20.4)	45 (19.5)	
2-3 times a week	806 (26.3)	84 (24.8)	55 (23.8)	
4-6 times a week	432 (14.1)	43 (12.7)	36 (15.6)	
Once a day	189 (6.2)	21 (6.2)	23 (10.0)	
More than twice a day	44 (1.4)	4 (1.2)	1 (0.4)	
Sleep hours (hours)	7.0±1.8	7.1±1.9	7.0±1.8	0.37

Abbreviations: SD; standard deviation, BMI; body mass index, METs; metabolic equivalents.

†Weight category is defined according to the WHO classification, corresponding to < 18.5 kg/m^2 for underweight and < 25 kg/m^2 for normal.

‡ Means for continuous values were compared by ANOVA and proportions for categorical valuables by the chi-squared test.

*Dunnett test were performed for continuous variables with reference to the normal group.

Table 2-2. Dietary characteristics of 3634 Japanese young women

	Normal weight† (n=3064)	Underweight without a desire for thinness†(n=339)	Underweight with a desire for thinness† (n=231)	p§
	Mean±SD	Mean±SD	Mean±SD	
Energy (kcal/day)	1830±449	1780±503	1797±496	0.15
Nutrient intake				
Protein (% energy)	13.3±2.1	13.2±2.5	13.2±2.2	0.82
Fat (% energy)	30.1±5.8	29.0±5.8*	30.7±6.2	0.0008
SFA (% energy)	8.1±2.1	7.7±2.0*	8.2±2.1	0.002
MUFA (% energy)	10.2±2.4	9.8±2.3*	10.5±2.7	0.0005
PUFA (% energy)	7.1±1.6	6.9±1.6*	7.3±1.6	0.02
n-3 fatty acids (% energy)	1.3±0.4	1.3±0.4	1.4±0.4	0.19
n-6 fatty acids (% energy)	6.4±1.4	6.1±1.4*	6.5±1.5	0.001
Cholesterol (mg/1000kcal)	165±63	158±66	167±63	0.11
Carbohydrate (% energy)	55.2±6.7	56.5±6.7*	54.3±7.0	0.0003
Dietary fiber (g/1000kcal)	6.5±1.9	6.6±2.4	6.6±2.3	0.5
Food intake (g/1000kcal)				
Cereal	220.9±65.7	230.0±71.1*	210.2±69.5*	0.002
Rice	158.1±69.7	167.1±71.2	145.6±67.9*	0.002
Bread	17.9±16.0	18.4±14.5	17.7±14.5	0.85
Noodles	36.2±32.4	36.1±16.4	39.1±31.5	0.41
Potatoes	15.1±11.1	16.0±13.8	15.0±10.2	0.41
Fats and Oils	13.5±6.5	12.8±6.4	14.2±7.0	0.03
Fish and shellfish	29.8±17.2	31.9±21.0	30.5±17.6	0.09
Meats	33.5±16.5	31.7±16.4	33.3±17.4	0.18
Eggs	18.2±13.9	16.4±13.6	18.3±13.6	0.09
Dairy products	26.2±29.0	22.4±25.3	26.0±31.9	0.06
Vegetables	107.6±61.7	113±81.3	109.3±67.1	0.33
Green and yellow vegetables	41.4±30.0	44.8±38.6	42.6±36.0	0.15
Seaweeds	7.1±8.0	7.6±9.6	6.9±9.1	0.53
Fruits	28.7±28.2	30.0±30.0	30.5±31.1	0.51
Soft drinks	43.7±65.4	49.9±82.7	43.9±53.4	0.27
Western-style confectioneries	41.8±23.2	38.5±22.2*	44.9±26.0	0.004
Pastries	17.8±14.2	17.8±15.1	17.7±14.1	1.0
Snack foods	2.7±3.2	2.6±2.8	2.9±3.4	0.48
Cookies	2.3±2.9	2.1±2.5	2.5±4.6	0.24
Chocolates	3.5±4.8	3.3±4.7	4.2±5.6	0.08
Candies	3.7±4.8	3.1±4.7	4.4±5.7*	0.005
Jellies	1.2±2.2	1.2±2.3	1.1±1.9	0.91
Ice creams	10.6±13.2	8.4±11.9*	12.0±17.9	0.003
Japanese sweets & snacks	3.0±3.0	3.1±3.2	3.0±3.5	0.98
Rice crackers	1.3±1.9	1.3±2.1	1.2±1.8	0.84
Japanese sweets	1.8±2.1	1.8±2.2	1.8±2.5	0.97

Abbreviations: SD; standard deviation, SFA; saturated fatty acids, MUFA; monounsaturated fatty acids, PUFA; polyunsaturated fatty acids.

†Weight category is defined according to WHO classification, corresponding to < 18.5 kg/m^2 for underweight and < 25 kg/m^2 for normal.

‡ Nutrient and food intake were energy-adjusted according to the density method.

§ Mean intake values of nutrients and foods in each group were compared by ANOVA.

No significant difference were noted for vitamins and minerals; Vitamin A, Vitamin D, Vitamin K, Vitamin B1, Vitamin B2, Niacin, Vitamin B6, Vitamin B12, Pantothenic acid, Vitamin C, Sodium, Potassium, Calcium, Magnesium, Iron and Zinc.

*Dunnett's test was performed with reference to the normal group.

Table 2-3. Multivariate adjusted odds ratios and 95% confidence intervals for underweight with or without a desire for thinness compared to normal by quintile of selected nutrient and food intakes among 3634 Japanese young women

Analysis for underweight with DFT Number of subjects	Q1 (Lowest) (n=659)	Q2 (n=659)	Q3 (n=659)	Q4 (n=659)	Q5 (Highest) (n=659)	*p* for trend‡
Nutrient intake (% energy)						
Fat	≤25.3	25.3-28.9	28.9-31.7	31.7-34.8	≥34.8	0.36
Underweight with DFT/Normal	43/600	42/611	49/606	39/628	58/619	
Adjusted OR (95%CI)	1.00 (ref.)	0.96 (0.62, 1.47)	1.01 (0.66, 1.54)	0.82 (0.52, 1.28)	1.30 (0.86, 1.95)	
SFA	≤6.3	6.3-7.4	7.4-8.4	8.4-9.8	≥9.8	0.41
Underweight with DFT/Normal	50/596	34/617	46/612	43/620	58/619	
Adjusted OR (95%CI)	1.00 (ref.)	0.67 (0.43, 1.05)	0.91 (0.60, 1.38)	0.83 (0.54, 1.27)	1.10 (0.74, 1.63)	
MUFA	≤8.3	8.3-9.6	9.6-10.7	10.7-12.1	≥12.1	0.46
Underweight with DFT/Normal	47/595	45/596	36/634	46/622	57/617	
Adjusted OR (95%CI)	1.00 (ref.)	0.95 (0.62, 1.44)	0.75 (0.48, 1.17)	0.88 (0.57, 1.35)	1.21 (0.81, 1.81)	
PUFA	≤5.9	5.9-6.7	6.7-7.5	7.5-8.4	≥8.4	0.32
Underweight with DFT/Normal	41/601	47/614	44/612	44/617	55/620	
Adjusted OR (95%CI)	1.00 (ref.)	1.16 (0.76, 1.79)	1.04 (0.67, 1.62)	1.06 (0.68, 1.64)	1.33 (0.87, 2.03)	
n-6 fatty acids	≤5.2	5.2-6.0	6.0-6.6	6.6-7.5	≥7.5	0.15
Underweight with DFT/Normal	39/603	43/609	41/616	58/612	50/624	
Adjusted OR (95%CI)	1.00 (ref.)	1.20 (0.77, 1.86)	0.99 (0.63, 1.57)	1.49 (0.98, 2.28)	1.27 (0.82, 1.96)	
Carbohydrates	≤49.7	49.7-53.2	53.2-56.7	56.7-60.6	≥60.6	0.33
Underweight with DFT/Normal	60/618	43/627	41/604	42/618	45/597	
Adjusted OR (95%CI)	1.00 (ref.)	0.72 (0.47, 1.08)	0.71 (0.47, 1.08)	0.68 (0.45, 1.03)	0.83 (0.56, 1.24)	
Food intake (g/1000kcal)						
Cereal	≤164.2	164.2-199.8	199.9-230.3	230.3-273.0	≥273.1	0.03
Underweight with DFT/Normal	57/602	51/608	45/614	39/620	39/620	
Adjusted OR (95%CI)	1.00 (ref.)	0.88 (0.59, 1.31)	0.79 (0.52, 1.18)	0.67 (0.44, 1.03)	0.67 (0.44, 1.03)	
Rice	≤98.6	98.8-132.0	132.1-167.6	167.7-212.9	≥213.1	0.03
Underweight with DFT/Normal	56/603	45/614	54/605	42/617	34/625	
Adjusted OR (95%CI)	1.00 (ref.)	0.80 (0.53, 1.21)	0.97 (0.66, 1.44)	0.75 (0.49, 1.14)	0.59 (0.38, 1.92)	
Western-style confectioneries	≤22.7	22.8-32.8	32.8-43.3	43.4-58.6	≥58.7	0.16
Underweight with DFT/Normal	41/618	41/618	51/608	46/613	52/607	
Adjusted OR (95%CI)	1.00 (ref.)	0.99 (0.64, 1.56)	1.25 (0.81, 1.91)	1.13 (0.72, 1.74)	1.32 (0.87, 2.03)	
Candies	≤0.6	0.6-1.4	1.4-2.9	2.9-5.3	≥5.3	0.32
Underweight with DFT/Normal	48/611	43/616	40/619	44/615	56/603	
Adjusted OR (95%CI)	1.00 (ref.)	0.91 (0.59, 1.39)	0.84 (0.54, 1.30)	0.95 (0.62, 1.45)	1.22 (0.82, 1.83)	

(continued)

Ice cream	≤2.6	2.6-6.0	6.0-8.4	8.4-13.3	≥13.3	0.89
Underweight with DFT/Normal	48/611	46/613	49/610	40/619	48/611	
Adjusted OR (95%CI)	1.00 (ref.)	0.96 (0.63, 1.46)	1.05 (0.70, 1.59)	0.83 (0.54, 1.29)	1.03 (0.68, 1.56)	
Fats and Oils	≤8.4	8.4-11.2	11.2-13.9	13.9-17.9	≥17.9	0.21
Underweight with DFT/Normal	34/625	53/606	47/612	48/611	49/610	
Adjusted OR (95%CI)	1.00 (ref.)	1.58 (1.01, 2.47)	1.41 (0.89, 2.22)	1.44 (0.92, 2.27)	1.49 (0.95, 2.34)	

Analysis for underweight without DFT

Number of subjects	Q1 (Lowest) (n=680)	Q2 (n=681)	Q3 (n=681)	Q4 (n=681)	Q5 (Highest) (n=680)	p for trend‡
Nutrient intake (% energy)						
Fat	≤25.2	25.2-28.7	28.7-31.6	31.6-34.7	≥34.7	0.001
Underweight without DFT/Normal	83/600	74/611	72/606	60/628	50/619	
Adjusted OR (95%CI)	1.00 (ref.)	0.85 (0.60, 1.18)	0.85 (0.61, 1.19)	0.66 (0.47, 0.95)	0.57 (0.40, 0.83)	
SFA	≤6.3	6.3-7.4	7.4-8.4	8.4-9.7	≥9.7	0.002
Underweight without DFT/Normal	80/596	76/617	69/612	64/620	50/619	
Adjusted OR (95%CI)	1.00 (ref.)	0.88 (0.63, 1.23)	0.80 (0.57, 1.12)	0.73 (0.52, 1.04)	0.57 (0.39, 1.82)	
MUFA	≤8.2	8.2-9.5	9.6-10.7	10.7-12.1	≥12.1	0.0004
Underweight without DFT/Normal	84/595	86/596	57/634	59/622	53/617	
Adjusted OR (95%CI)	1.00 (ref.)	1.01 (0.73, 1.40)	0.63 (0.44, 0.90)	0.67 (0.47, 0.96)	0.60 (0.42, 0.87)	
PUFA	≤5.8	5.8-6.7	6.7-7.4	7.4-8.3	≥8.3	0.02
Underweight without DFT/Normal	84/601	66/614	71/612	66/617	52/620	
Adjusted OR (95%CI)	1.00 (ref.)	0.73 (0.52, 1.03)	0.84 (0.60, 1.17)	0.72 (0.51, 1.02)	0.61 (0.43, 0.88)	
n-6 fatty acids	≤5.2	5.2-5.9	5.9-6.6	6.6-7.5	≥7.5	0.004
Underweight without DFT/Normal	84/603	75/609	70/616	57/612	53/624	
Adjusted OR (95%CI)	1.00 (ref.)	0.84 (0.60, 1.17)	0.81 (0.58, 1.14)	0.69 (0.49, 0.98)	0.60 (0.42, 0.87)	
Carbohydrates	≤49.9	49.9-53.4	53.4-56.8	56.8-60.8	≥60.8	0.0004
Underweight without DFT/Normal	48/618	57/627	82/604	67/618	85/597	
Adjusted OR (95%CI)	1.00 (ref.)	1.22 (0.82, 1.82)	1.80 (1.24, 2.62)	1.47 (1.00, 2.17)	1.93 (1.33, 2.81)	
Food intake (g/1000kcal)						
Cereal	≤165.9	165.9-201.2	210.2-232.5	232.5-274.4	≥274.5	0.004
Underweight without DFT/Normal	58/622	61/620	57/624	82/599	81/599	
Adjusted OR (95%CI)	1.00 (ref.)	1.06 (0.72, 1.54)	1.01 (0.69, 1.48)	1.52 (1.06, 2.17)	1.49 (1.04, 2.13)	
Rice	≤100.6	100.7-134.1	134.2-169.0	169.1-215.0	≥215.0	0.02
Underweight without DFT/Normal	49/631	64/617	81/600	72/609	73/607	
Adjusted OR (95%CI)	1.00 (ref.)	1.36 (0.92, 2.01)	1.78 (1.23, 2.59)	1.56 (1.07, 2.29)	1.59 (1.08, 2.32)	

(continued)

Western-style confectioneries	≤22.5	22.5-32.3	32.3-42.9	42.9-58.1	≥58.2	0.05
Underweight without DFT/Normal	74/606	81/600	66/615	59/622	59/621	
Adjusted OR (95%CI)	1.00 (ref.)	1.10 (0.78, 1.54)	0.85 (0.60, 1.22)	0.77 (0.54, 1.11)	0.80 (0.56, 1.15)	
Candies	≤0.6	0.6-1.3	1.3-2.7	2.7-5.1	≥5.1	0.002
Underweight without DFT/Normal	75/605	84/597	79/602	52/629	49/631	
Adjusted OR (95%CI)	1.00 (ref.)	1.16 (0.83, 1.62)	1.08 (0.77, 1.51)	0.70 (0.49, 1.02)	0.65 (0.45, 0.96)	
Ice cream	≤2.6	2.6-5.8	5.8-8.3	8.3-12.8	≥12.9	0.0002
Underweight without DFT/Normal	82/598	80/601	74/607	62/619	41/639	
Adjusted OR (95%CI)	1.00 (ref.)	0.98 (0.70, 1.36)	0.93 (0.66, 1.30)	0.75 (0.53, 1.06)	0.49 (0.59, 0.77)	
Fats and Oils	≤8.4	8.4-11.1	11.1-13.8	13.8-17.7	≥17.7	0.02
Underweight without DFT/Normal	75/605	81/600	65/616	67/614	51/629	
Adjusted OR (95%CI)	1.00 (ref.)	1.07 (0.77, 1.50)	0.85 (0.59, 1.20)	0.88 (0.62, 1.24)	0.66 (0.46, 0.97)	

Abbreviations: DFT; desire for thinness, OR; odds ratio, CI; confidence interval, Q; quintile.

† Food intake was energy-adjusted according to the density method.

‡ P for trend shows the risk of having a desire for thinness and not having a desire for thinness towards Q5 with reference to normal weight.

§ Adjusted for eating speed (fast, normal or slow).

CHAPTER 3

The effect of nutrition knowledge, media exposure, and thin-ideal internalization on dietary intake between underweight and not underweight individuals.

3.1 Introduction

In Japan, obesity and metabolic syndrome among middle-aged men has become a serious public health issues, whereas in young women, underweight in their twenties has reached to 21.5% due to an excessive desire to be slim (6). However, comprehensive measure against thinness is yet to be introduced due to the lack of evidence on factors associated with thinness especially in Japanese populations.

Based on the finding in Chapter 2, the author hypothesized that unfavorable dietary behavior may be caused by lack of nutrition knowledge. A study conducted among professional ballet dancers revealed that those with disordered eating displayed lower level of nutrition knowledge (16). In addition, Japanese government is currently promoting "*shokuiku*" which defined as "Acquisition of knowledge about food and nutrition and ability to make appropriate food choices through various experiences related to food, in order to develop people with the ability to practice a healthy diet" (17). The target is also set on underweight women as it has been stated in the "Basic Law on *Shokuiku*" itself (18).

Additionally, in recent years, mass media has been recognized as a behavior conditional source. An Italian study has concluded that mass media exposure provided a beneficial role towards healthy eating behavior (19). On the other hand, media with thin-ideal images are reported to cause body dissatisfaction, thin-ideal internalization, and disordered eating (20-22).

3.1.1 Nutrition knowledge

Nutrition education is designed for improving one's nutrition knowledge, with the aim of supporting appropriate dietary habits within the certain population (92-94). Despite the wide implementation of nutrition education initiatives known as *shokuiku*, the studies that have evaluated the association between nutrition knowledge level and dietary intake are

limited especially in Asian countries including Japan.

To date, most of the studies have reported that nutrition knowledge was associated with favorable aspects of diet as reviewed in Chapter 1 (34-54). Studies have shown that nutrition knowledge is also related to BMI. An Italian study reported that those with higher nutrition knowledge were associated with lower prevalence of obesity (34). A study conducted among UK professional ballet dancers revealed that those with disordered eating displayed lower level of nutrition knowledge, and suggested the negative impact on BMI (16). Another study conducted among UK university students, those with healthy BMI (18.5–25.0 kg/m^2) had higher nutrition knowledge scores than those who were underweight (95). Therefore, being underweight may be associated with lower nutrition knowledge level.

Currently, there is no study exist in Japan, which examined the effect of nutrition knowledge on dietary intake across the different BMI categories. Understanding of the relationship between nutrition knowledge and dietary intake is crucial in order to implement effective nutrition education initiatives. Additionally in Japan, usually women are responsible for cooking at home (96), meaning that her food choice not only influence her own diet but her future spouse's diet as well as their children.

3.1.2 Media exposure and thin-ideal internalization

Television viewing is widely recognized as weight-related health outcomes such as cardiovascular event, obesity (97, 98) and metabolic syndrome (99). However, a recent study found that combination of different types of media have a possibility of being behavior-conditioning source (19). An Italian study has concluded that mass media exposure provided a beneficial role towards healthy eating behavior, in this case adherence to Mediterranean diet (19). This particular study have found no association between mass

media exposure and BMI (19), which indicates that media exposure may be associated with healthy eating behavior regardless of BMI.

Mass media is defined as channels that carry mass communication; mass communication is any form of communication transmitted through a medium channel that simultaneously reaches the large number of people (56). A study has found that nearly three quarters of American adults reported the mass media was their top source of information on health and nutrition (57). A German study has also reported that mass media are the top sources of nutrition information among adolescents and adults (57). An Austrian study also indicated that newspaper articles, and the internet and booklets acted as a source of nutrition information, and were positively associated with daily fruits and vegetables consumption among adolescents (57).

To our knowledge, the relationship between mass media exposure and dietary intake is not previously investigated among Japanese population.

On the other hand, certain types of media with thin-ideal images are reported to cause body dissatisfaction, thin-ideal internalization and disordered eating (20-22). Western media is saturated with images promoting thinness, and such types of media could give a negative impact on dietary behaviors (21). It has been reported that Internet, watching soap operas, music program on TV, and magazines were positively related with disordered eating (21, 22, 58, 59). This phenomenon is called thin-ideal internalization, which defined as individual cognitions of societal norms of size and appearance, to the point of modifying one's behavior to approximate these standards (71). Thin-ideal internalization through the media is considered as one of the important factor for developing a DFT or disordered eating (20, 62, 64).

The author has also identified in Chapter 2 that the eating behavior of underweight Japanese women with a DFT was different from normal weight counterparts as they

consumed significantly less cereal and rice. Whereas in underweight women without a DFT consumed more cereal and rice, and lesser confectioneries and fats and oils. Having a DFT is likely to show diminishment of staple foods consumption even in underweight Japanese young women. A recent study also shows that internalization of weight bias is associated with eating problems even in lean individuals (100). Based on this, thin-ideal internalization is also likely show similar trend in dietary characteristics between different BMI categories.

This particular area of research is mainly conducted in the Western society, only few have seen in Asian countries, which do not include Japanese population. In addition, the effect of thin-ideal internalization to specific dietary intake has not been investigated, as main focus was being to identify whether the person have an eating disorder utilizing the scale called EAT-26 as described in Chapter 1.

3.2 Objectives and hypotheses

This chapter has thee objectives: **(Figure 3-1)**

1) To examine the effect of nutrition knowledge on dietary intake in different BMI categories among young Japanese women.
2) To examine the effect of mass media exposure on dietary intake in different BMI categories among young Japanese women.
3) To examine the effect of thin-ideal internalization on dietary intake in different BMI categories among young Japanese women.

3.3 Methods

3.3.1 Study design

The present study was based on a self-administered questionnaire survey conducted

from October to December 2014, among first year dietetic major and art major students of nine universities, located in the region includes the Greater Tokyo Area (including Saitama, Tokyo, and Chiba Prefectures) as well as Kansai region lies in Southern-central region (Nara, Kyoto, Osaka, Hyogo, and Shiga Prefectures) of Japan. The academic year usually commences from April in Japan, so that the participants did not have strong background of their specialty at this stage. The protocol of the study was approved by the Ethics Committee of the University of Tokyo, Faculty of Medicine (No.10526), and was also approved by each participating institution as necessary. The collaborators at each university explained the general purpose and outline of the survey to the participants and distributed a diet history questionnaire (DHQ) and a nutrition knowledge questionnaire (NKQ) either after/ before the assembly or lecture takes place. Written informed consent was obtained from all participants before completing the questionnaires. The participants were asked to complete those two sets of questionnaires in their free time and hand them over to the collaborator of corresponding institution. The completed questionnaires were then returned to the secretariat via collaborators and closely reviewed by the author and well-trained staff, most of whom were registered dietitians. Any questionnaire which does not fulfill the guideline, more than three unanswered in DHQ, or more than one unanswered in NKQ were returned to the participants, and asked to complete them before returning to the secretariat. Such clarifications were repeated up to twice.

3.3.2 Study population

A total of 719 students out of 1212 distributed, 381 were dietetic major (response rate = 59.0%) and 338 were art major (response rate = 59.7%) completed both questionnaires. For the present study, we selected 685 female subjects aged 18-20 y after exclusion of the following: 1) male subjects (n = 25), 2) subjects do not fall into the age category of 18-20 y

(n = 8), 3) subject with an energy intake less than 500 or more than 4000 kcal/day, as this individual was considered to be extreme under- or over-reporter (n = 1). **(Figure 3-2)**

3.3.3 Dietary assessment

Dietary habits of the preceding month were assessed using a previously validated; DHQ (79-83) Details of questionnaire is previously described in Chapter 2.

Selection of nutrient was performed based on its importance of causing particular health outcome due to excess or little intake, especially among young women. Other than energy providing macronutrients, lack of dietary fiber is related to constipation (76), lack of folate is causing neural tube defects in pregnant women (101), and lack of potassium and excess intake of sodium is associated with hypertension (102). Furthermore, little intake of calcium and iron may affect bone health (103) and cause anemia (104) respectively.

3.3.4 Estimation of nutrition knowledge

Nutrition knowledge level of each subject was assessed using a previously pilot tested NKQ. The framework of the questionnaire was based on the “Nutrition Knowledge Questionnaire” developed by Parmenter et al (105). The questionnaire consists of five parts of the following: 1) Nutrients found in food, 2) Physiological function of nutrients, 3) Awareness of dietary recommendations, 4) Nutrients and its relation to health consequences, and 5) Other questions related to dietary behaviors and background information of subjects.

The total score of nutrition knowledge was initially planned to calculate by using the percentage of correct answers obtained from part 1), 2), 3), and 4) respectively. However, since the section on “awareness of dietary recommendation” had a much lower percentage of correct answers compare to other sections, therefore it was not included in the analysis.

In order to calculate the percentage of correct answers of all sections, those who got the right answer receive 1 point, and those did not get the right answer receive 0 point in each question, and such calculation was repeated in all 78 questions. Total number of right answers were then divided by 78 (all questions) to get the total percentage of correct answers **(See Appendix 1 for full list of questions)**.

The determination of each items (questions) were made in following steps. First, papers in English which include full description of all items of nutrition knowledge questionnaire were searched through PubMed and relevant articles cited in the original articles were also reviewed. Those including questions on variety of nutrients and mainly developed in developed countries were selected. A total number of literatures used upon development of questionnaire was eight (49, 105-111), and all questions were translated into Japanese language. Since all questionnaires were established in countries other than Japan, foods, nutrients, and dietary behavior asked in the questionnaire were reconsidered to adapt to Japanese food culture.

Total percentages of correct answers were calculated in both underweight (BMI <18.5) and not underweight group (BMI >18.5).

3.3.5 Media Exposure Questionnaire

The study employed a Media Exposure Questionnaire (MEQ) that have been developed and validated previously by Italian researchers (19). MEQ included questions on 1) newspaper, magazines and specialized press reading frequency; 2) whether the subjects have received information on health and prevention, and 3) whether they use the Internet to read press agency online.

3.3.6 Sociocultural Attitudes towards Appearance Questionnaire-3 (SATAQ-3)

The present study has employed previously developed SATAQ-3JS which was translated into Japanese language (112). SATAQ-3 is originally consists of 30 item assessing four dimensions of media influence on body image, including information, pressures, internalization-general, and internalization-athletic (71). The newly created SATAQ-3JS version consists of 12 items covering the same four dimensions. Although SATAQ-3JS is shorter than the original scale, the total score and sub scale were both found to be internally consistent (112). Thus SATAQ-JS3 is considered to be reliable and a valid scale to be used in the screening purpose. In the present study, three items on internalization-athletic were not included as the target population was young female, who are very unlikely to internalize the muscular body image. The research has suggested that men and women may experience body dissatisfaction in different ways, women being are more likely to report wanting to lose weight, while men are more likely to report wanting to gain muscle mass (113). Each question has five scales of definitely disagree (1 point), mostly disagree (2 points), neither agrees nor disagrees (3 points), mostly agree (4 points) and definitely agree (5 points).

3.3.7 Socio-demographic and lifestyle variables

The subjects reported their body weight, height in the DHQ. BMI was calculated as current body weight (kg) divided by the square of body height (m). Socio-demographic and lifestyle variables were obtained also through NKQ. In the NKQ, the subject reported whether she is living in a dormitory, their name of the university and major, and the region and municipality level that she resides in the past month. Residential area was divided into two big regions of Japan (Eastern Japan and Western japan), as well as into three municipality levels (Ward, City, Town or Village). Since the survey was conducted right

after the summer holiday, some students declared that they spent their summer in their hometown. Interest in food and cooking, interest in nutrition, and interest in health were also asked. In addition, self-perceived weight status, presence of a DFT, and history of weight loss attempts were obtained. To better understand other related dietary behaviors, the questionnaire also asked on frequency of eating breakfast, frequency of eating out for dinner. The subjects also reported hours of sleep, and the frequency and intensity of different types of physical activity. For those whose recorded duration of activities totaled less than 24 hours, unrecorded hours were assumed as sedentary activities, while for over-reporters, the total duration of activity was proportionally adjusted to equal 24. Metabolic equivalent hours (METs*hour) were calculated by assigning activities with a metabolic equivalent value in accordance with a previous paper (i.e. 1.0 for sleeping, 1.3 for sedentary activity, 3.5 for walking, 6.0 for moderate-intensity activity, and 8.0 for high-intensity activity) (84). The total number of hours spent on each activity was then multiplied by the metabolic equivalent value assigned for each activity.

3.3.8 Statistical Analysis

The mass media exposure component was obtained by principal component analysis (PCA) utilizing the same methodology as the previous study (19). The main purpose of PCA is to derive a small number of components that explains the variability in large number of subjects. In this case, the PCA was conducted on the correlation matrix of the eight items of the mass media exposure (predictors) and identify linear functions of predictors (factors). In the present study, we adopted the procedure that was used in the previous study, which extracted single factor. The correlation of each extracted factor and mass media exposure, namely factor loadings were obtained through this process, and numbers are illustrated in **Table 3-1**. A factor score was calculated by summing all the

predictors and each of them are weighed by factor loadings.

The SATAQ score was obtained by adding the corresponding score, the five scales of definitely disagree (1 points), mostly disagree (2 points), neither agrees nor disagrees (3 points), mostly agree (4 points) and definitely agree (5 points) on each question.

Values of nutrients and food intakes used in the analysis were adjusted for energy using the density method (i.e. percentage of energy for energy-providing nutrients and amount per 1,000 kcal of energy of other nutrients and foods) (114).

All socio-demographic variables and mean dietary intake were compared by t-test for continuous variables, and chi-squared test for categorical variables between underweight and not underweight group.

Multiple regression analyses were performed to investigate the effect of nutrition knowledge, media exposure, and thin-ideal internalization on dietary intake in both underweight and not underweight group.

For assessing the effect of nutrition knowledge on dietary intake, as nutrition knowledge is likely to be higher in the dietetic major students, and university variation may affect nutrition knowledge, major and university variation were added as confounders. Physical activity level (METs) was also included as confounders for energy intake, and the rest of the energy-adjusted nutrients and food groups were only adjusted for major and university variation.

For assessing the effect of media exposure on dietary intake, other than major, university variation, and physical activity level, living status was added as media exposure level of those who are living with family and alone are considered to be different.

For assessing the effect of thin-ideal internalization, other than physical activity level, frequency of eating out for dinner and sleep hours were chosen as possible confounders. The frequency of eating out for dinner may affect the dietary intake. Sleep deprivation is

associated with lower diet quality among young female (115).

Further, the difference in effect of nutrition knowledge, media exposure, and thin-ideal internalization on dietary intake among underweight and not underweight group were examined by adding the interaction term.

All statistical analyses were performed using SAS program version 9.4 (SAS Institute Inc., Cary, NC, USA). All reported p values of < 0.05 were considered statistically significant.

3.4 Results

Socio-demographic and lifestyle characteristics of the subjects of underweight and not underweight group are described in **Table 3-2**. The mean nutrition knowledge of all subjects was 67.1 ± 11.8 (mean ± SD) and there was no significant difference between underweight and not underweight group. Media exposure component was significantly higher in the underweight group (p=0.05) and SATAQ score was significantly higher in the not underweight group.

Mean values of all subjects were aged 18.6 years, height 158.2 cm, weight 50.9 kg, and BMI 20.3 kg/m^2. The mean METs of all subjects was 35.2 ± 19.3 (mean ± SD).

As much as 63.2% of not underweight subjects consider themselves being heavy in their body weight, 82.2% had a DFT and 78.8% had a history of weight loss behavior. While in underweight group, 28.1% still had a DFT and as much as 92.2% of the subject had a history of weight loss behaviors. No statistical differences were noted for other variables.

Table 3-3 describes the dietary intake between two groups. No statistical differences were found in all nutrient and food groups.

Despite the interaction between two groups were significant in intake of fruits and meat, the association between nutrition knowledge was different between the groups. After

adjusting the confounders, nutritional knowledge was positively associated with intake of protein (p = 0.02), dietary fiber (p = 0.02), folic acid (p = 0.01), potassium (p = 0.004), calcium (p = 0.003), iron (p = 0.03) among not underweight group. Whereas in underweight group, nutrition knowledge was positively associated with protein (p=0.005), iron (p=0.05), and meat intake (p=0.04). For food intake, nutrition knowledge was positively associated with intake of vegetables (p = 0.0008), and dairy products (p = 0.003) among not underweight group. Whereas in underweight subjects, nutrition knowledge was positively associated with intake of meat**.** The number of significant association between nutrition knowledge and nutrients or food intake of which considered as an indicator for healthy eating behavior was greater among not underweight individuals **(Table 3-4)**.

The effect of media exposure on dietary intake was examined in both groups as described in **Table 3-5**. Although, interaction of media exposure among two groups were only significant in sodium and eggs, the association between media exposure and dietary intake was different between two groups. Media exposure was significantly positively associated with energy (p=0.03), protein (p = 0.002), dietary fiber (p = 0.0005), folic acid (p = 0.0001), sodium (p=0.0007), potassium (<0.001), calcium (p = 0.003), iron (<0.001) among not underweight group. On the other hand, media exposure was positively associated with intake of fat (p=0.05), and inversely associated with intake of carbohydrate (p=0.05). For food groups, media exposure was positively associated with intake of fruits (p=0.05), vegetables (p = 0.007), and fish and shellfish (p = 0.001), and inversely associated with cereal intake (p=0.001) among not underweight group. Whereas in underweight subjects, media exposure was positively associated with meat intake (p=0.04). The number of significant association between media exposure and nutrients or food intake of which considered as an indicator for healthy eating behavior was greater among not underweight individuals, except for outstandingly high sodium intake.

Table 3-6 shows the effect of thin-ideal internalization on dietary intake. SATAQ score was positively associated with intake of energy (p=0.006), fat (p=0.04), folic acid (p=0.05), iron (p=0.008) among not underweight group. Whereas in underweight group, SATAQ score was positively associated with intake of energy (p=0.02), fat (p=0.03), sodium (p=0.008) and potassium (p=0.05), and inversely associated with carbohydrate (p=0.02). For food intake, SATAQ score was positively associated with intake of sugar and confectioneries (p=0.02), and inversely associated with cereal intake (p=0.006). For underweight subjects, SATAQ score was positively associated with fats and oils, (p=0.03), and negatively associated with and cereal intake (p=0.005). In terms of interaction between the two groups, significant difference were observed in protein and sodium intake. The results indicate no clear difference between two groups, however it should be noted that significantly high sodium intake among underweight individuals with high SATAQ score was observed.

3.5 Discussion

The present study inferred that increasing one's nutrition knowledge gives a beneficial impact on dietary intake among not underweight individuals, as nutrition knowledge was positively associated with intake of protein, dietary fiber, folic acid, potassium, calcium, iron, vegetables and dairy products among not underweight group.

However, those who were underweight did not show the same effect of nutrition knowledge on dietary intake, which indicates that the nutrition education may not be the most preventive measure for underweight individuals.

Based on the review conducted in Chapter 1, nutrition knowledge is associated with favorable aspects of diet (34-54). Some of our results indicated the consistent results with the previous studies, increased nutrition knowledge level is associated with higher intake

of protein (35), dietary fiber (39, 50), iron (36), vegetables (38, 40-42, 44, 49-52), and dairy products (47, 48, 51, 52). Since there was no significant difference found on nutrition knowledge between two groups, similar trend of dietary intake should have been observed. However, the current study has found that effect of nutrition knowledge on dietary intake differed between two groups, indicating that nutrition education may not be the most preventive measure for underweight individuals. It may be necessary to consider different approach for the implementation of healthy eating behavior among underweight women. A study conducted in Spain indicated that nutrition education along with the psychological and psychiatric treatment may be effective among anorexia nervosa patients (116). Since the characteristics of patients with eating disorder and underweight women are appeared be different, further studies with a large number of underweight women are required for the development of effective approach.

There was other inconsistency with previous studies, which showed lower nutrition knowledge level among underweight individuals (16, 95). However, the present study have found no significant difference between two groups. Although one study conducted previously found no association between nutrition knowledge and BMI (117), one of the reason could be because of the population characteristic of this study. Subjects were all equally educated as we recruited university students. Educational level is closely related with healthy eating behavior (118).

For media exposure, association between the two groups were clearly different. Media exposure showed positive relationship with generally favorable eating behavior except for high sodium intake among not underweight subjects. On the other hand, underweight women indicated no clear association between media exposure and dietary intake.

In recent years, mass media is considered as a behavior conditioning source for the

implementation of healthy diet, as an Italian study have shown that a higher adherence to Mediterranean diet as they are highly exposed to mass media (19). In addition, exposure to nutrition information on mass media such as newspaper, Internet and booklets showed higher fruit and vegetable intake (57). The present study has found that those who are underweight had significantly higher exposure to mass media and associated with undesirable aspects of diet, although previous study indicated that no significant association was noted on mass media exposure and BMI (19).

Table 3-1 indicates that the factor loading of magazine exposure was larger than other types of media this particular population. This finding leaves the possibilities of either excess exposure to mass media, particularly magazines is associated with undesirable dietary habits, or being underweight is not susceptible for gaining quality information from the mass media contents, but susceptible for obtaining other unnecessary information that gives undesirable effect on dietary habits. However, in order to proof this, the quality assessment of Japanese mass media contents is necessary for further discussion.

The effect of thin-ideal internalization on dietary intake did not show clear difference in both groups. SATAQ score was associated with both undesirable and favorable aspects of diet in both BMI categories. Notably, sodium intake was significantly higher among underweight individuals. In both BMI categories, SATAQ score was inversely associated with cereal consumption. This phenomenon may be related to recognition of low-carbohydrate diet as already discussed in Chapter 2.

Previous studies have indicated that thin-ideal media internalization is associated with disordered eating (20, 62, 64). Even those who were underweight had eating problems when a DFT (Chapter 2) or internalization of weight bias (100) was present. However, this study did not show clear association which indicates disordered eating. This may be

because media is not only factor for developing thin-ideal internalization among Japanese young female. Other factors such as pressures from the family or friends may play a role to affect one's dietary intake (25).

To combat against anorexia nervosa, banning of skinny models whose BMI is under 18 which are already in force in some European countries, including France, Italy, Spain and Israel (119). However, based on the results obtained in the current study, quality assessment of mass media contents is the first priority.

3.6 Study strength and limitations

This is the first study documented the association between nutrition knowledge, media exposure, and thin-ideal internalization and dietary intake among Japanese young women in different BMI categories. In addition, author employed the previously validated DHQ for dietary assessment, which made it possible to compare with studies conducted in the past.

However, several limitations can be noted. First, the selection of universities was based on our research network and thus random sampling was not adopted. In order to standardize the characteristics of subjects, we have recruited both dietetic and art major students to increase the representativeness of the specific age categories. All the universities are located in urban or suburban region of both Kanto (greater Tokyo area) and Kansai (greater Osaka area), where they can easily access to supermarkets with similar market prices. Additionally, considering the educational level, the questionnaires were distributed only to the first year students in both major; ensuring that dietetic students are yet to be fully educated which may influence their dietary intake.

Second, the NKQ we have utilized in the study is a newly developed questionnaire for Japanese adults and not validated elsewhere. However, we employed the concepts, which

are in line with Parmenter et al. that was developed and validated for use in the UK (105).

Third, all the variables including body weight and height were self-reported and these values may have been under-, over-reported or biased. However, these body weight and height can be considered to be similar to national representative, as our subjects were in line with the recent National Health and Nutrition Survey 2013, which was measured individually, reported average body weight and height of 18 year old women were 158.1 cm, and 50.4 kg respectively (120).

Fourth, we have employed English version of MEQ that was used in the previous study. The English version of the questionnaire has been validated by a test-retest method, and Cronbach's alpha was also used to estimate internal consistency. Although the Italian version has been validated as described above, our Japanese version was translated by the author and did not go through validation procedure. Therefore, based on the fact that number of people who read newspaper is decreasing, especially at younger population, the questionnaire may needed to adapt to Japanese culture for future use.

Fifth, as mentioned in Chapter 2, there is a possibility that the current population may have some hidden cases of eating disorders, as the diagnostic criteria of anorexia nervosa in Japan (established by the study group of the Ministry of Health, Labour and Welfare) include "having erroneous self-perceived weight and/or body image" as an item. However, since the prevalence of anorexia nervosa was ranged between from 0.025% to 0.2% in Japan (89), the number of subjects with eating disorder in the present study may not be so large.

Sixth, there may be other potential variables that have confounded the results, such as monetary cost of diet (121), or family and peer endorsement (63, 122), which may have given an impact on dietary intake.

Finally, all self-reported dietary assessments are subject to measurement error and

under- or over-reporting of dietary intake (90, 91). We attempted to minimize these possibilities by adopting a previously validated DHQ (79-83). In addition, completed questionnaires were closely reviewed by well-trained staff and unclear responses were confirmed with the student.

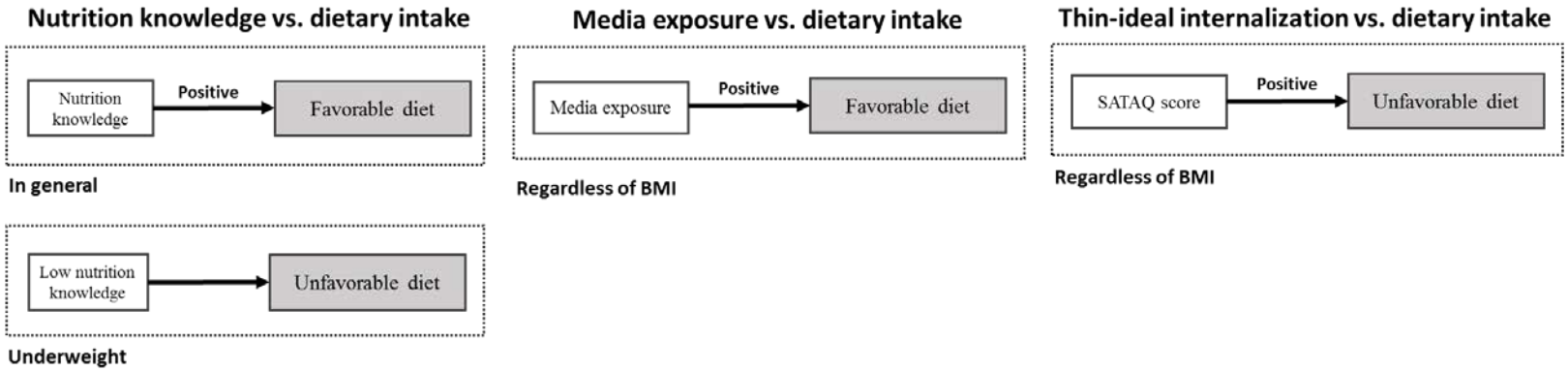


Figure 3-1. Flow diagram of study hypotheses.

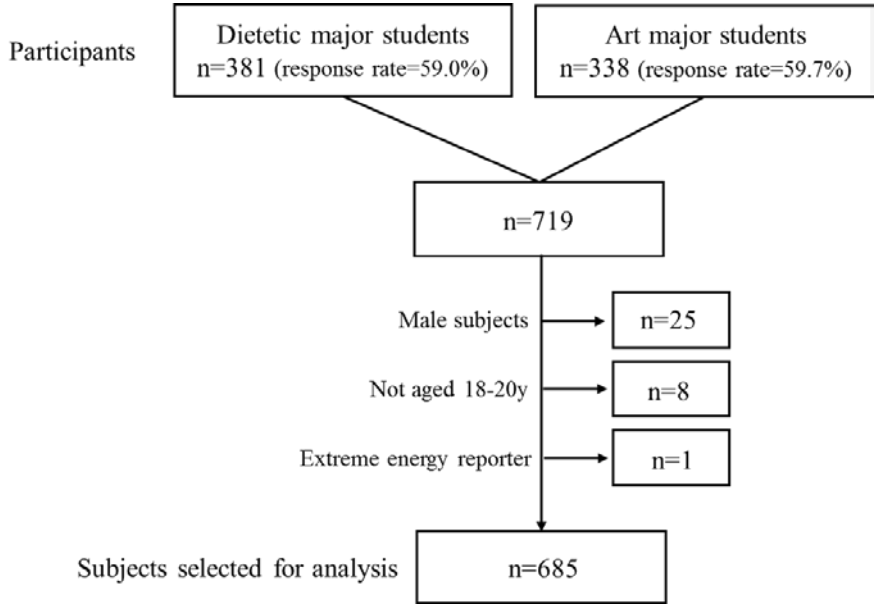


Figure 3-2. Flow chart of subjects.

Table 3-1. Factor loadings of media exposure information score empirically derived by principal component analysis

Questions	n	Factor loading†
How often do you watch TV news?		0.47
Many times a day	36	
Everyday	302	
Some days a week	260	
Some days a month	37	
Never or almost never	50	
How often do you buy newspapers per week?		0.19
Daily	150	
4-5 times	7	
A couple of times	11	
Never or almost never	517	
How often do you read newspapers not bought directly by you (e.g. clinics or cafes)?		0.33
Daily	13	
4-5 times	7	
A couple of times	62	
Never or almost never	603	
How often do you buy monthly magazines in a year?		0.67
Once a month	123	
Less than 4 times per year	119	
Never or almost never	443	
How often do you read monthly magazines not bought directly by you in a year?		0.72
Once a month	102	
Less than 4 times per year	118	
Never or almost never	465	
Have you ever received information on health and prevention?		0.1
Yes	500	
No	184	
Do you read newspapers online when surfing the Internet?		0.33
Yes	118	
No	567	
Do you read press agency online when surfing the Internet?		0.38
Yes	490	
No	194	

† Factor loadings are the correlation between each extracted factors and mass media exposure.

Table 3-2. Basic characteristics of 685 Japanese young women.

	All (n=685)	Not underweight (n=557)	Underweight (n=128)	p†
	Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)	
Nutrition knowledge	67.1±11.8	67.3±11.4	66.3±13.5	0.42
Media exposure component	1.76±1.0	-0.04±1.0	0.2±1.1	0.05
SATAQ score	31.0±7.4	31.6±7.3	28.6±7.2	<.0001
Age	18.6±0.6	18.7±0.6	18.6±0.6	0.26
18 years	272 (39.7)	215 (39.7)	57 (44.5)	0.46
19 years	385 (56.2)	319 (56.2)	66 (51.6)	
20 years	28 (4.1)	23 (4.1)	5 (3.9)	
Height (cm)	158.2±5.2	158.0±5.1	159.1±5.5	0.03
Weight (kg)	50.9±6.7	52.5±6.2	44.2±3.7	<.0001
BMI (kg/m^2)	20.3±2.4	21.0±2.1	17.4±0.9	<.0001
Dormitory				0.56
Yes	74 (10.8)	62 (11.1)	12 (9.4)	
No	611 (89.2)	495 (88.7)	116 (90.6)	
Residential status				0.56
Living with family or others	594 (86.7)	481 (86.4)	113 (88.3)	
Living alone	91 (13.3)	76 (13.6)	15 (11.7)	
Region				0.46
Eastern Japan	231 (34.0)	192 (34.7)	39 (31.2)	
Western Japan	448 (66.0)	362 (65.3)	86 (68.8)	
Municipality level				0.27
Ward	184 (27.1)	156 (28.2)	28 (22.6)	
City	479 (67.7)	372 (67.2)	87 (70.2)	
Town or village	35 (5.2)	26 (4.7)	9 (7.3)	
University variation				0.55
University 1	62 (9.1)	51 (9.2)	11 (8.6)	
University 2	57 (8.3)	49 (8.8)	8 (6.3)	
University 3	92 (13.4)	73 (13.1)	19 (14.9)	
University 4	28 (4.1)	24 (4.3)	4 (3.1)	
University 5	96 (14.0)	80 (14.4)	16 (12.5)	
University 6	35 (5.1)	28 (5.0)	7 (5.5)	
University 7	52 (7.6)	47 (8.4)	5 (3.9)	
University 8	48 (7.0)	36 (6.5)	12 (9.4)	
University 9	215 (31.4)	169 (30.3)	46 (35.9)	
Major				0.72
Dietetics	354 (51.7)	286 (51.4)	68 (53.1)	
Art	331 (48.3)	271 (48.7)	60 (46.9)	
Interests in food and cooking				0.64
Yes	587 (85.7)	479 (86.0)	108 (83.4)	
No	98 (14.3)	78 (14.0)	20 (15.6)	
Interests in nutrition				0.87
Yes	560 (81.8)	456 (81.9)	104 (81.3)	
No	125 (18.3)	101 (18.1)	24 (18.6)	
Interests in health				0.15
Yes	613 (89.5)	503 (90.3)	110 (85.9)	
No	72 (10.5)	54 (9.7)	18 (14.1)	
Physical activity (METs: hrs/wk)	34.5±7.7	34.6±7.9	34.3±6.5	0.7

(Continued)

Self-perceived weight status				<.0001
Thin	76 (11.1)	18 (3.2)	58 (45.3)	
About right	241 (35.2)	187 (33.6)	54 (42.2)	
Heavy	368 (53.7)	352 (63.2)	16 (12.5)	
Desire for thinness				<.0001
Yes	494 (72.1)	458 (82.2)	36 (28.1)	
No	191 (27.9)	99 (17.8)	92 (71.9)	
History of weight loss behavior				0.0005
Yes	557 (81.3)	439 (78.8)	118 (92.2)	
No	128 (18.7	118 (21.2)	10 (7.8)	
Breakfast				0.55
Everyday	504 (73.7)	415 (74.6)	89 (69.5)	
4 to 6 days a week	142 (20.8)	113 (20.3)	29 (22.7)	
1 to 3 days a week	30 (4.4)	22 (4.0)	8 (6.3)	
None	8 (1.2)	6 (1.1)	2 (1.6)	
Duration of dinner				0.64
Less than 10 mins	10 (1.5)	9 (1.6)	1 (0.8)	
10 to 30 mins	411 (60.0)	339 (60.9)	72 (56.3)	
30 mins to 1 hr	255 (37.2)	202 (36.3)	53 (41.4)	
More than 1 hr	9 (1.3)	7 (1.3)	2 (1.6)	
Frequency of eating out for dinner				0.25
None	89 (13.0)	70	19 (14.8)	
Less than once a month	103 (15.0)	90	13 (10.2)	
Less than once a week/More than once a month	371 (54.2)	295	76 (59.4)	
More than twice a week	122 (17.8)	102	20 (15.6)	
Sleep hours (hours)	6.6±1.8	6.6±1.7	6.6±2.0	0.85

Abbreviations: SD; standard deviation, BMI; body mass index, METS; metabolic equivalents.

† Means for continuous values were compared by t-test and proportions for categorical valuables by the chi-squared test.

Table 3-3. Dietary characteristics of 685 Japanese young women.

	All (n=685)	Not underweight (n=557)	Underweight (n=128)	p‡
	Mean±SD	Mean±SD	Mean±SD	
Energy (kcal/day)	1763±524	1761±516	1771±558	0.86
Nutrient				
Protein (% energy)	13.0±2.1	13.0±2.1	13.1±2.1	0.47
Fat (% energy)	29.7±6.4	29.7±6.4	29.9±6.5	0.77
SFA (% energy)	8.6±2.4	8.6±2.4	8.6±2.5	0.57
Carbohydrate (% energy)	56.0±7.3	56.1±7.3	55.7±7.3	0.62
Dietary fiber (g/1000kcal)	6.1±1.8	6.1±1.8	6.2±2.1	0.37
Folic acid (μg/1000kcal)	141±51	141±51	141±52	0.92
Sodium (mg/1000kcal)	2062±619	2046±625	2131±591	0.16
Potassium (mg/1000kcal)	1040±280	1041±284	1036±264	0.85
Calcium (mg/1000kcal)	247±88	249±87	241±93	0.36
Iron (mg/1000kcal)	3.6±1.0	3.6±1.0	3.6±0.9	0.8
Food (g/1000kcal)				
Cereal	222.0±72.5	221.5±73.1	224.3±70.5	0.7
Sugar and Confectioneries	57.3±29.3	57.8±29.7	55.1±27.7	0.35
Fats and Oils	12.7±7.5	12.6±7.3	12.7±0.7	0.74
Fruits	29.4±33.8	29.0±33.7	31.0±34.3	0.55
Vegetables	97.0±58.6	96.1±57.9	100.5±61.7	0.44
Fish and shellfish	22.8±15.0	22.6±15.1	23.4±14.6	0.62
Meats	38.0±19.0	37.5±18.8	40.0±19.7	0.18
Eggs	19.6±16.7	19.6±16.3	19.7±18.4	0.97
Dairy products	22.4±25.0	22.7±25.4	21.1±23.6	0.5

Abbreviations: SD; standard deviation, SFA; saturated fatty acids.

† Nutrient and food intake were energy-adjusted according to the density method.

‡ Mean intake values of nutrients and foods were compared by t-test.

Table 3-4. Comparison of the effect of nutrition knowledge on dietary intake between not underweight and underweight Japanese young women by multiple regression models.

	Not underweight (n=557)				Underweight (n=128)				Interaction
	β1	±	SE	p	β1	±	SE	p	p[§]
Energy (kcal/day)	2.24	±	2.02	0.27	-0.86	±	3.97	0.83	NS
Nutrient									
Protein (% energy)	0.02	±	0.008	0.02	0.04	±	0.01	0.005	NS
Fat (% energy)	-0.02	±	0.02	0.52	0.06	±	0.04	0.2	NS
SFA (% energy)	-0.005	±	0.01	0.62	0.02	±	0.02	0.27	NS
Carbohydrate (% energy)	0.001	±	0.03	0.97	-0.09	±	0.05	0.07	NS
Dietary fiber (g/1000kcal)	0.02	±	0.007	0.02	0.01	±	0.01	0.32	NS
Folic acid (μg/1000kcal)	0.52	±	0.20	0.01	0.37	±	0.37	0.32	NS
Sodium (mg/1000kcal)	0.48	±	2.44	0.84	-1.67	±	4.24	0.69	NS
Potassium (mg/1000kcal)	3.20	±	1.11	0.004	2.21	±	1.84	0.23	NS
Calcium (mg/1000kcal)	1.02	±	0.34	0.003	0.64	±	0.64	0.33	NS
Iron (mg/1000kcal)	0.0008	±	0.004	0.03	0.01	±	0.007	0.05	NS
Food (g/1000kcal)									
Cereal	-0.24	±	0.28	0.41	-0.50	±	0.49	0.31	NS
Sugar and Confectioneries	-0.08	±	0.12	0.53	-0.20	±	0.19	0.3	NS
Fats and Oils	-0.05	±	0.03	0.08	-0.001	±	0.05	0.98	NS
Fruits	0.02	±	0.13	0.9	0.43	±	0.24	0.07	*
Vegetables	0.76	±	0.23	0.0008	0.26	±	0.43	0.54	NS
Fish and shellfish	0.08	±	0.06	0.14	0.14	±	0.10	0.17	NS
Meats	-0.07	±	0.07	0.37	0.29	±	0.14	0.04	*
Eggs	0.10	±	0.06	0.1	0.12	±	0.12	0.3	NS
Dairy products	0.29	±	0.10	0.003	0.06	±	0.17	0.74	NS

Abbreviations: SE; standard error, NS; not significant, SFA; saturated fatty acids, METs; metabolic equivalents.

† Nutrient and food intake were energy-adjusted according to the density method.

‡ The effect of nutrition knowledge was adjusted for METs (only apply for energy intake), major (dietetics or art), and university variation.

§ The interaction between normal weight and underweight group was examined in the following model: nutrients or food intake = intercept + β1 (nutrition knowledge (continuous)) + β2 weight category (not underweight or underweight) + β3 (METs (only apply for energy intake)) + β4 (major (dietetics or art)) + β5 (university variation) + β6 (nutrition knowledge (continuous))*weight category not underweight or underweight) (*P<0.05, **P<0.01, and ***P<0.001)

Table 3-5. Comparison of the effect of media exposure on dietary intake between not underweight and underweight Japanese young women by multiple regression models.

	Not underweight (n=557)				Underweight (n=128)				Interaction
	β1	±	SE	p	β1	±	SE	p	p[§]
Energy (kcal/day)	49.07	±	22.58	0.03	36.68	±	47.41	0.44	NS
Nutrient									
Protein (% energy)	0.29	±	0.09	0.002	0.15	±	0.18	0.4	NS
Fat (% energy)	0.32	±	0.28	0.25	1.04	±	0.53	0.05	NS
SFA (% energy)	0.10	±	0.11	0.36	0.26	±	0.21	0.21	NS
Carbohydrate (% energy)	-0.46	±	0.32	0.15	-1.21	±	0.60	0.05	NS
Dietary fiber (g/1000kcal)	0.27	±	0.08	0.0005	0.10	±	0.18	0.58	NS
Folic acid (μg/1000kcal)	8.64	±	2.24	0.0001	3.28	±	4.45	0.46	NS
Sodium (mg/1000kcal)	93.00	±	27.30	0.0007	-21.67	±	50.78	0.67	*
Potassium (mg/1000kcal)	60.54	±	12.29	<.0001	20.97	±	22.08	0.34	NS
Calcium (mg/1000kcal)	11.2	±	3.79	0.003	-1.95	±	7.74	0.8	NS
Iron (mg/1000kcal)	0.16	±	0.04	<.0001	0.02	±	0.15	0.76	NS
Food (g/1000kcal)									
Cereal	-10.2	±	3.14	0.001	-8.60	±	5.84	0.14	NS
Sugar and Confectioneries	-1.01	±	1.33	0.45	-0.39	±	2.29	0.87	NS
Fats and Oils	-0.12	±	0.33	0.72	0.96	±	0.65	0.14	NS
Fruits	2.93	±	1.49	0.05	2.05	±	2.86	0.47	NS
Vegetables	6.93	±	2.56	0.007	4.31	±	5.17	0.41	NS
Fish and shellfish	2.16	±	0.66	0.001	2.06	±	1.23	0.1	NS
Meats	0.13	±	0.84	0.88	3.51	±	1.66	0.04	NS
Eggs	0.51	±	0.71	0.48	-2.18	±	1.43	0.13	*
Dairy products	1.46	±	1.13	0.2	1.23	±	2.02	0.54	NS

Abbreviations: SE; standard error, NS; not significant, SFA; saturated fatty acids, METs; metabolic equivalents.

† Nutrient and food intake were energy-adjusted according to the density method.

‡ The effect of media exposure was adjusted for living status (living with family or living alone), METs (only apply for energy intake), major (dietetics or art), and university variation.

§ The interaction between normal weight and underweight group was examined in the following model: nutrients or food intake = intercept + β1 (media exposure (continuous)) + β2 weight category (not underweight or underweight) + β3 (living status (living with family or living alone) + β4 (METs (only apply for energy intake)) + β5 (major (dietetics or art)) + β7 (university variation) + β7 (media exposure (continuous))*weight category (not underweight or underweight) (*P<0.05, **P<0.01, and ***P<0.001)

Table 3-6. Comparison of the effect of thin-ideal internalization on dietary intake between not underweight and underweight Japanese young women by multiple regression models.

	Not underweight (n=557)				Underweight (n=128)				Interaction
	β1		SE	p	β1		SE	p	p[§]
Energy (kcal/day)	8.18	±	2.99	0.006	16.41	±	7.21	0.02	NS
Nutrient									
Protein (% energy)	-0.006	±	0.01	0.62	0.05	±	0.03	0.06	*
Fat (% energy)	0.08	±	0.04	0.04	0.19	±	0.08	0.03	NS
SFA (% energy)	0.02	±	0.01	0.09	0.04	±	0.03	0.17	NS
Carbohydrate (% energy)	-0.06	±	0.04	0.16	-0.22	±	0.09	0.02	NS
Dietary fiber (g/1000kcal)	0.01	±	0.01	0.22	0.009	±	0.03	0.77	NS
Folic acid (μg/1000kcal)	0.58	±	0.30	0.05	0.54	±	0.68	0.43	NS
Sodium (mg/1000kcal)	-0.20	±	3.68	0.97	20.44	±	7.63	0.008	*
Potassium (mg/1000kcal)	2.94	±	1.67	0.08	6.96	±	3.48	0.05	NS
Calcium (mg/1000kcal)	0.63	±	0.52	0.23	1.93	±	1.22	0.12	NS
Iron (mg/1000kcal)	0.01	±	0.005	0.008	0.02	±	0.01	0.12	NS
Food (g/1000kcal)									
Cereal	-1.19	±	0.43	0.006	-2.57	±	52.71	0.005	NS
Sugar and Confectioneries	0.39	±	0.17	0.02	0.33	±	0.36	0.36	NS
Fats and Oils	0.08	±	0.04	0.07	0.23	±	0.10	0.03	NS
Fruits	-0.07	±	0.20	0.71	0.14	±	0.45	0.76	NS
Vegetables	0.37	±	0.34	0.27	0.28	±	0.81	0.73	NS
Fish and shellfish	-0.04	±	0.09	0.69	0.03	±	0.19	0.89	NS
Meats	-0.07	±	0.11	0.51	0.13	±	0.26	0.22	NS
Eggs	-0.05	±	0.10	0.62	0.21	±	0.24	0.38	NS
Dairy products	0.24	±	0.15	0.1	0.56	±	0.30	0.07	NS

Abbreviations: SE; standard error, NS; not significant, SFA; saturated fatty acids, METs; metabolic equivalents.

† Nutrient and food intake were energy-adjusted according to the density method.

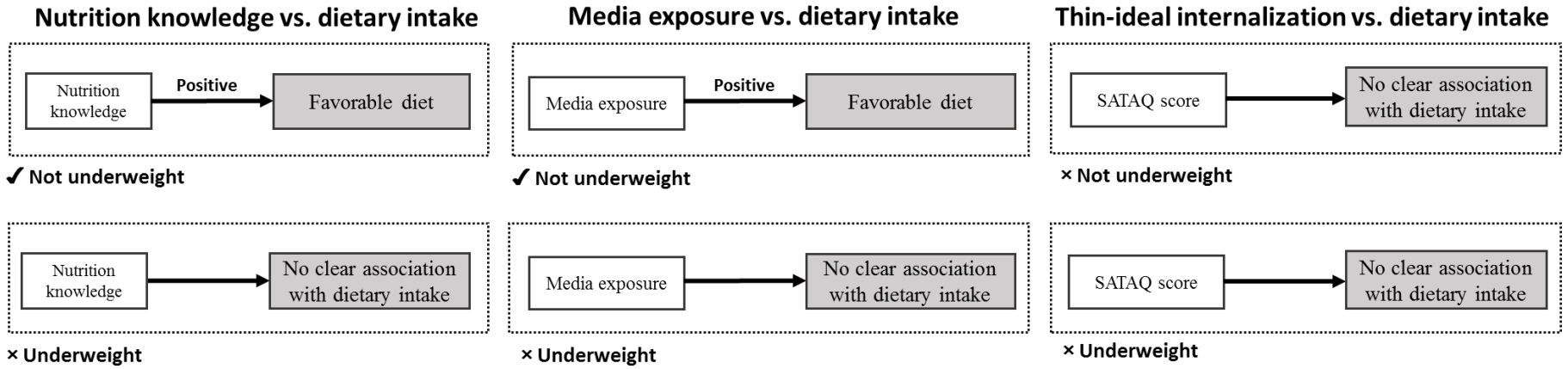
‡ The effect of thin-ideal internalization was adjusted for METs (only apply for energy intake), frequency of eating out for dinner (none, less than once a month, less than once a week/more than once a month, more than twice a week) and sleep hours.

§ The interaction between normal weight and underweight group was examined in the following model: nutrients or food intake = intercept + β1 (SATAQ score (continuous)) + β2 weight category (not underweight or underweight) + β3 (METs (only apply for energy intake)) + β4 (frequency of eating out for dinner (none, less than once a month, less than once a week/more than once a month, more than twice a week)) + β5 (sleep hours (continuous)) + β6 (SATAQ score (continuous))*weight category (not underweight or underweight) (*P<0.05, **P<0.01, and ***P<0.001)

CONCLUSION

Although previous studies have reported that higher nutrition knowledge and heavier media exposure may have had preventive effect on underweight epidemic, the author has identified that the effect of these factors on dietary intake was different between underweight and not underweight individuals. Nutrition education only focused on increasing nutrition knowledge is probably insufficient to modify dietary behavior among underweight women.

To improve the quality of nutrition education among underweight women, further research on other aspects, such as recognition of nutrition and health, or difference of behavioral change based on their knowledge are needed. In addition, linkage of research, theory, and practice is probably the key for overcoming underweight problems among Japanese young women.



† ✔ indicates the consistency with hypotheses.
‡ × indicates the inconsistency with original hypotheses.

Figure 4. Summary flow diagram of study findings

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APPENDIX

APPENDIX 1

Ⅰ．食品と、それに含まれる栄養素について、以下の質問に答えてください。「多い」「少ない」の判断は、同じ重量当たり（例えば 100g 当たり）でどうか、というように行ってください。あっていると思う欄の番号1つに○をつけてください。

※ 問題・回答例：朝食に食べたいと思う食品はどれですか?

	食べたい	食べたくない	わからない
1) 白飯	①	2	3
2) 納豆	1	2	③
3) パン	①	2	3
4) シリアル	①	2	3
5) フルーツ	①	2	3
6) 焼き肉	1	②	3

1) 次の食品は、でん粉を多く含みますか?

	多い	少ない	わからない
1) チーズ	1	2	3
2) バター	1	2	3
3) ナッツ	1	2	3
4) 白飯	1	2	3
5) コーンフレーク	1	2	3

2) 次の食品は、たんぱく質を多く含みますか?

	多い	少ない	わからない
1) 鶏肉	1	2	3
2) チーズ	1	2	3
3) 煮豆	1	2	3
4) バター	1	2	3
5) クリーム	1	2	3

3) 次の食品は、脂質(脂肪・油脂)を多く含みますか?

	多い	少ない	わからない
1) パスタ（ソースなし）	1	2	3
2) 煮豆	1	2	3
3) ウインナーソーセージ	1	2	3
4) はちみつ	1	2	3
5) ナッツ	1	2	3

4）次の食品は、食物繊維を多く含みますか?

	多い	少ない	わからない
1) コーンフレーク	1	2	3
2) バナナ	1	2	3
3) 赤身の肉	1	2	3
4) ブロッコリー	1	2	3
5) 魚	1	2	3
6) 煮豆	1	2	3

5）次の食品は、ビタミンＣを多く含みますか?

	多い	少ない	わからない
1) 白飯	1	2	3
2) さつまいも	1	2	3
3) 納豆	1	2	3
4) ブロッコリー	1	2	3
5) バター	1	2	3

6）次の食品は、カルシウムを多く含みますか?

	多い	少ない	わからない
1) 木綿豆腐	1	2	3
2) 鶏肉	1	2	3
3) まぐろ	1	2	3
4) ひじき	1	2	3
5) 小松菜	1	2	3

7）次の食品は、食塩を多く含みますか?

	多い	少ない	わからない
1) ソーセージ	1	2	3
2) 白飯	1	2	3
3) 赤身の肉	1	2	3
4) 冷凍野菜	1	2	3
5) チーズ	1	2	3

8）次の食品は、砂糖を多く含みますか?

	多い	少ない	わからない
1） バナナ	1	2	3
2） アイスクリーム	1	2	3
3） サイダー（炭酸飲料）	1	2	3
4） トマトケチャップ	1	2	3
5） 缶詰の果物（シロップ入り）	1	2	3

Ⅱ．各栄養素の性質、はたらきについて以下の質問に答えてください。ご自分の考えにあてはまる番号に1つ〇をつけてください。

1）私たちの食事の中で、炭水化物は主要なエネルギー源である。

1．正しい　**2．**まちがっている　**3．**わからない

2）脂質（脂肪・油脂）を摂りすぎることだけが肥満の原因である。

1．正しい　**2．**まちがっている　**3．**わからない

3）脂質はいつも健康を害するものである。そのため、脂質はできる限り避けるべきである。

1．正しい　**2．**まちがっている　**3．**わからない

4）食品によっては、脂質を多く含むものの、コレステロールを含まないものがある。

1．正しい　**2．**まちがっている　**3．**わからない

5）成人は、脂質・炭水化物から十分にエネルギーを得ていれば、たんぱく質をとる必要はない。

1．正しい　**2．**まちがっている　**3．**わからない

6）次の栄養素が同じ重さだけあるとき、どの栄養素が最も高いエネルギー（いわゆる〝カロリー〟）を含みますか?

1．たんぱく質　**2．**脂質　**3．**でん粉　**4．**食物繊維

7）食物繊維は炭水化物の一部であり、エネルギー源として重要な役割をはたす。

1．正しい　**2．**まちがっている　**3．**わからない

8）果物や野菜の健康への好影響は、ビタミンやミネラルが供給されることにだけある。

1．正しい　**2．**まちがっている　**3．**わからない

9）ビタミンには水溶性ビタミンと脂溶性ビタミンがあり、どの種類のものでもできる限りたくさん（サプリメントの摂取も含め）とったほうがよい。

1．正しい　　**2．**まちがっている　　**3．**わからない

10）ビタミンの欠乏により死ぬことがある。

1．正しい　　**2．**まちがっている　　**3．**わからない

11）カルシウムの摂取が不足すると、血液中のカルシウム濃度を保つために骨からカルシウムがとけ出す。

1．正しい　　**2．**まちがっている　　**3．**わからない

12）カルシウムが体内で有効に利用されるために必要なビタミンは何ですか?

1．ビタミンA　　**2．**ビタミンC　　**3．**ビタミンD　　**4．**ビタミンK

13）食塩から得られる主なミネラルはナトリウムである。

1．正しい　　**2．**まちがっている　　**3．**わからない

14）食塩は生きていくのに必要であり、一定量以上必ずとらなければならない。

1．正しい　　**2．**まちがっている　　**3．**わからない

15）砂糖は炭水化物の一部であり、でん粉の代わりに砂糖をおもなエネルギー源としてもよい。

1．正しい　　**2．**まちがっている　　**3．**わからない

Ⅲ. 食品の適切な摂取量に関して、以下の質問に答えてください。あてはまる番号に1つ○をつけてください。

1）バランスの取れた食事とは、すべての食品を同じ量食べることをさしている。

1．正しい　　**2．**まちがっている　　**3．**わからない

2）健康で普通の生活をしている成人（18～69 歳）が 1 日に必要とするエネルギーの量はどのぐらいですか?1 日中ほとんど寝たきりの人や、とても激しい肉体労働をしている人、スポーツ選手などは含みません。

1．男性　2000kcal 前後、女性　1600kcal 前後
2．男性　2500kcal 前後、女性　2000kcal 前後
3．男性　3000kcal 前後、女性　2500kcal 前後
4．男性　3500kcal 前後、女性　3000kcal 前後

3）厚生労働省の決めた基準では、1 日に摂取するエネルギー（いわゆる「カロリー」）のうち、何%を脂質（脂肪）からとることがすすめられていますか?
（正確には年齢によってちがいますので、各選択肢の数字にも幅があります。）

1． 5～10 もしくは 15%
2． 10～15 もしくは 20%
3． 20～25 もしくは 30%
4． 30～35 もしくは 40%

4）厚生労働省の決めた基準では、成人（18 歳以上）が 1 日にとる食塩は何ｇにするべきとすすめられていますか?

1． 男性　5g 未満、女性　4.5g 未満
2． 男性　9g 未満、女性　7.5g 未満
3． 男性　12g 未満、女性　10g 未満
4． 男性　15g 未満、女性　12g 未満

5）厚生労働省の決めた基準では、成人（18 歳以上）が 1 日にとるカルシウムは何 mg にするべきとすすめられていますか？ 正確には成人でも年齢によりちがいますので、大体このぐらい、ということでお答えください。

1． 男性　500mg 以上、女性　450 mg以上
2． 男性　600mg 以上、女性　550 mg以上
3． 男性　700mg 以上、女性　650 mg以上
4． 男性　800mg 以上、女性　750 mg以上

Ⅳ. 栄養と健康状態の関連について、以下の質問に答えてください。ご自分の考えにあてはまると思う欄の番号に○をつけてください。

1）次のことが、ある種のがんにかかる確率（がんにかかる危険性）をへらすことがあると思いますか?

	あると思う	ないと思う	わからない
1)　より多くの食物繊維を食べる	1	2	3
2)　砂糖を食べる量をへらす	1	2	3
3)　果物を食べる量をへらす	1	2	3
4)　食塩を食べる量をへらす	1	2	3
5)　より多くの果物や野菜を食べる	1	2	3
6)　保存料や添加物を食べる量をへらす	1	2	3

2) 次のことが、心臓の病気（特に狭心症や心筋梗塞などの、心臓の血管の病気）を予防することがあると思いますか?

	あると思う	ないと思う	わからない
1) より多くの食物繊維を食べる	1	2	3
2) 飽和脂肪酸を食べる量をへらす	1	2	3
3) 多価不飽和脂肪酸を食べる量をへらす	1	2	3
4) 食塩を食べる量をへらす	1	2	3
5) より多くの果物や野菜を食べる	1	2	3
6) 保存料や添加物を食べる量をへらす	1	2	3

3) 食物繊維を多くとることで、以下の健康上の問題や病気は予防できると思いますか?

	予防できる	予防できない	わからない
1) 便秘	1	2	3
2) 胃がん	1	2	3
3) 肥満	1	2	3
4) 痛風	1	2	3
5) 心筋梗塞	1	2	3

4) 食塩の摂取を減らすことで、以下の健康上の問題や病気は予防できると思いますか?

	予防できる	予防できない	わからない
1) 高血圧	1	2	3
2) 脳卒中（脳出血、脳こうそく）	1	2	3
3) 胃がん	1	2	3
4) 骨折	1	2	3
5) 肝炎	1	2	3