lead to unhealthy consumption practices and lifestyles[5]. Therefore, it will result in the emergence of non-communicable diseases such as cardiovascular disease[6], several types of cancer[7], chronic obstructive pulmonary disease[5], obesity and diabetes[8-10]. Obesity problem[10] along with Japan's aging population are expected to put an enormous strain on the country's health services in the near future[11]. In addition, nutrition related disorders such as obesity and diabetes in children are also becoming problematic[12]. Fear of being overweight and beauty conscious among young female led to unnecessary attempts at weight loss[13], to the point of leading extreme thinness that can lead to nutritional deficiencies such as iron deficiency anemia[14]. Urbanization the fraying of traditional family forms are correlated with the rise in eating disorders in Japan. Undoubtedly, eating disorders appears to be strongly linked with broader social transformations, specific cultural and historical factors among Japanese society[15].

Modifiable risk factors such as smoking, tobacco and alcohol use considered contributing factors for chronic diseases such as cancer[16]. Rapid urbanization is also an exacerbating factor in non-communicable diseases which reflects easier access to processed foods and lack of physical activity. Falling rate of physical activity are closely associated with greater dependence on motor vehicles. Motorized transportation contribute air pollution, excess death from traffic accidents, increased stress and anxiety in society[5]. Currently, 75.0% of Japan's population live in urban area[3] geared to crowding, changes in human behavior, unsanitary condition and increased mobility. These characteristics of unhealthy lifestyles lead not only to non-communicable diseases but also the spread of infectious diseases[5,19]. The increase of aging population in parallel with increase occurrence of chronic diseases, has led to the public interest in health and nutrition[3]. One extreme reaction has been the resistance to economic development in the name of protecting and sustainability of public health nutrition[18]. Based on the evidence of the diverse diseases related to nutrition and health, Japan authorities have introduced a new version of food education called *Shokuiku*[11]. However, our fundamental concern here, is whether the Japanese healthy diet and longevity envelope in the Japan's affluent economy will be sustainable? The relationship of food education and its sustainability is one main concern, however the whole understanding of *Shokuiku* is still ambiguous among Japanese[19]. In this paper, we will discuss and highlight on the roles of food education for a sustainable future and also an attempt to get a better understanding of the conceptual definition of *Shokuiku*.

NUTRITION TRANSITION IN JAPAN

Food transitions can be defined as any changes in food consumption and food-related practices in the population of an economically emerging country. Food transitions also can be accompanied by other changes of lifestyle[20] The process of food transition can be very fast and volatile, however the process become very slow overlapping the traditional food culture as food items were newly introduced[21] Food transition occurred in many continents, but main food transitions are currently taking place in Asia. Japan is one of the example which experienced surplus economic growth after 1950 (after World War II). In 1910, food consumption per capita in Japan consisted of 430 gram of rice (carbohydrate), 13 g of fat and 3 g of animal protein. However, in 1989, the consumption pattern decreased to 190 gram of CHO and animal protein increased to 42 g. Consumption of salt dropped from 30 g to 12 g per day in the same period. Japanese nutrition professionals viewed this development positively as if reflected the transition from malnutrition to better nutritional status among Japanese[22].

Dietary habit is associated with socioeconomic status in general. From the nutritional point of view, income is related to the diet of the country's population where fat and sugar consumption is positively correlated with increasing income[23]. Even though the staple food in Japan is steamed rice, however, the dietary habits of Japanese have shifted from 'traditional' to 'modern' with excessive amount of energy and animal fat[24]. The traditional Japanese eating styles in an agrarian-based environment has changed dramatically to a westernized diet[3]. Food shortages also occurred during World War II and caused malnutrition in many Japanese before 1946[24]. Over the past 50 years, the Japanese diet has changed from traditional, natural foods to high-fat foods[3]. The Japanese population enjoyed affluent industrialized living along with 'delicious food' was between 1970 to 1980[25]. This changes eating pattern has been accompanied with a shift lifestyle such as decreased in exercise and physical activity[3,26].

Wealth is associated with the improvement of diets. Increased income in many countries have boosted world average calorie consumption according to food balance sheet data in 1995 and 1997. Japan as a wealthy country is not exceptional in this nutrition transition[18]. High fat diet is associated with wealth. Consumption of animal products signified populations with high income at both individual or national level[27]. Furthermore, health has been shown to improve in parallel with industrial growth. The economy is considered as an automatic by-product lead to the improvement in socioeconomic status. Urbanization as a result of increase income enabled people to consume energy dense diet, where sugar and fats are easily available. On the other hand, and the high carbohydrates and fiber diet are on the decline[18]. Index of wealth are portrayed through eating meats, transportation, mobile phones, childhood immunization or indoor plumbing. In short, nutrition transition is associated with diversity of dietary intake and improve availability of cheap energy-dense food[28].

The undesirable effects of nutrition paradigm in Japan are realistic. For instance, early stages of nutrition transition are characterized by the sharp increase of use in cheap vegetable oils, notably soya bean, palm oil, rapeseed and sunflower[28] however at later stage, nutrition transition are typified by a sharp rise in meat and milk consumption, including the frequency of take away meals[19]. Western habit of eating meat have penetrated into Japanese life and led to important changes in their dietary and eating practices[29,30].

CONCEPT OF SUSTAINABLE DEVELOPMENT IN HEALTH

Health is an elusive concept. Population health and sustainable development require 'big picture' analysis which involves economic, socio-cultural and environmental dimensions. Towards achieving sustainability of health, there are few questionable issues. Public health expertise

will asked "What must we do to keep people healthy? Health promotion is concerned with questions of "How or to what extent we improve and sustain the health of population; and finally the question of 'Why are some people are healthier than others'?[31].

What is sustainable development? Sustainable development was originally defined in the Brundtland Commision's report entailed as 'Development that meets the needs of the present, without compromising the ability of future generations to meet their own needs'[32]. This concept has been broadened in recognition of the non-environmental aspects of sustainability, and the non-economic development[33]. Health is now one of the key areas singled out as warranting special attention apart from water, energy, biodiversity and agriculture[34], World Health Organization has sought to place health more centrally on the sustainable development agenda[35,36]. In general, sustainable development is concerned with balancing of environmental, social and economic factors in order to attain maximum societal well-being, both for current and future generation. According to the first principle of 1992 Rio Declaration, human beings are at the center for sustainable development. They are entitled to be healthy and productive life in harmony with nature[5]. The Rio Declaration emphasized the importance of linkages between social, economic and environmental pillars of sustainability which underpinned good health[37] by combating unhealthy diets and promoting physical activity[17].

The term *sustainable* should cover environmental issues (assumed to the center of the needs of future generations), whereas *development* capture the needs of the present[5]. As Japan is a developed country and providing aid on partnership for sustainable development to other countries, so the concept of sustainable development is applicable for one arm according to the definition; which focusing on environmental issue for future generations. Furthermore, since health is already improved in Japan parallel with the growth of the industrial revolutions for last decades, health was thought to be an automatic by-product of socioeconomic development[38]. Hence, in this paper we would like to link the concept of sustainability in health through Japan's new Basic Law on Shokuiku (food and nutrition education) which has been adopted in July 2005.

'Sustainability' means to hold onto or to keep, or to provide conditions for the continuance of well-being. These ideas of sustainability can be applicable to social relations such as maintaining civil society, to physical bodies such as sustaining life of human beings, animals or plants and to ecosystem in sustaining biodiversity or the biosphere of our planet[31]. The continuance of well-being includes people's health and also a prioritized area contributing towards sustainability[39]. A decade ago, health was seen primarily as social services[40], but currently the direction of health had changed after The World Summit on Sustainable Development in Johannesburg, 2002. The world is now beginning to accept broader perspective of health. Health is not only social services but stimulating growth, protecting the environment and combating poverty in urban and rural areas. It includes providing food, healthy nutrition, shelter and general health for everybody on this planet including for future generations[39]. In conclusion, health is an integral part of the concept of sustainability and this objective was at the heart of the Rio Declaration. Again, we would like to emphasize the first principle of Rio Declaration stated "Humans are at the center of concerns in sustainable development. They are entitled to be healthy and productive life in harmony with nature"[41].

Most of the countries consider health as a form getting treatment, issues confined to hospitals, clinic and services. It means health deals with treating sickness and seeking to restore patients back to complete good health which become the main discourse. However, maintaining good health in a community and sustainability demands wide-ranging actions in variety of ways, yet effective health promotion was not given a primary focus in some country[42]. According to the World Commission on Environment and Development position statement, good health is the foundation of human welfare and productivity[43]. In the community health or population discourse, health and sustainability have, to date, be seen as a casualty of developmental or incidental beneficiary[44]. In other words, population health is seen primarily from a unitarian perspective as an input to the development of nation. The healthier the population, the more efficient its economic function[18].

Another threat to health in society is the existence of global burden of disease. WHO estimated 23.0% of preventable ill health at the global level is due to environmental risks factors. The WHO 'Global Burden Disease' project is updating these estimates for the major modifiable environmental risks factors[45]. Japan is no exception to this, with growing overweight among middle age and children, malnutrition in elderly and young female age. Activities now so-called 'modern hazard' become a health problems of major concern both in developing and developed countries. These concern include motorcar-based transport system, tobacco, smoking, drug abuse, high consumption of fat and sugar also lack of physical mobility[46]. Episodes of population disease resulted from human culture has increased over the years such as transportation culture, tobacco culture and also food culture[44].

Food culture is well signified by the progression of human food sources, way of eating and health. Societies began farming activities and reliance on staple-based agrarian diets since the past of 10,000 years. Malnutrition and recurring famines were overwhelming among agrarian societies prior to the second agricultural revolution in 19th century[47]. However, the radical transformation of our food supply, entailing massive shifts in the level of energy consumption in term of saturated fats, simple sugars, salt and dietary fiber has contributed to varieties of communicable diseases process that characterized longer living populations in developed countries[48]. It can be concluded that many of the diseases which characterized modern urbanized society reflected the discordance between our ancestrally evolved biological needs and our contemporary way of lifestyle[49]. Urbanization and migration from rural to urban area to get 'food' as basic needs led to crowding society which facilitates the spread of infectious disease. Thus, both communicable disease and non-communicable disease existed simultaneously in same timeframe. The structure of modern environment led to lacking of planned exercise which is a predisposing factor towards rising prevalence of obesity in both of rural and urban populations. Nevertheless, shifting our cultural way of life together with technical advances led to remarkable decrease of maternal and infant mortality rate due to health care services. This has resulted in gaining longer life expectancy and declining of birth rates. Demographic and epidemiological transitions have been reached a plateau in developed countries. This shifting paradigm will create fundamental influence to the global environment which couldn't be sustained for future generations[5].

Sustainable development of human health is now moving toward the center of the discourse of sustainable development and in line with a sustainability transition as in the case of demographic transition, epidemiological transition and risk transition[5,17]. Sustainability means having an economic structure within which we consume only as much as the natural environment can produce. This is illustrated in Food Guide Pyramid and we generate only as much waste as that natural environment can absorb[63]. According to the WHO, the definition of health has already implied the relationship between human health, social, economic and environmental situation long time ago, since 1948. In 2002, World Summit on Sustainable Development held in Johannesburg has re-emphasized the discussion on how human health is a meaningful weapon to promote economic growth and protect the environment. Protecting natural environments include drinking water and foods eaten. Social factors include supporting health choices of energy consumption and lifestyles including coping skills. At the same time economic factors such as income levels, employment status, and access to quality health services are important determinants of sustainability in health[50].

ENERGY CONSUMPTION FOR SUSTAINABILITY

An experience of ultimate sustainability of Japan society was in the Edo period. As Japan is completely surrounded by the sea, agrarian and pre-industrial society were exclusive during the Edo era[51]. Surrounding sea provided food, other resources needed such as salt and also means of transportation. In short, Japan in a sense embarked on large scale survival based on material and energy available on the island. The diet system during this period was much more efficient in energy use because the Japanese diet consisted of rice, vegetables and occasionally fish, but not meat. Meat was rarely eaten or consumed as they require raising domestic livestock such as cows and pigs. Cows and horse also have been used for transportation[52]. Almost all of farming activity was carried out by human power and nature friendly. A study was carried out to estimate energy efficiency in various aspects of human activities in the Edo period; rice productions was estimated to be about 1500% (15 times) energy efficiency compared to present techniques of using mechanical equipments or machines. The energy value of fish obtained or energy input was 1000 to 2000%, whereby current mechanized fishing industry seems to be about 50%[53]. It is well recognized that Japan's modern era survive in energy-saving society. Japanese now really enjoy an excellent transportation system, automatic machine systems of electrical goods at home and workplace, so-called energy saving-society[26].

Japan as developed agrarian society with a number of large urban areas and densely populated and highly industrialized is facing the global market economy will not be sustainable if Japanese do not maintain their notions way of life toward linkage of food, nature and culture. The philosophy of life in Japanese culture includes that man is part of nature and man should live harmoniously with nature. The important concern of an individual is his or her feelings toward other persons rather than his or her individuality which is often termed as "group mentality" as opposed to the concept of Western 'individualism'. For example, in the Edo period this notion was practiced where they were farmers and lived in harmony with nature. Modern society lives in cities and also created living environments but do not have direct feeling toward nature[54].

POSITION OF SUSTAINABILITY IN NUTRITION EDUCATION

Sustainability means the capability of being maintained over for a long term[56] and meeting the needs of the presents without compromising the ability future generations to meet their needs[39]. How can diet be sustainable? A sustainable diet is comprised of foods that contribute to human health and also promote the sustainability of food production[56] by maintaining the food systems. In this instance the raw materials or inputs for foods and cultural resources for consumption and distribution of food must be conserved, not depleted or degraded[57]. It is the position of American Dietetic Association (ADA) to encourage environmentally responsible practices that conserve natural resources, minimize the quantity of waste generated and supported the ecological sustainability of food system. In which case it covers the process of food production, transformation, distribution, access and consumption[58]. Education for sustainability in health is about change and transformation in changing society[59]. Strategies developed for the action on sustainability such as health promotion and nutrition education[60] should be managed, governed and monitored for its sustainability.

Sustainability in health should be a national innovative project, require local knowledge of environmental change and education will need to be different from traditional approaches[59]. In conclusion, food and nutrition is not only the concern of sustainability, but the environment, housing and parenting are also health-related concern[60]. Many of the health and nutrition promotion initiatives are professionally led, but some of them have been criticized for giving little attention to lay people's concerns and priorities[61]. Learning through food education in conserving resources and utilizing available information is critical for the future sustainability of the food system[62], especially among kids and schoolchildren[58]. Food and nutrition professionals can implement the practices on how to conserve natural resources by supporting ecological sustainability[58]. How can this be achieved? It can be implemented through educating peoples on production of food, and transformation of food (processing, labeling and food packaging, storage and transportation, access via retailing and institutional food service). When the ecosystem is well understood, people will respect and protect them. In the future the sustainability of the food supply will be featured by nutrition education[62] as well as what have been emphasized in *Shokuiku* in Japan[63].

Education on the consumption of foods such as how to cook, retaining nutrient values during food preparation and cooking, presentation of food and the impact of health outcomes to individual, family members and community within biophysical and socio-cultural context should be included[64]. For example, nutrition professionals have strong potential to influence people or patient's food choice and play a major role in the consumption sector of food system. Whereas professionals in food service and catering are also obliged to the food distribution: procuring, preparing and

serving foods in large quantities and ensure food safety and hygiene[58].

In term of sustainability in energy consumption, food and nutrition professionals should comprehend and be aware of the consumption patterns within their facilities to conserve energy. All food production facilities should run equipment with full loads wherever possible and turn off the equipment when it is not in use[65]. For instance, educating people and children about changes in energy consumption from dietary protein of animal origin and how they can sustain their health based on the sources of energy consumption[66]. Sustainability of food education can be applied through educating peoples or building community food system throughout regional agriculture. The availability vicinity should be explored where local plants and animals can be grown. Natural environment should be increased in the community to support the ecological sustainability of the food system on our planet[58]. Evidence-based research linking homegrown and locally produced fruits and vegetables to improve access and intake in communities through environmental changes towards sustainability of health should be encouraged. Relating farming activities to school lunch program is one of the efforts geared toward different levels of advocacy and is needed for sustainable of linking health, nature and environment[67]. A study showed that eating homegrown fruits and vegetable not only promote awareness of local sources and daily diet among children, but also improved the nutrient intake and quality even after adjusting for socio-demographic variables[68]. Programs that encourage gardening will not only increase access to fresh fruits and vegetables but improved knowledge, togetherness in family members, food security and social well-being[58,69].

FOOD AND NUTRITION EDUCATION (*SHOKUIKU*) CAN GO GLOBAL

Shokuiku is not a new term in describing ways of dietary life in Japan. Japanese wisdom regarding nutrition education has been discussed in the book called *Honzo-Komoku*. The contents of the book promoted concept of health management in the Edo period (1603-1868). This concept is based on a theory that a gift of human life was in the form of personal well-being, where eating and drinking is for sustainability of life. The development of nutrition education in this era also included dining manners and the atmosphere of family togetherness. The principles during the Edo era consisted basically of steamed polished white rice, one soup, and one side to be taken only three times per day. During this era, the exclusion of meat consumption and the beginning of aesthetics in Japanese Cuisine is being presented until now[71]. In Meiji Period (1868-1912), nutrition education was taught before moral, intellectual or physical education. Gensai Murai, the author of "Shoku-Yojo-Hou" emphasized on children's nurture in physical and mental well-being through nutritious food grown locally[71].

The Basic Law on *Shokuiku* regarding food and nutrition education was enacted in the Japanese Diet (Parliament) on July 15, 2005. The Basic Promotion Program was introduced to promote *Shokuiku*. Four ministries which include the Cabinet, Ministry of Health, Labor and Welfare, Ministry of Education, Culture, Sports, Science and Technology and Ministry of Agriculture, Forestry and Fisheries cooperate to promote *Shokuiku* nationwide. This program was designated comprehensively to promote nutrition education as the basis of living and the foundation of intellectual, physical and moral education. It is meant to nurture a society so that people can maintain a healthy diet with knowledge of foods and select right foods through a wide range of experiences[63]. In short, it covers mind and body. In order to fulfill this new law, Ministry of Agriculture, Forestry and Fisheries and the Ministry of Health, Labor and Welfare have revised the food guide pyramid to a new balance spinning top. The Basic Law on *Shokuiku* covers fundamental aspects of living, along with intellectual, intelligent, moral and physical education as highlighted in the Meiji Period[71]. They were based on the four pillars of educations which consisted of *chiiku* (intellectual training), *saiiku* (intelligent education), *tokuiku* (moral education) and *taiiku* (physical education)[72]. This law encourages respect for diverse traditional food culture, appreciation of food production in harmony with environment, revitalization of rural communities with locally grown products and improvement of food security[63].

Shokuiku bring together the concept of slow food movement where it endows issues of sustainability in promoting right pleasure of eating and food with cultural dignity. It also involved identifying food products and methods of production linked to geographical area, protecting biodiversity as cultural heritage, focusing young generation, and respecting natural rhythms, environment and health consumers[72]. Slow food movement as well as Shokuiku also encourages public debate and discussion to raise awareness towards protecting culinary heritage to improve quality of life[73]. For example one of the activities related *Shokuiku* was implemented as "Tokushima Miso Soup Project" at Ichiba Elementary School. From the viewpoint of environmental *Shokuiku*, "Project of Agricultural Environment in Hokkaido" is an excellent example[69,74].

Why food education in Japan now becomes a hot topic? Japan's reputation as leading the world's longest life expectancy is currently under threat as the country faces an undesirable rise in diet-related illness as elaborated at the initial part of this paper. Furthermore, this longevity is becoming a myth when Okinawa people who traditionally boosted the highest rate of longevity among 47 prefectures as well as in the world had slipped down to the 26th position in 2000[70]. Overweight is a Japan's new health problem[9] with Japan's youth started to abandon their traditional nutrition and food culture[63,75]. Thus, food education become a buzz word in Japan nowadays as a response to these threats to food traditions[63]. It was reported that, 20% of children at elementary school and junior high school skip breakfast sometimes or often and eating their families[76].

The definition of *Shokuiku* may still be ambiguous, though it has recently come into used nationwide[19]. There are too many fields for food education, not enough forerunners with system available. The practice of food education in schools is not appreciated by parents. And the worst part is food education in agriculture did not have any commercial values, therefore it is not an interest to farmers especially among those who have problems with the failure of annual gross production[69]. According to the opinion polls and surveys in 2006 among internet users (n = 12,489) only 13.3% of them knew the term of *Shokuiku* and 39.0% only knew the outline meaning that *Shokuiku* is promoting healthy eating. More than thirty percent (33.2%) did not know what *Shokuiku* was all about but have heard about them and 14.4% did not know anything about *Shokuiku*.

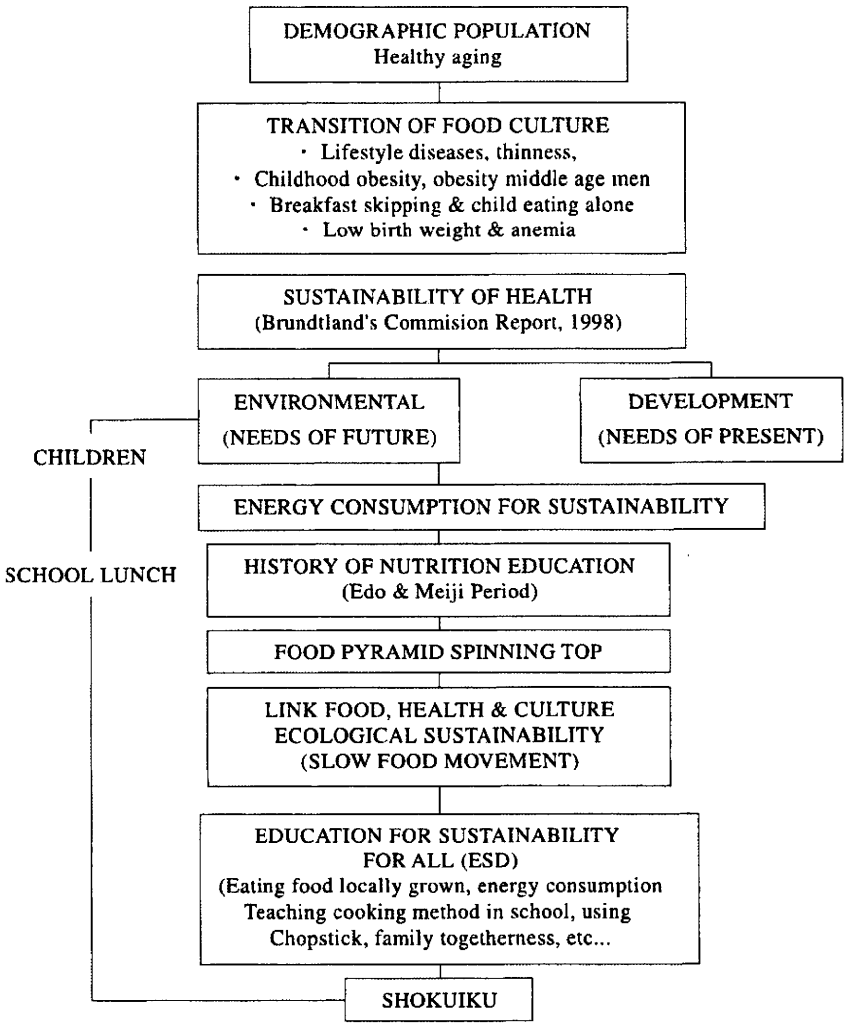

Figure 1. Conceptual framework of sustainability of health thorough food education in Japan

Amongst respondents who knew about *Shokuiku* they were also asked about their interest or attention in *Shokuiku*, whereby only 14.5% of respondents reported very interested, and 46.7% were moderately interested in this issue. The newest annual survey by the cabinet in 2008 reported that 74.0% of the respondents knew the term of *Shokuiku* and 41.0% of respondents knew the term and meaning. The percentage of people who know *Shokuiku* is increasing gradually. However, only 2.4% understand about "Food Balance Guide the spinning top' and practiced it wisely, unfortunately 50.0% never heard of it. The rest of respondents know only the outline of Food Balance but never put into practice in their daily life[77]. The understanding of *Shokuiku* also was studied by researchers from Kagawa Nutrition University based on public expectations for *Shokuikiu*. '*Shokuiku* matrix' was used as a methodology to identify whether Japanese can comprehend *Shokuiku* at individual level, family, peer as well as community. Descriptions in *Shokuiku* matrix was also to identify not only on the importance of food and nutrition, but also include choosing healthy lifestyle foods, developed eating behavior which can improve quality of life, food production, transportation and disposition in community[19]. More peoples were talking about *Shokuiku*, some of them define *Shokuiku* as 'acquisition and nurture of good spirit and physical condition through eating foods[78]. We referred *Shokuiku* as promotion of not only healthy eating, but also all sensible diet from selecting the food to enjoying their taste. However, The Buzz Magazine stated that *Shokuiku* was referring to teach people, particularly children, about every aspect of food including food safety and nutrition with the aimed to give more knowledge and ability to choose and prepare healthy, nutritionally balanced meals on a regular basis. Others highlighted *Shokuiku* as the relationship between food, society and individuals[77].

CONCLUSION

Reflecting on available resources that has been discussed above, we hope this paper will provide the insight of whole concept of '*Shokuiku*' food and nutrition education" as a new initiatives of health promotion among Japan society (Figure 1). In short, the movement of *Shokuiku* is applicable towards sustainability of health without ignoring needs of future generations. It promotes respect of diverse Japanese food cultures and appreciation in food, health, culture and environment. In term of knowledge, practice and attitude, they are no longer a big issue for Japan soci-

ety but to achieve sustainability in health and nutrition is a challenge. To retain the economic growth and social stability depends on the power of the people. In order to build a cohesive society and quality of life, the Japan government has been promoting policies for the upbringing of future youth and June become a Food Education Month every year. It is also to fulfill the Health Japan 21 vision. '*Shoku*' means diet and '*iku*' means education is a new wave of initiation in health promotion, and it should be conceptualized and defined for everyone in order to achieve the sustainability in health for future Japan. Hopefully Japan's children may get better to understand the relationship between food, its sources and their society. In doing so, their own health in the future looks much more promising.

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［表題］

肥満解消を目的とした介入研究で、外食の嗜好・頻度が肥満因子に及ぼす影響

Effect of eating out of home on risk for obesity and weight loss

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研究発表要旨

肥満解消を目的とした介入研究で、外食の嗜好・頻度が肥満因子に及ぼす影響

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【目的】

外食の摂取頻度が高いことは摂取栄養素の偏りや肥満に繋がる事が先行研究によって報告されているが、外食産業において健康に重きをおいたメニュー開発などが行われるようになった近年、外食の摂取頻度が栄養素の摂取状況や身体状況に及ぼす影響については明らかではない。本研究では、減量プログラムの参加者を対象とし、外食の摂取頻度と栄養摂取状況・肥満関連指標との関連を検討することを第一の目的とした。また、本研究では減量プログラム参加後における対象者の外食摂取頻度の変化と減量の程度との関連についても解析を行い、肥満者が減量する際の外食に対する指導の必要性について検討を試みた。

【方法】

長野県にて行われた 1 年間の減量プログラムに参加した男性 56 名（平均年齢 53.6±6.7 歳）及び女性 52 名（平均年齢 55.0±6.6 歳）を研究対象とした。対象者にはプログラム開始時とプログラム終了時において、外食の摂取頻度、栄養素摂取量、食品群別摂取量の調査、及び身体計測、血液検査、歩数調査を実施した。

【結果と考察】

減量プログラム開始時では、外食の摂取頻度が高いほどエネルギー摂取量や脂質摂取量が多く、一方でビタミン、ミネラル、食物繊維の摂取量が少なかった。また、男性では外食の摂取頻度が高いほど体重が多い傾向が認められた。男性では減量プログラム開始時に外食の摂取頻度が高かった人において減量プログラム期間中に外食の摂取頻度が減少し、エネルギー摂取量および腹部皮下脂肪面積の減少量も最も多かった。女性では男性と同様、プログラム開始時に外食の摂取頻度が高かった人でプログラム期間中のエネルギーの摂取減少量が最も多かったものの、体重や BMI の減少量はプログラム開始時に外食の摂取頻度が低かった群で最も多く、この結果には身体活動量の変化の違いが影響している可能性が考えられた。以上のことから、外食の摂取頻度が高い肥満者に対しては、外食の摂取頻度を減少させるような指導がエネルギー摂取量を減少させるのに有効であると考えられ、その際女性に関しては、身体活動量の変化に関しても十分考慮する必要性が示唆された。

［報告書本文］

目　的

平成20年の国民健康・栄養調査結果によると、メタボリックシンドロームが強く疑われる人またはその予備群は40−74歳男性の2人に1人、女性の5人に1人とされている[1)]。平成20年4月から特定健診・保健指導が開始され、国としてメタボリックシンドロームへの取り組みが始まった。メタボリックシンドロームを解消するためには肥満及び生活習慣の改善が肝要であり、その保健指導において食事に対する指導は不可欠である。平成14年までの国民健康・栄養調査によると、日本人の1日の外食率（外食数/1日の食事数）は平成2年、いわゆる「バブル経済期」にピークを迎え、その後やや減少傾向を示しているものの、依然として外食の利用頻度は高く、その利便性や経済性から現代人にとって欠かせない存在となっている。しかし、外食や弁当類は脂質含量が高いものが多いことや[2)]、多価不飽和脂肪酸と飽和脂肪酸の比率（P/S比）が低く、n-6系脂肪酸とn-3系脂肪酸の比率（n-6/n-3比）が高いことが報告されている[3)]。さらに、平成12年の国民健康・栄養調査では、男女共に外食の摂取頻度が高いほど野菜の摂取量が少なくなることが指摘されるなど[4)]、外食による摂取栄養素の偏りが危惧されている。また、海外では外食摂取とエネルギー摂取量、肥満との関連の検討も行われ、外食の摂取頻度とエネルギー摂取量との間に正の相関が見られる事や[5)]、外食の摂取頻度が高いと肥満のリスクが高くなることが報告されている[6),7)]。その一方で、近年、我が国では国民の健康志向が高まってきている。外食産業でもそれに合わせて栄養成分表示や健康に重きを置いたメニュー開発・提供が行われ、外食のイメージも以前と比べて随分変化してきた。このことから、近年では外食頻度が高くとも摂取栄養素の偏りや肥満に必ずしも繋がるとは言いきれない状況になってきている。しかし、実際に外食の摂取頻度と栄養摂取状況、肥満との関連を検討した研究はここ数年では行われておらず、その関連については明らかではない。

そこで本研究では、減量プログラムの参加者を対象とし、外食の摂取頻度と栄養摂取状況、肥満関連指標との関連を検討することを第1の目的とした。また、本研究では肥満者の減量指導に外食に関する指導を取り入れるべきであるかどうか検討するための基礎的研究として、対象者の減量プログラム参加後における外食摂取頻度の変化と減量の程度についても検討を試みた。

方　法

＜対象者＞

対象は長野県佐久市にて行われた減量プログラム（佐久肥満克服プログラム）の参加者とした。2006年6月に、佐久総合病院の人間ドック科より直近の人間ドック受診時のBMIが全受診者の上位5%（BMI≧28.3kg/m²）で年齢が40-64歳の人へプログラムへの参加案内を送付した。対象者には事前説明会で研究目的、方法、データの使用等について口頭と

文面で説明を行い、研究参加への同意を文章で得た。なお、本研究は佐久総合病院及び独立行政法人国立健康・栄養研究所の倫理委員会の承認を得て実施した。

＜減量プログラムの内容＞

プログラムは 1 年間行われ、プログラムでは健診および管理栄養士・健康運動指導士による集団・個別指導（各 6 回）を実施した。個別指導では生活習慣改善のための食事、運動に関する目標設定及び目標実施状況の確認を行った。また集団指導ではストレッチング、歩き方など安全で効果的な運動方法の教育を行った。

＜評価指標＞

健診はプログラム開始時及びプログラム終了時（1 年後）に実施した。

1）身体測定値：身長、体重は体内脂肪計（BF-220、株式会社タニタ）を用いて測定し、体脂肪率は同じ測定機器を用いて生体インピーダンス法によって測定した。BMI は体重(kg)を身長の 2 乗で除して算出した。腹囲測定にはロングメジャー200（クローバー株式会社）を用い、立位で臍の高さの腹囲を 2 回測定し、分析には 2 回の値の平均値を用いた。腹部皮下脂肪面積、腹部内臓脂肪面積は、対象者が仰向けの状態で臍高部の CT を撮影し、その画像から Fat Scan(株式会社東日本技術研究所)を用いて各脂肪面積を算出した。

2）生化学指標：対象者は健診前日の夜 9 時以降飲食しない状態で来院し、健診開始後すぐに採血を行った。血液検査では、空腹時血糖、HbA1c、総コレステロール、HDL コレステロール、LDL コレステロール、中性脂肪の 6 項目を評価した。

3）歩数：歩数の計測には、ライフコーダ EX(株式会社スズケン)を用いた。対象者には起床後から就寝前までライフコーダを装着してもらい、分析には着用期間 2 週間の平均歩数を用いた。

4）食事摂取状況：外食摂取頻度、栄養素摂取量、食品群別摂取量の把握には自記式食事歴法質問票（DHQ）[8)-10)] を用い、回答内容については管理栄養士によって記入漏れ等が無いか確認を行った。外食の摂取頻度に関しては、過去 1 ヶ月間の外食の摂取頻度に関して、「毎日 2 回以上」、「毎日 1 回」、「週 4-6 回」、「週 2-3 回」、「週 1 回」、「月 2-3 回」、「月 1 回」、「食べなかった」のいずれかを選択してもらった。なお、市販品を買って家庭や職場で食べる場合や、職員食堂を利用する場合は外食に含め、手作りの弁当は外食に含めなかった。

＜分析方法＞

1）外食の摂取頻度と肥満関連指標、栄養素等摂取量、食品群摂取量との関連

減量プログラム開始時における外食の摂取頻度と肥満関連指標、栄養素等摂取量、食品群摂取量との間に線形の関連(トレンド)が見られるかどうか検討するため、初めに対象者を外食摂取頻度によって 3 つの区分(外食の摂取頻度が週 1 回未満/ 週 1-3 回/ 週 4-6 回以上)

に分類した。次に、各区分における外食の摂取頻度の平均値を求め（例えば、週 1 回未満の区分には、「月 2-3 回」、「月 1 回」、「食べない」の選択肢が含まれるが、月 2-3 回のように範囲で示されているものに関してはその平均値をとり（月 2.5 回とする）、3 つの選択肢における外食頻度の平均値を求めた（{月 2.5 回（0.625 回/週）+月 1 回（0.25 回/週）+0 回}÷3=0.29 回/週となる）。同様に「週 1-3 回」、「週 4-6 回以上」のそれぞれの区分においても摂取頻度の平均値を求め、各区分の平均値と栄養素等摂取量、食品群摂取量との相関を求めた。また、肥満指標に関しては歩数を制御変数とする偏相関を求めた。

2）外食摂取頻度の変化と肥満関連指標、栄養素等摂取量、食品群摂取量の変化

各 3 つの区分（外食の摂取頻度が週 1 回未満/ 週 1-3 回/ 週 4-6 回以上）における減量プログラム参加前後の外食の摂取頻度の変化に関しては、「毎日 2 回以上」=1、「毎日 1 回」=2、「週 4-6 回」=3、「週 2-3 回」=4、「週 1 回」=5、「月 2-3 回」=6、「月 1 回」=7、「食べなかった」=8 とした上で、プログラム開始時の値から減量プログラム終了時の値を引いて差を計算した（引き算の結果、値が正の数であればプログラム終了時に外食の摂取回数が増加したことになる。逆に負の数であれば外食の摂取回数が減少、0 であれば外食の摂取回数に変化なしと解釈する）。その後、3 つの区分間で、減量プログラム期間における外食の摂取頻度、肥満指標、栄養素等摂取量、食品群摂取量の変化量を比較した。比較には共分散分析を用い、共変量はプログラム開始時の値とした。肥満指標に関しては歩数変化量も共変量に加えた。共分散分析にて有意な結果が得られた項目に関しては、その後 Bonferroni の多重比較を行った。

なお、解析は全て男女別に実施した。また、食品群の摂取量に関しては対数変換後に解析を行った。統計解析には統計ソフト SPSS®12.0J for Windows を用い、全ての検定の有意水準は 5%とした。

結果

本研究では男性 56 名（平均年齢 53.6±6.7 歳）、女性 52 名（平均年齢 55.0±6.6 歳）を対象とした。対象者における減量プログラム開始時の外食摂取状況を表 1 に示す。
男性では週 1 回以上外食をする人が 56 名中合計 30 名(53.6%)であり、女性では 52 名中 22 名(42.3%)であった。

次に、外食の摂取頻度別に肥満関連指標および栄養素・食品群の摂取状況を比較した結果を表 2、表 3 に示す。男性では、外食の摂取頻度と肥満関連指標との間に有意な線形の関連は認められなかったものの、体重は外食の摂取頻度が高いほど多くなる傾向が見られた（p=0.069）（表 2）。次に、栄養素等の摂取状況を比較したところ、外食の摂取頻度が高くなるほどエネルギーの摂取量が多かった一方で、ビタミン B2、ビタミン C、カルシウム、食物繊維の摂取量は少なく、有意な線形の関連が認められた。また、食品群別摂取量では、外食の摂取頻度が高いほど穀類、魚介類、肉類の摂取量が多くなっていた。

女性では、外食の摂取頻度と肥満関連指標との間に有意な線形の関連は認められなかったものの、外食の摂取頻度が高いほどエネルギー摂取量、脂肪エネルギー比、飽和脂肪酸、一価不飽和脂肪酸の摂取量が多い一方で、たんぱく質エネルギー比、炭水化物エネルギー比、カルシウム、鉄、カリウム、食物繊維の摂取量が少なくなっており、有意な線形の関連が認められた(表 3)。また、食品群に関しても、外食の摂取頻度が高いほど菓子類や植物性油の摂取量が多くなっていた。

次に、減量プログラム参加前後における外食摂取頻度の変化と肥満指標、栄養素等摂取量、食品群摂取量の変化について比較した結果を表 4 と表 5 に示した。

男性では、プログラム開始時に週 4-6 回以上外食を摂取していた群（週 4-6 回群）で外食の摂取頻度が減少していたが、週 1-3 回外食を摂取していた群（週 1-3 回群）では外食の摂取頻度に変化は少なく、週 1 回未満外食を摂取していた群（週 1 回未満群）では外食の摂取頻度が増加していた（表 4)。多重比較の結果、週 4-6 回群と週 1-3 回群、週 4-6 回群と週 1 回未満群との間で外食の摂取頻度の変化量に有意差が認められた。また、週 4-6 回群では肥満指標の減少量も最も多く、腹部皮下脂肪面積の減少量は週 1 回未満群と比較して有意に多かった。また、有意差は認められなかったものの、摂取エネルギー量の減少量は、週 1 回未満群で 298kcal、週 1-3 回群では 333kcal、週 4-6 回群では 875kcal と、プログラム開始時の外食摂取頻度が高いほど多くなっていた。その他、摂取栄養素量、食品群量、歩数の変化量については 3 群間で有意差は認められなかった。女性も男性と同様、週 4-6 回群で外食の摂取頻度が減少していた一方で、週 1-3 回群では外食の摂取頻度に変化は見られず、週 1 回未満群では外食の摂取頻度が増加しており、週 4-6 回群と週 1 回未満群との間で外食摂取頻度の変化量に有意差が認められた（表 5)。肥満指標に関しては、男性の結果とは逆に、週 1 回未満群における体重や BMI の減少量が最も多く、週 1-3 回群と比較して有意差が認められた。歩数の増加量は週 1 回未満群で 2462 歩、週 4-6 回群では 673 歩であったため、歩数変化量で調整して検討を行ったが、調整後でも体重や BMI の減少量に関して 2 群間で有意差が認められた。また、摂取エネルギーの減少量は、週 1 回未満群と比較して週 4-6 回群で有意に多かった。その他、摂取栄養素、食品群の摂取変化量に群間で有意差は見られなかった。

考　察

減量プログラム開始時における外食の摂取頻度と肥満関連指標、栄養素、食品群摂取量との関連の検討の結果、外食の摂取頻度が高いほどエネルギー摂取量や脂質摂取量が多く、一方でビタミン、ミネラル、食物繊維などの摂取量が少ないことが明らかとなった。また、男性では外食の摂取頻度が高いほど穀類、魚介類、肉類の摂取量が多く、女性では菓子類や植物性油の摂取量が多かった。今回、外食の食事内容に限定した検討を行うことができなかったため、外食で喫食したものが上記で挙げた栄養素や食品群の摂取量にどの程度反映されているかは不明であるが、外食の摂取頻度が高い人ほどエネルギーの摂取過多や栄

養素の摂取不足に繋がりやすい食事をしていることが明らかとなった。この結果は、外食摂取頻度とエネルギー摂取量との間に正の相関が見られた先行研究[5]の結果とも一致する。また、男性では外食の摂取頻度が高いほど体重が多い傾向が認められたことから、男性では先行研究[6),7)]と同様、外食の摂取頻度が高いほど肥満に繋がりやすいことが示唆された。

本研究では、減量プログラム参加前後における外食の摂取頻度の変化と減量の程度との関連についても検討を行った。プログラム開始時の外食摂取頻度状況によってプログラム期間中の外食摂取頻度の変化が異なることが考えられたため、週 1 回未満群、週 1-3 回群、週 4-6 回群の３群に分けて解析を行った。その結果、プログラム期間中の外食摂取状況の変化には違いがみられ、男女共にプログラム開始時に外食摂取頻度が高かった週 4-6 回群では外食の摂取頻度が減少していた一方で、外食摂取頻度が低かった週 1 回未満群では外食の摂取頻度が増加していた。また、摂取エネルギーの減少量も外食の摂取頻度が減少した週 4-6 回群で最も多かったのに対し、外食の摂取頻度が増加した週 1 回未満群では最も少なかったことから、外食摂取頻度の変化が摂取エネルギーの減少と関連していることが示唆された。さらに男性では外食摂取頻度が減少した週 4-6 回群で腹部皮下面積の減少量が有意に多かったことから、外食摂取頻度の減少がエネルギー摂取量の減少、ひいては肥満の改善にも影響を与えたと考えられる。それに対し女性では、週 1 回未満群でむしろ体重や BMI の減少量が最も多かった。週 1 回未満群では歩数増加量が最も多かったため、歩数変化量で調整した上でも検討を行ったが、やはり体重や BMI の減少量には有意差が認められた。しかし、本研究では身体活動の強度までは把握しなかったため、身体活動強度の違い、ひいてはエネルギー消費量の違いが３群の減量の程度に影響を与えた可能性が考えられる。今回、減量プログラムでは外食に焦点を当てた指導は行わなかったため、対象者が外食以外の食事を変化させ、それが結果に影響を与えた可能性は否定できない。そのため、今後は外食とそれ以外の食事を分けて調査及び解析を行う必要があると思われる。しかし本研究の結果から、外食の摂取頻度が高い肥満者に対しては、外食の摂取頻度を減らすような指導がエネルギー摂取量を減少させるのに有効であると考えられた。また、その際女性に関しては、外食の摂取頻度の変化によって身体活動の変化量も異なる可能性があるため、外食のみならず身体活動量の変化も十分に考慮した上で指導を行う必要があることが示唆された。

要　約

外食の摂取頻度が高いことは摂取栄養素の偏りや肥満に繋がる事が先行研究によって報告されているが、外食産業において健康に重きをおいたメニュー開発などが行われるようになった近年、外食の摂取頻度が栄養素の摂取状況や身体状況に及ぼす影響については明らかではない。本研究では、減量プログラムの参加者を対象とし、外食の摂取頻度と栄養摂取状況及び肥満関連指標との関連を検討することを第一の目的とした。また、本研究では減量プログラム参加後における対象者の外食摂取頻度の変化と減量の程度との関連につ

いても解析を行い、肥満者が減量する際の外食に対する指導の必要性について検討を試みた。その結果、男女ともに外食の摂取頻度が高い人ほどエネルギーの摂取過多や栄養素の摂取不足に繋がりやすい食事をしていることが明らかとなった。また、男性では外食の摂取頻度が高いほど体重が多い傾向が認められた。男性では減量プログラム開始時に外食の摂取頻度が高かった人において減量プログラム期間中に外食の摂取頻度が減少し、エネルギー摂取量および腹部皮下脂肪面積の減少量も最も多かった。女性では男性と同様、プログラム開始時に外食の摂取頻度が高かった人でプログラム期間中のエネルギーの摂取減少量が最も多かったものの、体重や BMI の減少量はプログラム開始時に外食の摂取頻度が低かった群で最も多く、この結果には身体活動量の変化の違いが影響している可能性が考えられた。このことから、男女共に外食の摂取頻度が高い肥満者に対しては、外食の摂取頻度を減少させるような指導がエネルギー摂取量を減少させるのに有効であると考えられ、その際女性に関しては、身体活動量の変化に関しても十分考慮する必要性が示唆された。

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表1 男女別外食摂取頻度の状況

	外食摂取頻度	n	%
男性	毎日2回以上	1	1.8
	毎日1回	8	14.3
	週4-6回	6	10.7
	週2-3回	10	17.9
	週1回	5	8.9
	月2-3回	21	37.5
	月1回	2	3.6
	食べなかった	3	5.4
	合計	56	100.0
女性	毎日2回以上	2	3.8
	毎日1回	3	5.8
	週4-6回	7	13.5
	週2-3回	5	9.6
	週1回	5	9.6
	月2-3回	17	32.7
	月1回	10	19.2
	食べなかった	3	5.8
	合計	52	100.0

表2 外食摂取頻度と肥満関連指標、栄養素等摂取量、食品群摂取量(男性)

	週1回未満 (n=26)	週1-3回 (n=15)	週4-6回以上 (n=15)	トレンド p値
体重 (kg)	81.9 ± 9.8	86.1 ± 5.7	86.3 ± 7.9	0.069
BMI (kg/m^2)	29.6 ± 2.8	29.6 ± 1.7	30.4 ± 2.0	0.272
体脂肪率(%)	27.9 ± 3.8	29.7 ± 3.6	28.2 ± 3.2	0.983
腹囲 (cm)	101.4 ± 7.4	105.3 ± 5.1	104.8 ± 5.0	0.500
腹部皮下脂肪面積 (cm^2)	234.0 ± 76.5	253.5 ± 58.4	248.0 ± 52.6	0.876
腹部内臓脂肪面積 (cm^2)	135.5 ± 44.7	166.1 ± 54.9	159.9 ± 39.8	0.468
空腹時血糖 (mg/dl)	111.0 ± 30.4	110.4 ± 14.5	111.3 ± 35.1	0.271
$HbA1_c$ (%)	5.7 ± 1.0	5.6 ± 0.5	5.9 ± 1.6	0.569
総コレステロール (mg/dl)	205.0 ± 34.0	205.0 ± 23.9	206.5 ± 27.4	0.841
HDLコレステロール (mg/dl)	45.9 ± 11.3	52.3 ± 10.3	48.5 ± 9.7	0.974
LDLコレステロール (mg/dl)	128.7 ± 32.9	115.9 ± 17.3	120.8 ± 30.4	0.775
中性脂肪 (mg/dl)	151.8 ± 74.0	184.2 ± 110.9	186.2 ± 120.9	0.488
エネルギー (kcal/日)	2450 ± 484	2649 ± 455	3213 ± 1126	0.001
たんぱく質エネルギー比 (%/日)	14.5 ± 1.8	15.1 ± 1.9	15.0 ± 2.2	0.491
脂肪エネルギー比 (%/日)	25.0 ± 5.2	24.6 ± 5.3	24.5 ± 5.2	0.833
炭水化物エネルギー比 (%/日)	54.9 ± 7.6	48.6 ± 7.4	50.5 ± 11.2	0.249
飽和脂肪酸 (%/日)	7.4 ± 1.8	6.6 ± 1.2	7.0 ± 1.7	0.615
一価不飽和脂肪酸 (%/日)	8.7 ± 2.1	8.9 ± 2.3	8.9 ± 2.1	0.841
多価不飽和脂肪酸 (%/日)	5.6 ± 1.2	6.0 ± 1.5	5.7 ± 1.1	0.995
n-3系脂肪酸 (%/日)	1.1 ± 0.3	1.2 ± 0.4	1.1 ± 0.3	0.996
n-6系脂肪酸 (%/日)	4.5 ± 1.0	4.8 ± 1.2	4.6 ± 0.9	0.982
n-6/n-3比	4.3 ± 1.0	4.2 ± 0.7	4.2 ± 1.1	0.969
PS比	0.8 ± 0.2	0.9 ± 0.1	0.8 ± 0.1	0.682
ビタミンA (μgRE/1000kcal/日)	267 ± 224	306 ± 173	214 ± 104	0.291
ビタミンB1 (mg/1000kcal/日)	0.48 ± 0.12	0.46 ± 0.10	0.44 ± 0.08	0.257
ビタミンB2 (mg/1000kcal/日)	0.92 ± 0.16	0.90 ± 0.18	0.80 ± 0.19	0.046
ビタミンC (mg/1000kcal/日)	49.7 ± 30.7	45.7 ± 11.9	32.6 ± 12.0	0.022
ビタミンD (mg/1000kcal/日)	4.0 ± 2.0	5.0 ± 2.2	4.3 ± 1.7	0.828
カルシウム(mg/1000kcal/日)	434 ± 76	393 ± 68	355 ± 98	0.017
鉄 (mg/1000kcal/日)	3.3 ± 0.7	3.7 ± 0.7	3.0 ± 0.6	0.104
カリウム (mg/1000kcal/日)	1365 ± 267	1350 ± 203	1222 ± 239	0.063
食物繊維 (g/1000kcal/日)	5.7 ± 1.6	5.6 ± 1.9	4.5 ± 1.2	0.020
穀類 (g/日)	556.6 ± 138.8	554.7 ± 171.2	732.0 ± 345.0	0.025
種実類 (g/日)	1.8 ± 1.7	3.3 ± 3.7	5.4 ± 9.5	0.151
いも類 (g/日)	27.2 ± 21.8	29.7 ± 26.7	26.5 ± 21.7	0.830
砂糖類 (g/日)	14.0 ± 10.6	12.0 ± 4.7	11.6 ± 6.9	0.681
菓子類 (g/日)	67.4 ± 56.5	39.2 ± 32.2	53.5 ± 27.5	0.895
動物性油 (g/日)	0.7 ± 1.3	0.2 ± 0.4	0.6 ± 1.0	0.667
植物性油 (g/日)	26.2 ± 13.7	27.1 ± 15.5	29.6 ± 13.5	0.352
豆類 (g/日)	53.4 ± 33.4	75.3 ± 62.0	58.7 ± 38.3	0.857
果実類 (g/日)	131.5 ± 227.8	95.7 ± 60.8	128.7 ± 112.7	0.180
緑黄色野菜 (g/日)	102.3 ± 88.9	127.3 ± 59.3	94.6 ± 68.5	0.430
その他の野菜 (g/日)	162.7 ± 85.8	195.8 ± 85.3	113.0 ± 73.7	0.141
きのこ類 (g/日)	13.7 ± 13.5	12.0 ± 10.1	11.5 ± 13.4	0.823
海草類 (g/日)	12.8 ± 11.9	10.7 ± 11.9	12.5 ± 13.1	0.892
酒類 (g/日)	156.5 ± 214.4	398.9 ± 287.4	329.7 ± 436.9	0.069
魚介類 (g/日)	82.6 ± 35.1	119.2 ± 60.4	140.8 ± 72.1	0.006
肉類 (g/日)	58.0 ± 31.1	77.1 ± 33.1	133.4 ± 93.5	<0.001
卵類 (g/日)	46.1 ± 37.2	54.8 ± 24.7	37.5 ± 24.1	0.292
乳類 (g/日)	536.7 ± 115.6	487.3 ± 69.5	540.0 ± 155.7	0.845
歩数 (歩/日)	7621 ± 3484	6763 ± 1906	5963 ± 2200	0.099

表3 外食摂取頻度と肥満関連指標、栄養素等摂取量、食品群摂取量(女性)

	週1回未満 (n=30)	週1-3回 (n=10)	週4-6回以上 (n=12)	トレンド p値
体重 (kg)	73.9 ±9.8	74.9 ±6.0	75.7 ±6.7	0.421
BMI (kg/m^2)	31.0 ±3.1	31.0 ±2.6	30.7 ±2.9	0.262
体脂肪率(%)	38.6 ±4.3	40.7 ±4.7	41.3 ±7.3	0.102
腹囲 (cm)	131.3 ±15.5	136.3 ±14.8	133.1 ±19.2	0.885
腹部皮下脂肪面積 (cm^2)	341.6 ±76.2	348.1 ±64.1	341.4 ±106.4	0.876
腹部内臓脂肪面積 (cm^2)	126.9 ±48.4	118.3 ±46.4	124.2 ±46.7	0.939
空腹時血糖 (mg/dl)	112.6 ±27.2	119.6 ±47.5	105.7 ±16.2	0.513
HbA1$_C$ (%)	6.0 ±1.3	6.0 ±1.3	5.6 ±0.7	0.288
総コレステロール (mg/dl)	213.4 ±37.2	206.6 ±45.6	205.7 ±21.0	0.324
HDLコレステロール (mg/dl)	56.1 ±12.6	57.5 ±9.5	55.2 ±12.3	0.675
LDLコレステロール (mg/dl)	129.9 ±35.4	122.5 ±34.5	127.8 ±18.8	0.893
中性脂肪 (mg/dl)	137.1 ±62.7	133.3 ±67.2	113.1 ±50.7	0.384
エネルギー (kcal/日)	1942 ±595	2653 ±791	2680 ±1293	0.024
たんぱく質エネルギー比 (%/日)	16.2 ±1.8	16.3 ±1.2	14.8 ±2.3	0.035
脂肪エネルギー比 (%/日)	26.1 ±4.3	27.8 ±5.4	32.7 ±7.5	0.001
炭水化物エネルギー比 (%/日)	56.7 ±4.7	55.0 ±6.0	51.0 ±7.4	0.005
飽和脂肪酸 (%/日)	7.6 ±1.4	8.0 ±1.5	9.5 ±1.5	<0.001
一価不飽和脂肪酸 (%/日)	9.1 ±1.9	9.5 ±2.4	11.7 ±3.9	0.004
多価不飽和脂肪酸 (%/日)	6.1 ±1.2	6.3 ±1.6	7.1 ±2.4	0.092
n-3系脂肪酸 (%/日)	1.3 ±0.3	1.2 ±0.4	1.4 ±0.5	0.321
n-6系脂肪酸 (%/日)	4.9 ±1.0	5.1 ±1.3	5.7 ±2.0	0.076
n-6/n-3比	3.9 ±0.8	4.2 ±0.4	4.3 ±1.0	0.270
PS比	0.8 ±0.2	0.8 ±0.2	0.7 ±0.2	0.281
ビタミンA (μgRE/1000kcal/日)	313 ±136	376 ±128	308 ±283	0.849
ビタミンB1 (mg/1000kcal/日)	0.49 ±0.11	0.49 ±0.08	0.50 ±0.11	0.782
ビタミンB2 (mg/1000kcal/日)	1.04 ±0.13	0.97 ±0.15	0.94 ±0.16	0.074
ビタミンC (mg/1000kcal/日)	54.9 ±23.8	61.0 ±29.5	43.6 ±20.4	0.146
ビタミンD (mg/1000kcal/日)	4.7 ±1.8	5.1 ±1.2	4.3 ±2.1	0.399
カルシウム(mg/1000kcal/日)	518 ±82	467 ±94	439 ±97	0.014
鉄 (mg/1000kcal/日)	4.0 ±0.7	4.0 ±0.5	3.4 ±0.8	0.021
カリウム (mg/1000kcal/日)	1617 ±296	1518 ±190	1349 ±245	0.005
食物繊維 (g/1000kcal/日)	7.3 ±2.0	6.9 ±1.5	5.5 ±1.5	0.004
穀類 (g/日)	399.9 ±75.3	433.8 ±101.7	455.6 ±225.1	0.491
種実類 (g/日)	1.7 ±2.3	4.6 ±6.2	7.0 ±10.8	0.087
いも類 (g/日)	37.3 ±79.0	60.0 ±47.9	27.4 ±28.9	0.662
砂糖類 (g/日)	12.7 ±9.3	18.3 ±10.2	12.4 ±5.7	0.917
菓子類 (g/日)	76.7 ±56.6	121.7 ±87.7	161.9 ±93.5	0.004
動物性油 (g/日)	0.5 ±1.1	0.4 ±0.5	0.6 ±0.9	0.216
植物性油 (g/日)	23.2 ±14.3	31.2 ±24.5	42.9 ±34.1	0.034
豆類 (g/日)	51.4 ±26.9	72.5 ±26.8	55.3 ±60.6	0.367
果実類 (g/日)	102.9 ±89.9	227.1 ±208.1	134.0 ±226.0	0.982
緑黄色野菜 (g/日)	131.8 ±115.9	128.3 ±50.1	115.2 ±85.2	0.587
その他の野菜 (g/日)	204.8 ±238.6	200.3 ±97.2	167.7 ±87.8	0.712
きのこ類 (g/日)	18.8 ±14.0	20.3 ±18.0	11.6 ±9.0	0.271
海草類 (g/日)	21.8 ±28.8	17.6 ±17.1	10.7 ±10.2	0.108
酒類 (g/日)	21.2 ±66.8	30.3 ±59.3	53.5 ±150.4	0.900
魚介類 (g/日)	84.5 ±39.4	136.2 ±83.6	101.9 ±73.9	0.965
肉類 (g/日)	41.1 ±24.8	71.1 ±47.3	80.7 ±83.2	0.291
卵類 (g/日)	30.3 ±23.6	42.4 ±23.9	39.4 ±26.7	0.552
乳類 (g/日)	483.5 ±77.4	530.9 ±76.8	529.2 ±159.8	0.351
歩数 (歩/日)	8005 ±2944	7319 ±2144	9081 ±3162	0.235

表4 減量プログラム参加後における外食頻度の変化と肥満指標、栄養素摂取量、食品群摂取量の変化(男性)

	週1回未満 (n=26)		週1-3回 (n=15)		週4-6回以上 (n=15)		週1回未満 (n=26)	週1-3回 (n=15)	週4-6回以上 (n=15)	
	参加前	1年後	参加前	1年後	参加前	1年後	変化量	変化量	変化量	p値[1]
外食区分変化							0.4 ±1.1	0.1 ±0.9	-1.0 ±1.1	0.001
体重 (kg)	81.9 ±9.8	78.1 ±8.8	86.1 ±5.7	81.2 ±6.2	86.3 ±7.9	79.3 ±10.7	-3.8 ±4.7	-4.9 ±3.6	-7.0 ±6.5	0.156
BMI (kg/m^2)	29.6 ±2.8	28.3 ±2.6	29.6 ±1.7	27.9 ±2.2	30.4 ±2.0	27.9 ±2.8	-1.4 ±1.6	-1.6 ±1.2	-2.5 ±2.5	0.242
体脂肪率(%)	27.9 ±3.8	26.3 ±4.9	29.7 ±3.6	27.9 ±4.3	28.2 ±3.2	26.6 ±3.6	-1.6 ±3.7	-1.7 ±3.7	-1.7 ±4.0	0.719
腹囲 (cm)	101.4 ±7.4	97.5 ±8.0	105.3 ±5.1	100.0 ±6.7	104.8 ±5.0	97.5 ±7.8	-3.9 ±5.6	-5.3 ±5.1	-7.3 ±7.0	0.183
腹部皮下脂肪面積 (cm^2)	234.0 ±76.5	210.8 ±70.3	253.5 ±58.4	212.9 ±51.1	248.0 ±52.6	195.3 ±60.5	-23.2 ±39.0	-40.7 ±30.0	-52.8 ±37.2	0.033
腹部内臓脂肪面積 (cm^2)	135.5 ±44.7	115.7 ±37.5	166.1 ±54.9	142.8 ±55.5	159.9 ±39.8	126.4 ±46.3	-19.8 ±31.8	-23.4 ±32.2	-33.5 ±37.0	0.408
エネルギー (kcal/日)	2450 ±484	2152 ±396	2649 ±455	2316 ±550	3213 ±1126	2338 ±704	-298.4 ±469.6	-332.5 ±709.3	-874.9 ±837.0	0.597
たんぱく質エネルギー比 (%/日)	14.5 ±1.8	14.4 ±2.1	15.1 ±1.9	14.4 ±1.7	15.0 ±2.2	13.5 ±1.9	-0.1 ±2.4	-0.8 ±2.2	-1.5 ±2.1	0.228
脂肪エネルギー比 (%/日)	25.0 ±5.2	27.0 ±5.1	24.6 ±5.3	25.8 ±4.6	24.5 ±5.2	24.9 ±6.3	2.0 ±6.1	1.2 ±6.5	0.4 ±5.9	0.497
炭水化物エネルギー比 (%/日)	54.9 ±7.6	53.2 ±6.2	48.6 ±7.4	46.8 ±7.8	50.5 ±11.2	51.2 ±13.1	-1.7 ±6.9	-1.8 ±6.8	0.7 ±10.2	0.440
飽和脂肪酸 (%/日)	7.4 ±1.8	7.0 ±1.8	6.6 ±1.2	6.5 ±1.9	7.0 ±1.7	6.5 ±2.0	-0.3 ±1.7	-0.1 ±2.3	-0.4 ±1.7	0.863
一価不飽和脂肪酸 (%/日)	8.7 ±2.1	9.7 ±2.1	8.9 ±2.3	9.4 ±2.2	8.9 ±2.1	9.1 ±2.5	1.0 ±2.6	0.5 ±2.8	0.2 ±2.4	0.618
多価不飽和脂肪酸 (%/日)	5.6 ±1.2	6.7 ±1.3	6.0 ±1.5	6.5 ±1.3	5.7 ±1.1	6.3 ±1.5	1.1 ±1.6	0.4 ±1.6	0.6 ±1.4	0.456
n-3系脂肪酸 (%/日)	1.1 ±0.3	1.4 ±0.4	1.2 ±0.4	1.3 ±0.4	1.1 ±0.3	1.2 ±0.3	0.3 ±0.5	0.1 ±0.4	0.1 ±0.4	0.413
n-6系脂肪酸 (%/日)	4.5 ±1.0	5.4 ±1.0	4.8 ±1.2	5.1 ±1.1	4.6 ±0.9	5.1 ±1.2	0.8 ±1.2	0.3 ±1.3	0.5 ±1.1	0.521
n-6/n-3比	4.3 ±1.0	4.1 ±0.9	4.2 ±0.7	4.0 ±0.8	4.2 ±1.1	4.3 ±0.9	-0.2 ±0.9	-0.2 ±0.9	0.0 ±1.0	0.584
PS比	0.8 ±0.2	1.0 ±0.3	0.9 ±0.1	1.0 ±0.3	0.8 ±0.1	1.0 ±0.2	0.2 ±0.2	0.1 ±0.3	0.2 ±0.1	0.757
ビタミンA (μgRE/1000kcal/日)	267 ±224	302 ±228	306 ±173	426 ±505	214 ±104	315 ±186	34.5 ±114.3	120.0 ±457.9	100.8 ±180.7	0.560
ビタミンB1 (mg/1000kcal/日)	0.48 ±0.12	0.44 ±0.09	0.46 ±0.10	0.45 ±0.10	0.44 ±0.08	0.43 ±0.09	-0.04 ±0.13	-0.01 ±0.12	-0.01 ±0.10	0.761
ビタミンB2 (mg/1000kcal/日)	0.92 ±0.16	0.68 ±0.12	0.90 ±0.18	0.69 ±0.15	0.80 ±0.19	0.67 ±0.16	-0.24 ±0.16	-0.21 ±0.18	-0.13 ±0.15	0.699
ビタミンC (mg/1000kcal/日)	49.7 ±30.7	43.9 ±16.7	45.7 ±11.9	49.4 ±15.1	32.6 ±12.0	49.1 ±40.0	-5.8 ±26.8	3.7 ±14.0	16.5 ±35.6	0.307
ビタミンD (mg/1000kcal/日)	4.0 ±2.0	5.3 ±2.4	5.0 ±2.2	5.5 ±1.9	4.3 ±1.7	4.3 ±1.7	1.4 ±2.6	0.4 ±2.7	-0.1 ±2.0	0.198
カルシウム(mg/1000kcal/日)	434 ±76	261 ±63	393 ±68	239 ±58	355 ±98	249 ±99	-172.9 ±72.7	-153.7 ±70.2	-105.5 ±76.9	0.476
鉄 (mg/1000kcal/日)	3.3 ±0.7	3.9 ±0.9	3.7 ±0.7	4.0 ±0.7	3.0 ±0.6	3.5 ±0.7	0.6 ±0.7	0.4 ±0.7	0.5 ±0.5	0.697
カリウム (mg/1000kcal/日)	1365 ±267	1206 ±239	1350 ±203	1241 ±241	1222 ±239	1205 ±292	-159.5 ±223.5	-109.0 ±239.4	-16.1 ±221.3	0.449
食物繊維 (g/1000kcal/日)	5.7 ±1.6	6.7 ±2.1	5.6 ±1.9	7.0 ±2.5	4.5 ±1.2	6.3 ±2.1	1.0 ±1.6	1.4 ±1.8	1.8 ±1.9	0.528
穀類 (g/日)	556.6 ±138.8	497.9 ±126.6	554.7 ±171.2	467.0 ±86.0	732.0 ±345.0	500.7 ±144.7	-58.7 ±125.7	-87.7 ±197.2	-231.2 ±294.2	0.668
種実類 (g/日)	1.8 ±1.7	2.2 ±4.5	3.3 ±3.7	3.9 ±6.6	5.4 ±9.5	3.9 ±5.6	0.4 ±5.0	0.6 ±5.6	-1.6 ±11.4	0.099
いも類 (g/日)	27.2 ±21.8	28.5 ±18.4	29.7 ±26.7	25.8 ±19.2	26.5 ±21.7	31.1 ±28.3	1.3 ±17.1	-4.0 ±18.6	4.6 ±22.0	0.754
砂糖類 (g/日)	14.0 ±10.6	11.8 ±5.7	12.0 ±4.7	12.6 ±3.9	11.6 ±6.9	10.9 ±6.2	-2.2 ±11.8	0.6 ±4.8	-0.7 ±4.7	0.477
菓子類 (g/日)	67.4 ±56.5	69.5 ±44.1	39.2 ±32.2	51.3 ±61.3	53.5 ±27.5	56.1 ±36.3	2.1 ±40.5	12.0 ±53.4	2.7 ±28.4	0.315
動物性油 (g/日)	0.7 ±1.3	0.6 ±1.0	0.2 ±0.4	0.3 ±0.4	0.6 ±1.0	0.3 ±0.8	-0.1 ±1.5	0.1 ±0.5	-0.3 ±0.7	0.211
植物性油 (g/日)	26.2 ±13.7	25.5 ±14.1	27.1 ±15.5	25.0 ±13.6	29.6 ±13.5	26.9 ±15.2	-0.7 ±20.2	-2.2 ±21.3	-2.6 ±12.6	0.793
豆類 (g/日)	53.4 ±33.4	72.4 ±55.4	75.3 ±62.0	68.8 ±29.8	58.7 ±38.3	70.3 ±34.9	19.0 ±45.4	-6.5 ±49.8	11.7 ±27.6	0.679
果実類 (g/日)	131.5 ±227.8	101.0 ±104.9	95.7 ±60.8	100.9 ±36.7	128.7 ±112.7	101.6 ±81.8	-30.5 ±214.6	5.2 ±70.4	-27.1 ±117.3	0.343
緑黄色野菜 (g/日)	102.3 ±88.9	114.0 ±65.6	127.3 ±59.3	155.5 ±87.2	94.6 ±68.5	135.4 ±84.8	11.7 ±70.3	28.1 ±79.3	40.9 ±67.9	0.770
その他の野菜 (g/日)	162.7 ±85.8	152.9 ±60.3	195.8 ±85.3	181.1 ±97.2	113.0 ±73.7	139.1 ±92.6	-9.8 ±74.8	-14.7 ±103.9	26.1 ±64.0	0.731
きのこ類 (g/日)	13.7 ±13.5	15.4 ±24.4	12.0 ±10.1	18.2 ±14.9	11.5 ±13.4	21.7 ±26.7	1.8 ±19.3	6.3 ±16.2	10.2 ±24.9	0.086
海草類 (g/日)	12.8 ±11.9	13.7 ±11.5	10.7 ±11.9	15.6 ±16.8	12.5 ±13.1	12.8 ±12.3	1.0 ±12.0	4.9 ±22.9	0.3 ±14.4	0.642
酒類 (g/日)	156.5 ±214.4	102.4 ±116.9	398.9 ±287.4	315.4 ±252.6	329.7 ±436.9	215.8 ±225.0	-54.2 ±172.0	-83.5 ±280.9	-113.8 ±270.6	0.568
魚介類 (g/日)	82.6 ±35.1	99.6 ±48.6	119.2 ±60.4	112.2 ±45.6	140.8 ±72.1	103.0 ±80.7	17.0 ±53.2	-7.0 ±68.4	-37.8 ±48.1	0.221
肉類 (g/日)	58.0 ±31.1	61.7 ±36.7	77.1 ±33.1	78.9 ±32.0	133.4 ±93.5	82.7 ±55.0	3.7 ±37.5	1.8 ±39.8	-50.7 ±77.4	0.100
卵類 (g/日)	46.1 ±37.2	49.5 ±46.7	54.8 ±24.7	52.8 ±41.8	37.5 ±24.1	29.5 ±24.9	3.4 ±29.6	-2.0 ±41.0	-8.0 ±19.2	0.414
乳類 (g/日)	536.7 ±115.6	132.4 ±76.9	487.3 ±69.5	95.4 ±64.4	540.0 ±155.7	162.5 ±142.3	-404.3 ±96.2	-391.9 ±68.1	-377.5 ±51.9	0.551
歩数 (歩/日)	7621 ±3484	9078 ±3851	6763 ±1906	8499 ±2055	5963 ±2200	7494 ±3785	1395.1 ±2620.5	1736.9 ±2491	1530.4 ±2422	0.935

[1]変化量に関して、プログラム開始時の値で調整した共分散分析を行った。肥満指標に関しては歩数変化量でも調整を行った。