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Review

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Food consumption and dietary factors involved in health and disease in Nikkeis: systematic review

ABSTRACT

OBJECTIVE: To analyze food consumption and dietary factors involved in the Nikkei population's health and disease processes

METHODS: A systematic review of observational studies that described Nikkeis' food intake was carried out in electronic databases Lilacs, SciELO and PubMed/Medline databases, from 1997 to 2012. Initially, 137 titles and abstracts were analyzed, excluding intervention studies, those which only presented metabolite and vitamin plasma levels and those which did not meet the objective of this study. Of these, 38 studies were selected and evaluated using a method based on Downs & Black (1998), adapted for observational studies, leaving 33 studies to be analyzed.

RESULTS: Few studies about Nikkei food intake were found outside of Hawaii, in the United States, and São Paulo (mainly in the city of Bauru) in Brazil. The total energy intake of Japanese-Brazilians had an elevated fat contribution, decreasing carbohydrate and protein intake. In the United States, the prevalence of Japanese-Americans who consumed high density energy food was elevated. The Niseis (children of immigrants) presented, on average, higher intake of Japanese food products, while the Sanseis (grandchildren of immigrants) showed more Westernized dietary habits.

CONCLUSIONS: Although some Japanese food habits have been maintained, the Nikkeis' dietary intake reveals a high prevalence of typical Westernized food intake (high in processed food, fat and sodium, and poor in fiber), that may be contributing to the increasing development of chronic disease in this population.

DESCRIPTORS: Food Consumption. Food Habits. Acculturation. Emigrants and Immigrants. Japan. Observational Studies. Review Literature as Topic.

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INTRODUCTION

Studies of migrant populations mean the impact of environmental factors on the appearance of non-communicable chronic diseases can be assessed.[48] Individuals who move to live in different countries are at high risk of developing these types of disease due to the socio-cultural changes they experience.[26]

In this context, diet constitutes an important factor involved in the development of these pathologies.[45] Dietary acculturation, defined as adopting and maintaining dietary habits from other traditions,[22] is common in the majority of immigrants, irrespective of their country of origin.

The demographic proportion of Japanese immigration means that dietary acculturation is relevant to this population. According to the *Associação* Kaigai Nikkeijin Kyokai,[a] in 2004 there were around 2.6 million individuals of Japanese origin residing outside of Japan. Data from the Ministry of Foreign Affairs of Japan,[b] from 2009, estimate that around 60 thousand Japanese and 1.5 million descendants of Japanese are living in Brazil. According to Hinata's[17] (2010) Japanese dictionary, the term Nikkei refers to Japanese immigrants and their respective descendants.

Analyzing changes in dietary habits in Nikkeis is justified by the drastic increase in incidence of cancer and cardiovascular disease in this population[45] compared with in their native country. In Brazil, studies[12,21] indicate that the prevalence of type II diabetes among Japanese-Brazilians tripled between the 1980s and the 2000s. The main food in the traditional Japanese is rice, accompanied by vegetables, mushrooms, seaweed and soya and soya derivatives. On average, this diet contains 15% protein, 17% fat and 61% carbohydrates in relation to the total daily calorie value.[26] For Japanese living in Japan, high consumption of fish throughout their lives may be linked to lower levels of arteriosclerosis in this population, due to the anti-inflammatory effects from ω-3 fatty acid, which improves endothelial function, reducing oxidative stress and the risk of thrombosis.[41] However, in the process of migrating to other countries, the Japanese population incorporated the habit of consuming bread, cereals, red meat, dairy products, snacks and soft drinks and reducing their fish consumption.[26]

Some studies show that American-Asian individuals born outside of the United States, after having lived a short period of time on American soil (less than five years), had a higher risk of being overweight and obese than those who had been living in the country for more than 15 years.[24] Moreover, Japanese-Americans have a higher prevalence of diabetes compared to white Americans and native Japanese.[31] However, Japanese-Americans who maintain a Japanese lifestyle (a relatively low fat diet, rich in complex carbohydrates and regular physical activity) seem to be less prone to developing diabetes than those who do not preserve these customs, especially with respect to the diet.[35]

In line with these findings, studies carried out with the population of Japanese origin in the municipality of Bauru, SP, Southeastern Brazil, also showed a high prevalence of glucose metabolism disorders and incidence of diabetes mellitus. Such results may reflect this population's strong genetic predisposition to these disorders associated with the Western lifestyle.[11] The aim of this article was to analyze food intake and the dietary factors involved in the health and disease process of the Nikkei population.

METHODS

A systematic revision of the literature on food intake of Japanese immigrants and their descendants was carried out. The Medline/PubMed, Lilacs and SciELO databases and selected articles from the period 1997 to 2012 were used, with the aim of including the latest on the topic. The terms used in the searches were: "issei",[c] "nisei",[d] "sansei"[e] "Nikkei", "Japanese-Brazilian", "Japanese-American" to characterize the subjects and "diet", "dietary habits", "dietary patterns", "food habits", "food intake" to identify the food intake of these individuals, either isolated or combined using "and" or "or".

Intervention studies or those which involved animal experimentation were excluded, as were those which only presented metabolite and vitamin plasma levels, revision studies and or reports of the results of various studies and articles which did not include the object of this review. Articles written in languages other than English, Spanish or Portuguese were also excluded.

Next, the complete test of the selected articles was analyzed, as well as the references cited, from which additional studies pertinent to the topic were selected. The total number of studies selected was then classified according to the criteria of Downs & Black[6] (1998), adapted for observational studies, with the aim of

[a] Associação Kaigai Nikkeijin Kyokai. Quem são os Nikkeis no Exterior? [cited 2012 Oct]. Available from: http://www.jadesas.or.jp/pt/aboutnikkei/index.html
[b] Ministry of Foreign Affairs of Japan. Japan - Brazil relations [cited 2012 Oct 6]. Available from: http://www.mofa.go.jp/region/latin/brazil/index.html
[c] Issei: Japanese grandfather (Japanese immigrant)[19]
[d] Nisei: Japanese second generation descendant (son of immigrant)[19]
[e] Sansei: Japanese third generation descendant (grandson of immigrant)[19]

evaluating their methodological quality. The adapted version consisted of 20 items from the original 32 point list. Thus, the adapted score had a total of 20 points. The cutoff point used to exclude articles using the Downs & Black[6] assessment was 10, representing half the total possible score (20).

The initial search identified 137 articles. Of these, six were found in SciELO, 22 in Lilacs and 109 in Medline/PubMed. Only those articles published between 1/1/1997 and 3/10/2012 were considered for selection. Based on analysis of the titles and abstracts, 26 repeated articles, seven articles which were about intervention studies, six which only contained data on metabolite and vitamin plasma levels and 68 which did not meet the objectives of this study or were narrative or systematic revisions were identified and excluded. The total number of eligible studies found in the databases was 30. Later, eight more articles were found through bibliographical references cited in the eligible articles. Therefore, the full text of 38 articles was read and analyzed according to the adapted Downs & Black criteria and five with scores below 10 were excluded. Finally, the systematic revision consisted of 33 studies.

For the purposes of analysis, the studies were organized into 3 groups: 1. Studies of Japanese-Brazilians, 2. Studies of Japanese-Americans and 3. Carried out in Brazil and Japan or the United States and Japan. Multiethnic studies which analyzed and described Nikkei dietary habits were also included in the revision.

RESULTS

Of all the studies analyzed, 36% (n = 12) were conducted with the Japanese-Brazilian population; 42% (n = 14) with the Japanese-American population (which was often allocated in a group in multi-ethnic studies); and 22% (n = 7) were studies carried out in two countries, Japan and Brazil or Japan and the United States.

Studies with Japanese-Brazilians

The majority of studies with Japanese-Brazilians were carried out in the population of Japanese descendants living in the municipality of Bauru in the state of Sao Paulo. Of the 12 studies, only two[2,15] had been carried out in other locations with high concentrations of Japanese descendants. Table 1 shows the list of the articles and the characteristics of each study.

With regards to language, eight articles[7-9,15,26,32-34] were in English and four[1,5,37,48] in Portuguese. As for the study design used, two studies were cohort studies[4,26] and the others[1-3,5,7-9,15,37,48] were cross-sectional studies, with three[1,2,5] being comparisons of transversal data.

With regards to the tools used to investigate food intake, all of the studies used food frequency questionnaires (FFQ) and only two articles[2] reported using three-day-food-diaries, in the second stage of the research.

Of the 12 articles analyzed, eight[1,2,4,5,7-9,48] verified a high contribution of lipids in the total calorie intake of the subjects studied, to the detriment of carbohydrates and proteins. Salvo et al[37] (2009) stated that the Nikkei diet, irrespective of macrovascular disease, was composed by 54% carbohydrates, 14% proteins and 32% lipids in relation to their daily calorie intake. In another publication, referring to the same study,[13] the authors verified that higher consumption of total fats was significantly linked to peripheral arterial disease. This link was corroborated by Freire et al[8] (2005), who verified significantly higher lipid intake in men with metabolic syndrome than in those without this disorder.

Also in this context, it was observed that individuals who were married to a non-Japanese spouse had higher mean values for calorie intake, carbohydrate, protein, lipid and saturated fat intake than those who were intra-ethnically married (2,183 kcal *versus* 1,990 kcal; 278.1 g *versus* 268.3 g; 71.2 g *versus* 68.9 g; 85.7 g *versus* 70.5 g; and 20.5 g *versus* 16.9 g, respectively).[48] Comparisons between generations also show relevant differences. Evidence indicates that consuming traditional Japanese food such as Miso soup (missoshiru), is declining among Nisseis compared with Isseis; on the other hand, there is higher reported lipid intake among the youngest. However, consuming traditional Japanese food, with soya derivatives, pickled vegetables and green tea was rare in both generations.[9]

With regards other dietary changes, De Castro et al[5] (2006) found that, between 1993 and 2000, Japanese-Brazilians, in the city of Bauru, SP, increased their consumption of dairy products, fruit and fruit juice. Damião et al[4] (2006), after following the same population for seven years, observed a decrease in the consumption of red meat and whole milk and an increase in consumption of skimmed milk.

Studies with Japanese-Americans

Of the 14 articles analyzed in this subgroup, 78.57% (n = 11) formed part of some multi-ethnic study, mainly carried out in Hawaii-California in the United States. All of the selected studies were published in English. Table 2 shows the list of the articles and their characteristics.

With regards to the studies' designs, ten were cohort studies,[16,18-20,23,25,42-44,46] one was of a case control,[47] and three[14,35-36] were cross sectional.

In the Multiethnic Cohort Study (MEC), carried out in Hawaii and California, Japanese-Americans had the most energy-dense diets and the lowest body mass index compared with other ethnic groups.[19]

Table 1. Characteristics of studies on dietary patterns and health outcomes among Japanese-Brazilians between 1997 and 2009.

Authors e score	Location and subjects	Year	Methodology (Study Design and Evaluation Instrument for Food Consumption)	Key findings
de Salvo et al[37] score: 15	Bauru, SP, Brazil 1,165 Japanese-Brazilians with and without macrovascular disease, aged 30 and over.	2009	Cross-sectional study FFQ validated for Japanese-Brazilians	Caloric distribution of Nikkei diet: 54% carbohydrate, 14% protein and 32% fat. In Japanese-Brazilians with macrovascular disease increased consumption of red meat, protein, trans fat, sodium, and low intake of fiber and calcium were observed.
Yamashita et al[48] score: 18	Bauru, SP, Brazil 1,009 married Japanese-Brazilians individuals.	2009	Cross-sectional study FFQ validated for Japanese-Brazilians	Inter-ethnic marriage (Nikkei man and non-Nikkei woman, Nikkei woman and non-Nikkei man): higher average values of total calories, carbohydrates, proteins, lipids and saturated fats Intra-ethnic marriage (Nikkei man and Nikkei woman) in both sexes, higher intake of carbohydrates, vegetables and miso soup. Increased intake of fruits and fruit juices in men. Increased consumption of cereal and protein in women.
Massimino et al[26] score: 14	Bauru, SP, Brazil 647 Isseis and Nisseis aged 40-79	2007	Cohort study FFQ adapted by Tsunehara et al	In individuals with peripheral arterial disease fiber intake of whole grains and linoleic acid was lower and saturated fat intake was higher than in individuals without the disease. Increased mortality among individuals with lower consumption of carbohydrates and cholesterol.
Bertolino et al[1] score: 19	Bauru, SP, Brazil 328 men and women first (Issei) and second generation (Nisei), 40-79 years of age	2006	Comparison of transversal data (from two surveys of health and nutrition) FFQ adapted by Tsunehara et al (1993) and FFQ validated for Japanese-Brazilians (2000)	Lack of association between changes in the consumption of trans fatty acids and changes in serum lipid profile. Level of trans fat intake was above that recommended by WHO (up to 1% of total calories).
De Castro et al[5] score: 19	328 individuals aged 40-79	2006	Comparison of transversal data FFQ adapted by Tsunehara et al (1993) and FFQ created and validated for Japanese-Brazilians (2000)	There was a decrease in cholesterol and increased consumption of linoleic and oleic fatty acids and fruit in the diet of Japanese-Brazilians. However, there is also an increased intake of total fat. Japanese-Brazilian women had an increased caloric value of their diets, with reduced contribution candy. In both sexes there was a decrease in caloric contribution of protein and increase in fats, dairy, fruits and fruit juices
Damião et al[4] score: 19	Bauru, SP, Brazil 218 individuals, aged de 40-79 without DM or hypertension or dyslipidemia	2006	Cohort study FFQ validated for Japanese-Brazilians	After 7 years of follow-up, Japanese-Brazilian men and women decreased protein intake and total cholesterol and increased intake of total fat, particularly monounsaturated and polyunsaturated. Intake of red meat and whole milk and skim milk decreased increased. The usual intake of red meat was associated with metabolic syndrome, especially among men

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Freire et al[8] score: 19	Bauru, SP, Brazil 877 individuals aged 30 and over	2005	Cross-sectional study FFQ validated for Japanese-Brazilians	The total fat intake may be a risk factor for metabolic syndrome (MS) in a population of Japanese-Brazilians. Men with MS: significantly higher intake of total fat, oleic acid and cholesterol. Consumption of fried foods was associated with an increased risk of MS in Japanese-Brazilians.
Freire et al[9] score: 18	Bauru, SP, Brazil 1.283 individuals aged between 30-90	2003	Cross-sectional study FFQ validated for Japanese-Brazilians	A common dietary pattern is shared between genders and generations of Japanese-Brazilians, with high risk of metabolic syndrome. The main difference in food consumption between generations studied was miso soup, being most commonly consumed among those of the first generation. The individuals of the second generation consumed more fats and oils. The consumption of traditional Japanese food was rare in both the first and second generation.
Ferreira et al[7] score: 10	Bauru, SP, Brazil 530 individuals, aged 40-79	2002	Cross-sectional study FFQ adapted by Tsunehara et al	Obese individuals and those with central adiposity had a greater proportion of the consumed energy from fat and carbohydrates lower ($p < 0.05$). The second generation showed higher energy consumption than the first generation ($p < 0.05$). After adjustment, protein intake was the only variable significantly associated with BMI.
Hamada et al[15] score: 14	São Paulo, SP, Brazil 96 cases and 192 controls Japanese-Brazilians aged between 38 and 89	2002	Case-control study Non-validated FFQ with 30 items	The introduction of the daily habit of meat consumption among Japanese immigrants and their descendants may be associated with stomach cancer. The protective effect of fruit consumption was confirmed in this population.
Costa et al[3] score: 19	Bauru, SP, Brazil 530 Japanese-Brazilians individuals, aged between 40-79	2000	Cross-sectional study FFQ adapted by Tsunehara et al	Results of the study do not support a significant association between nutritional factors and glucose intolerance. However, they suggest that consumption of foods rich in cholesterol and protein may be markers of increased BMI (which can lead to insulin resistance, preceding diabetes).
Cardoso et al[2] score: 13	São Paulo, SP, Brazil 166 individuals aged between 40-69	1997	Comparison of cross-sectional data FFQ adapted by Tsunehara et al. (1st stage in 1989), 3-day-food-diaries and repetition of the same FFQ (2nd stage in 1995).	Japanese-Brazilians born in Brazil have a higher intake of fats and oils, vegetables, chicken and red meat, dairy products and coffee Nikkeis born in Japan report high consumption of seaweed, green teat, fish and Miso soup. The two generations of Japanese-Brazilians report infrequent consumption of soya, pickled vegetables and green tea.

FFQ: Food frequency questionnaire; MS: Metabolic syndrome; WHO: World Health Organization; BMI: Body Mass Index

Table 2. Characteristics of studies on dietary patterns and health outcomes among Japanese-Americans between 2000 and 2010.

Authors and score	Location and subjects	Year	Methodology (Study Design and Evaluation Instrument for Food Consumption)	Key findings
Sharma et al[42] Score: 20	Hawaii and California, USA 186,916 individuals 45-75 years of age living in Hawaii and Los Angeles 1993-1996	2012	Multi-ethnic cohort study Validated FFQ	Main foods consumed by Americans of Japanese origin: rice, bread, cereals, chicken, turkey, nuts, fish, salad dressing, butter, fried meat with vegetables; orange juice or grape grapefruit; bananas, tropical fruits, juices and soft drinks artificial fruit
Steinbrecher et al[43] score: 20	Hawaii and California, USA 29,759 Caucasians, 35,244 Japanese-Americans and 10,509 Native Americans, 45-75 years of age at baseline	2011	Multi-ethnic cohort study Validated FFQ	Red meat consumption was positively associated with the risk of diabetes in men (fifth quintile vs. first quintile: HR: 1.43) and women (fifth versus first quintile: HR: 1. 30) in adjusted models. For men, there were significant interactions of ethnicity with the consumption of red meat and processed red meats: Caucasians had slightly higher risks than Japanese-Americans.
Hopping et al[18] score: 14	Hawaii and California, USA 75,512 Caucasians, Japanese Americans and Native Hawaiians	2010	Multi-ethnic cohort study FFQ	High intake of fiber from grains significantly reduced (by 10%) the risk of diabetes in men and women. High fiber intake (vegetable) decreased the risk by 22% in males but not in females. The intake mg reduced the risk (HR = 0.77 and 0.84) for men and women, respectively.
Hu et al[20] score: 20	Massachusetts, Illinois, Michigan, California, New Jersey, EUA 2,025 African-American, Chinese, Caucasian, Japanese-American and Hispanic women, between 46-58 years of age	2009	Population based cohort study SWAN dietary questionnaire – modified version of the Block FFQ, 1995	The glycemic load was highly correlated with caloric intake and total CHO. Rice was the largest source of glycemic load among Japanese-American, contributing about 35% of the total, followed by bread and orange juice.
Henderson et al[16] score: 17	Hawaii and California, USA Subjects: 139,406 Japanese-American individuals, African-Americans, Latinos, whites and Hawaiians	2007	Multi-ethnic cohort study Questionnaire used not specified.	The highest intake of saturated fat was associated with higher mortality from cardiovascular disease. In Japanese-American men, this consumption was dramatically lower compared with other ethnic groups.
Pierce et al[35] score: 18	Washington, EUA 496 Japanese-Americans	2007	Cross-sectional study FFQ with 40 items	Japanese-Americans of the second generation consumed more fish, tofu and tsukemonos, while the third ate more cheese, red meat and soft drinks. In the latter, the Western dietary pattern was significantly associated with the prevalence of diabetes.
Stram et al[44] score: 18	Hawaii and California, USA 82,486 white, African-American, Japanese-American, Latino and Hawaiian men	2006	Multi-ethnic cohort study Food frequency questionnaire, calibrated	No protective effect arising from the consumption of fruits and vegetables was found in relation to prostate cancer in any of the studied groups.

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Howarth et al[19] score: 18	Hawaii and California, USA 191,023 Latino, African-American, Caucasian, Japanese-American and Hawaiian men and women	2006	Multi-ethnic cohort study Calibrated FFQ	The mean energy density (ED) and BMI was lower among Japanese Americans than any other ethnic group studied. After adjusting for the amount of food consumed daily, age, current smoking, physical activity, chronic disease and education, an increase of 1 kJ / g ED was associated with an increase in BMI of 1 kg/m2 in each ethnic group.
Gold et al[14] score: 18	Pennsylvania, Massachusetts, Michigan, California, New Jersey, EUA 3,302 African-American, Latino, Japanese-American, Caucasian and Chinese women aged 42-52	2004	Cross-sectional study SWAN dietary questionnaire – modified version of the Block FFQ, de 1995, including Japanese and Chinese food items	Although no nutrient was significantly associated with vasomotor symptoms, in Japanese-Americans a positive relationship was indicated between intake of genistein, a soya phytoestrogen, with reported symptoms.
Willcox et al[46] score: 19	Hawaii, USA 1,915 Japanese-American men between 45-68 years of age at recruitment	2004	Cohort study 24-hour recalled food intake and 7-day-food-diary in a baseline subsample FFQ validated in the second monitoring	Lower mortality in individuals who were in the second quintile of energy intake, suggesting that men who consumed 15% below the average of the group had a lower risk of mortality from all causes. Increased consumption of mortality was below 50% of the average for the group
Laurin et al[25] score: 19	Hawaii, USA 2,459 Japanese-American men aged 45-68 years old in 1965-1968	2004	Prospective community – based study 24-hour recalled food intake	Intake of beta-carotene, flavonoids, vitamins E and C were not associated with risk of dementia or its subtypes. This study suggests that dietary intake of antioxidants in middle age does not modify the risk of dementia or its subtypes prevalent in a period later in life.
Wu et al[47] score: 18	California, EUA 501 cases and 594 controls: women of Japanese, Chinese and Filipino origin, aged 25-74	2002	Case-control study FFQ with 14 food items rich in soya	Soy consumption, particularly in early childhood, can have a protective effect in later life on the risk of breast cancer.
Rice et al[36] score: 16	Seattle, EUA 274 Japanese-American women between 65-93 years of age	2001	Cross-sectional study Nikkei soy food frequency questionnaire (NSFFQ), with 14 food items rich in soya	Foods rich in soy were more consumed: tofu (soybean), miso (fermented soybean paste) and aburaage (fried tofu). The intake of soy isoflavones in the diet was positively associated with the Japanese language, the consumption of traditional Japanese dishes (kamaboko, manju and mochi), skim milk and yellow / red vegetables, vitamin E supplement use and walking several blocks per day. Intake of soy isoflavones in the diet was negatively associated with the consumption of butter.
Kolonel et al[23] score: 11	Hawaii and California, USA 215,251 men and women from five different ethnicities, aged 45-75 at the time of recruitment	2000	Cohort study Validated FFQ 24-hour recalled food intake	Japanese-Americans intakes were significantly lower for cholesterol, fiber, lycopene, calcium and folate compared to other ethnic groups. And were the only group in which the relationship of polinsturados fatty acids / saturated fat was greater than 1.

FFQ: food frequency questionnaire; CHO: carbohydrates; HR: *hazard ratio*; BMI: Body Mass Index

Moreover, Henderson et al[16] (2007) found that higher consumption of saturated fat was related to higher mortality from cardiovascular disease, and that in Japanese-American men this consumption was significantly lower than in Afro-Americans, Latinos and Whites. Recently, Steinbrecher et al[43] (2011) verified that red meat consumption, whether processed or not, was positively associated with risk of diabetes, with higher risk for Caucasian individuals than for Japanese-Americans Sharma et al[42] (2013) highlighted that, in their cohort study, the main foods consumed by Americans of Japanese origin were: rice, bread, cereals, chicken, turkey, nuts, fish, salad dressing, butter, meat fried with vegetables, oranges, grape or pomelo juice, bananas, tropical fruit, soft drinks and fruit juice.

Concerning the intake of soya and soya derivatives, intake was highest in women of Chinese origin, medium in women of Japanese origin and lowest in those of Philipino descent.[47] Other studies found that the greatest indicator for isoflavone consumption was the language spoken in the interview (Japanese or English). Individuals who spoke Japanese consumed, on average, more isoflavone-rich foods. Birthplace also proved to be a strong indicator for intake of soya and soya derivatives. Consumption, over the preceding year, of isoflavone food sources were 7.8 mg/day, 6 mg/day and 22.5 mg/day in women born in the USA, Hawaii and in Japan, respectively.[36]

Tofu, consumed in its natural state or as part of a dish, was the main source of soya among Chinese, Japanese and Philipino women, comprising around 60% of total daily calorie intake.[47] In a study by Rice et al[36] (2001), isoflavone intake was positively linked to kamaboko (fish dumplings), manju and mochi (both Japanese desserts), skimmed milk and red and yellow vegetables. However, among women of Chinese and Japanese origin, genistein consumption (one of the soya isoflavones) showed a positive, although not significant, link with vasomotor menopausal symptoms.[14]

In the comparison between Japanese-Americans generations, the Nisseis, on average, consumed more Japanese food products, whereas the Sanseis had a more Westernized dietary profile.[35]

Mixed studies: Japan x Brazil and Japan x United States

Seven studies were carried out in two different countries and only one of them[39] was conducted in Brazil and Japan. Other six studies[27,29-31,33,45] were carried out in the United States and Japan.

Different instruments were used to obtain data on the diets of the individuals in question. Four studies[27,29,30,33] used 24 hour food diaries and the other three[31,39,45] used food frequency questionnaires. All of the studies were published in English. Table 3 shows the list of the articles analyzed.

Schwingel et al[39] (2007) observed that Japanese-Brazilians living in Brazil or in Japan consumed significantly less fish, more red meat, more fatty foods and sweets that Japanese living in Japan. Following this same dietary pattern, Takata et al[45] (2003) showed that in the city of Gifu, Japan, consumption of fish, eggs, soya, vegetable and seaweed products was higher, and consumption of meat, dairy products and fruit lower than that verified in the diets of Japanese-Americans and Caucasians from Hawaii.

Regarding calorie consumption and macronutrients, Miura et al[27] (2006) found that, in men, calorie intake was higher in Hawaii (2,427 kcal sd = 613 kcal) than in Japan (2,280 kcal sd = 428 kcal). However, this difference was not found in women. As for macronutrient intake, there was a higher consumption of animal protein, total fats, saturated and trans fats for both sexes.

Okuda et al[33] (2005) reported that, in men, energy, protein and total fat intake was higher in Hawaii than in Japan. Women in Japan consumed fewer carbohydrates (56.2% kcal sd = 6.4 *versus* 50.9% kcal sd = 8.7) and less total fat (26.1% kcal sd = 4.9 *versus* 31.9% kcal sd = 7.7) than Hawaiian women ($p < 0.001$). Findings by Nakamura et al[30] (2012) indicate that consumption of omega 3 fatty acids was greater in Japan than in Hawaii, for both men and women ($p < 0.001$).

On the other hand, Nakanishi et al[31] (2004) found no differences in total energy intake among Japanese-Americans and native Japanese. In contrast, total energy intake in women tended to be greater among the Japanese (1,925 kcal) compared with Japanese-American women (1,727 kcal). In the same context, Japanese women in Gifu reported the highest energy intake, followed by Japanese-American women and by Caucasians in Hawaii. The authors observed that, in Japanese women, the lowest percentage of calories came from fat and the greatest from carbohydrates.[45]

DISCUSSION

The results of the studies evaluated suggest that Japanese immigrants and their descendants, even when preserving many of their traditional dietary habits, at the same time, adopt a Western-style diet (rich in saturated fats, sodium and simple sugars and low in fiber).

In Brazil, over the years (1997 a 2012) various articles[1,2,4,5,8,9,37,45,48] have reported the increased contribution of lipids to the diets of Japanese immigrants and their descendants. The same pattern of increased intake was observed in the studies by Okuda et al (2005)[33] and Schwingel et al[39] (2007). In these two studies, the authors report that the contribution of lipids in the diet was greater among individuals living in Brazil or the United

Table 3. List of comparative studies on dietary patterns and health outcomes achieved in Japan or Brazil x USA x Japan between 2004 and 2012.

Authors and score	Location and subjects	Year	Methodology (Study Design and Evaluation Instrument for Food Consumption))	Key findings
Nakamura et al[30] score: 14	Aito, Japan 129 men and 129 women Hawaii, USA 100 men and 106 women Japanese-Americans	2012	Cohort study 4 surveys of 24-hour recalled food intake	The significantly higher mean concentration of leptin in Japanese-Americans than in Japanese can be attributed largely to differences in BMI. Differences in nutrient intake in the two samples were associated with only modest difference in relation to leptin. The consumption of omega-3 was lower in Hawaii, both in men and in women ($p < 0.001$), and the consumption of omega-6 was higher in Hawaii than in Japan ($p < 0.001$).
Nakamura et al[29] score: 15	Aito, Japão e Havaí, EUA 452 indivíduos de 40 a 59 anos de idade	2008	Estudo transversal 4 inquéritos de recordatórios 24 horas	The average concentration of adiponectin was higher in Japan than in Honolulu and no nutritional variable had a significant relationship with adiponectin. The average intakes of animal protein, total fat, saturated fatty acids and mono-and polyunsaturated fat were higher in Japanese-Americans. The caloric contribution of carbohydrates in the Japanese-Americans was lower than that of the Japanese.
Schwingel et al[39] score: 12	Kanto, Japan and Sao Paulo, SP, Brazil Individuals 35-79 years of age: native Japanese: 104 Japanese-Brazilians / Japan: 178 Japanese-Brazilians /Brazil: 108	2007	Cross-sectional study FFQ: usual weekly intake of fish, meat, fried snacks, fat to spread on bread, sweets and alcoholic beverages	Japanese-Brazilians residing in Brazil or Japan consumed less fish, more meat, more fats and sweets than Japanese residents in Japan.
Miura et al[27] score: 17	Shiga, Sapporo, Kanazawa and Wakayama, Japan and Hawaii, USA 1,342 individuals aged 40-59	2006	Cross-sectional study 4 surveys of 24-hour recalled food intake	Plasma fibrinogen levels in Japanese-Americans were higher than in Japanese, and it was shown that over 60% of this difference can be attributed to the high consumption of iron, sugar and caffeine by individuals residing in Hawaii. The overall energy intake in men was significantly higher in Japanese Americans than in Japanese. Men and women Japanese-Americans reported significantly higher intake of animal protein, total fat, saturated fat, trans fat, iron.
Okuda et al[33] score: 17	Shiga, Sapporo, Kanazawa and Wakayama, Japan and Hawaii, USA. 1,348 individuals aged 40-59	2005	Cross-sectional study 4 surveys of 24-hour recalled food intake	In men, the total intake of energy, protein, total fat was higher in Japanese Americans than in Japanese. Japanese-American women consumed fewer carbohydrates and more total fat than the Japanese.
Nakanishi et al[31] score: 15	Hawaii and California, USA, and Hiroshima, Japan 3,132 Individuals aged 40 to 70 years and over	2004	Cohort study Food frequency questionnaire	There was no difference in overall energy intake among Japanese-American men and Japanese. Japanese-Americans ate more fat, especially animal. In addition, most reported consuming simple carbohydrates when compared to Japanese, and also reported higher protein intake, especially of animal origin.
Takata et al[45] score: 16	Gifu, Japan and Hawaii, USA 206 Hawaiian, 165 Caucasian and 145 Japanese-American women	2003	Cross-sectional study Gifu: FFQ Hawaii: FFQ validated for multiethnic study	Japanese-American women reported higher soy consumption and lower consumption of dairy products than Caucasian women. Their grain intake was approximately 50% higher than in the other two groups (high consumption of rice). On the other hand, a meat intake was 10% higher than in Caucasians, and approximately twice as high as in Japan The Japanese diet was richer in fish (4.5 times) in eggs (4 times), soy products, vegetables and seaweed, and lower in meat, dairy products and fruits.

FFQ: food frequency questionnaire; BMI: Body Mass Index

States than those who were born and lived in Japan. However, in a multi-ethnic study comparing Japanese immigrants with those from other places, Henderson et al[16] (2007) found that lipid intake in Japanese-Americans was significantly lower than that found in individuals of other, non-Asian, descent.

Following a diet rich in lipids appears to increase with the number of generations of Japanese immigrants born in the country. Freire et al[9] (2003) and Ferreira et al[7] (2002) verified that Nisseis consumed more total fat than Isseis. High levels of lipid intake may explain the increase in the number of deaths caused by cardiovascular disease in a population whose country of origin, Japan, has the lowest mortality rates from heart disease in the world.[28]

Sharma et al[42] (2012) described how the foods which contributed the most to Japanese-Americans' energy consumption were rice and bread. The authors identified that soft drinks and artificial juices were the greatest source of added sugars in the population. These findings are relevant considering the elevated rates of type II diabetes (DM2) among Nikkeis and the link between this disease and excessive consumption of carbohydrates, added sugar and foods with a high glycemic index.[18]

Epidemiological studies[10,38] consistently show that migrant individuals rapidly incorporate the same patterns of chronic disease that exist in their destination. Japanese and Mexicans living in the United States have a higher prevalence of cardiovascular disease compared with those who live in the country of origin. One possible explanation for this would be dietetic acculturation and changes in patterns of physical activity. In addition to the Japanese, other ethnicities are affected by this process. In 2004, Neuhouser et al[32] found that immigrants of Hispanic origin acculturated in North America reported higher lipid consumption in their diet. Kim et al[22] (2007), in a study of North American and native Koreans, reported that the former consumed fewer typically Korean foods (32.5%) and more fast food (42.5%), whereas in the native Koreans the predominance of Korean food was 100%, and no fast food consumption was reported. The classic example of acculturation are the Pimas Indians, descendants of the Hohokans who inhabited the Pimeria region of what used to be Mexico, today part of the state of Arizona, United States. The considerable reduction in physical activity and changes in eating habits were determinants in increased weight gain. Today, as well as obesity, this population has the highest recorded prevalence of DM2 in the world. There is, then, compelling evidence that lifestyle changes associated with Westernization play an important part in the global DM2 epidemic.[38]

Analysis of Japanese-American[35,36] and Japanese-Brazilian[7] studies show that Nissei individuals had a higher intake of Japanese food products that Sanseis. However, in a study of young Asians who emigrated to the United States, Pan et al[34] observed significant changes in eating habits, with increased consumption of sweets and fat, dairy products and fruit and lower intake of meat and vegetables. The main reasons reported for not consuming a similar diet to that of their home country were: lack of time to prepare food, ingredients being unavailable, poor quality food products, not knowing how to prepare traditional dishes and the higher prices of these products.

Intake of soya based foods, such as tofu, seems to be strongly linked to the individual's birthplace and their preferred language of communication. Thus, immigrants who were born in Japan and those Nikkeis who chose to be interviewed in Japanese were those who consumed the most soya derivatives.[36] The study by Wu et al[47] (2002) shows that soya consumption, especially at a young age, may have a protective effect against breast cancer in later life. This cancer is the most prevalent among women in Brazil.[40]

This study has some limitations which should be borne in mind. There may have been a selection bias due to other databases not being used, although the Medline/PubMed, Lilacs and SciELO databases, together, include the majority of publication in English, Spanish and Portuguese. Another limitation is related to the methodologies of the selected and analyzed studies. Various aspects of design used may produce limitations which affect the accuracy and validity of the estimates inferred. The most common were: using non-representative samples, short follow-up periods and follow-up losses. Moreover, variations in age groups in the samples studied make comparisons between the studies difficult. Other criteria used which may also have led to systematic errors were: data obtained using strategies of recall and based on subjective perceptions of the group evaluated, sample selection made through advertisements in the media such as newspapers and magazines, and use of instruments to measure food intake valid for the population in general and not specific to Japanese descendants.

Using scores to assess the methodological quality of the articles aimed to make their assessment less subjective. However, due to the heterogeneity of the studies, it was difficult for the score to be appropriate for all designs. Thus, using the adapted Downs & Black criteria for observational studies may have also been a limitation.

In spite of this, this study provides up-to-date information on food intake and dietary factors related to the health and disease processes in Japanese immigrants and their descendants, providing support in formulating projects to promote the health and prevent the development of disease of this population.

This revision shows that few studies with standardized methodologies enabling comparisons exist on the food intake of Nikkeis outside of Hawaii in the USA and Bauru (Sao Paulo state) in Brazil. These findings are important for public health, considering the large

contingent of individuals of Japanese descent living in Brazil. In addition to public policies aimed at stimulating healthy eating, in regions with large concentrations of these immigrants there could also be incentives for them not to abandon the healthy eating habits characteristic of the Japanese population.

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