

A Case Study of Metabolic Syndrome without Hypertension in a Fijian Coastal Fishing Village

Loretta A. Cormier, Sharyn Jones, Christel Carlisle, Courtney Andrews, Caitlin Aamodt,
Anna Mc Cown, Mallory Messersmith, Ashley Wilson - and Lindsay Whiteaker

*University of Alabama at Birmingham 1401 University Blvd Birmingham,
Alabama U.S.A., 35294
E-mail: lcormier@uab.edu*

KEYWORDS Disease Ecology. Obesity. Diabetes. Acculturation. Subsistence. Marine Ecology. Hypertension. Body Image

ABSTRACT We describe a case study involving obesity, health, and body image on the small island of Nayau, in the Lau Group, Fiji. Nayau is a remote island of Fiji where traditional subsistence activities are practiced. They have only recently had exposure to Western media and television. Traditionally, large body sizes are valued as signs of health and happiness. As such, obesity can be considered a culture bound syndrome. The key aims of our study were to 1) to conduct qualitative and quantitative research on eating behaviors, body image, and activity patterns; 2) to measure the body mass indexes (BMI) of study participants, and; 3) to identify differences in health indicators related to obesity among Fijians and Western society. Our main findings were first, that although body image ideals are changing, most adult men and women still are overweight/ obese and tend to value larger body sizes. Second, adult Fijians engage in physical activity nearly 70% of the time during daytime hours, representing more than three times as much activity as the average adult American. Third, while the obesity, diabetes, and hypertension are often seen as linked in the “metabolic syndrome,” in Nayau, adults have similar rates of obesity and diabetes as in the U.S., but they have very low rates of hypertension. We examine possible explanations for the pattern of diabetes and hypertension including diet, activity patterns, and stress levels.

INTRODUCTION

Nayau is a small, relatively isolated island with a population of approximately 350 individuals (Fig. 1). Traditionally, indigenous Fijians have valued large body sizes as physically attractive, healthy, and as signs of social status. Over the last five years, the Nayau population has experienced increased exposure to Western media and Western material culture. Electricity, television reception, and DVD movie players are very recent introductions. We address not only potential changes in Fijian ideological constructions of the ideal body type in the wake of Western exposure, but we also use data from Nayau to present challenges to the biomedical paradigm that obesity should be universally considered to be an unhealthy disease state.

Obesity is recognized as a clear health concern, increasing the risk of hypertension, coronary artery disease, high cholesterol, and many other illnesses (National Heart, Lung, and Blood Institute 1998). Various initiatives have been taken both nationally and internationally to understand the core causes of obesity and other eating disorders, and the means to prevent their development (for example, Becker et al. 2007; Kumanyika et al. 2002; Swinburn et al. 2005). While the quality of the diet is most certainly a critical factor in body weight, food choices are also deeply embedded in cultural values and cultural histories. Moreover, attitudes about food have a demonstrable effect on how bodies are constructed in a given culture, both symbolically and literally.

In Western/industrialized societies, the cultural construction of bodies is reflected in eating disorders. Bulimia and anorexia nervosa are common in North America and Europe, particularly over the last 50 years, but these diseases are rare in non-industrial and traditional societies (Wade et al. 2000; Counihan 1999). Much of the current epidemiological research suggests that culture and environment contribute to the development of unhealthy eating

Address for correspondence:

Dr. Loretta A. Cormier
311 Heritage Hall, Department of Anthropology
University of Alabama at Birmingham
Birmingham, AL 35294, USA
Telephone: 205-975-6526
E-mail: lcormier@uab.edu

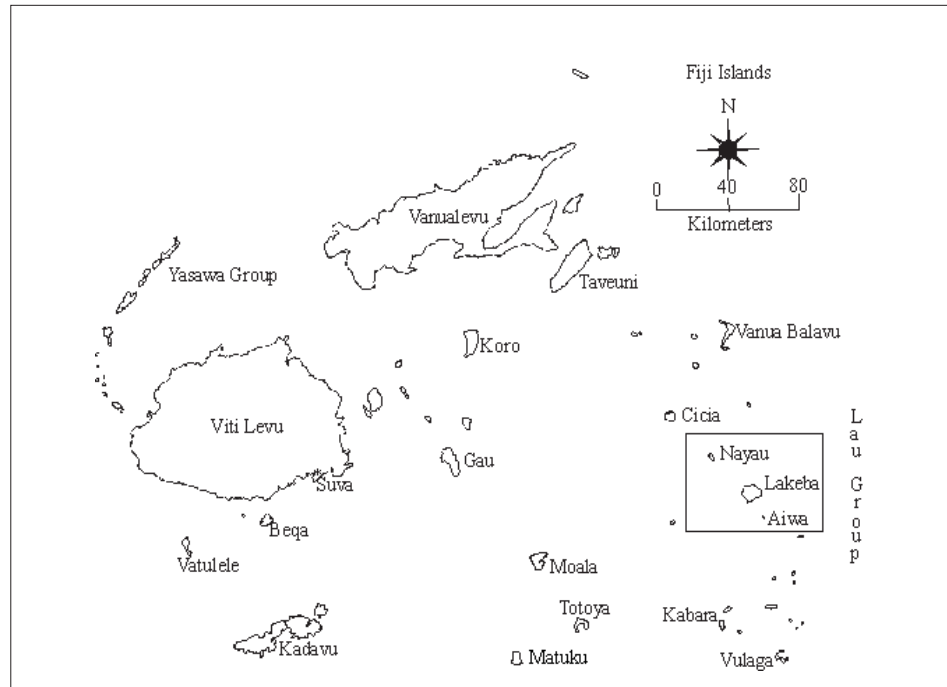


Fig. 1. Map of research area

practices and negative body imagery in Western/Industrialized societies (for example, Becker 1995; Becker et al. 2007; Counihan 1999; Tiggemann and Pickering 1996). Medical anthropologists refer to illnesses with somatic and psychological components that arise in a particular cultural context at a particular point in time as “culture bound syndromes” (Good 1992; Guarnaccia et al. 1999; Jilek 2001; Kleinman et al. 2006). With the advent of digital technologies, such as the internet and the spread of television, people all over the world are increasingly interconnected. Images, physical standards, and ideologies that accompany global culture are becoming part of everyday life for many peoples that have had little to no previous experience with the societies from which this media derive.

Relatively few studies have focused on examining the relationship between the introduction of western culture and media and disordered eating among newly-Westernized, media naïve populations. However, research is slowly mounting which documents an increased risk for disordered eating among populations undergoing Westernization (Gordon 2000; Katzman et al. 2001; Lieberman 2003). Two

possible (although not mutually exclusive) explanations for the association between disordered eating and acculturation are: 1) disordered eating is a way for individuals to cope with stress; and 2) exposure to Western media alters cultural attitudes about body type. Several studies have addressed this issue in the Fiji Islands, where naturalistic studies could be conducted in populations recently exposed to media and in those that have little or no exposure to western media (Becker 1995; Becker et al. 2002). These studies have documented an increased prevalence of disordered eating among Fijian adolescent girls in association with exposure to western media and television in particular. Research also suggests that the assimilation and acculturation of people into a global culture that promotes certain attitudes about body image may increase the likelihood that non-Western viewers will develop eating disorders (Becker et al. 2002, 2004, 2007).

Much less attention has been given to contemporary cultural contexts that value obesity such as that found in traditional Fiji, and other Polynesian societies. If obesity is a consequence of cultural forces impinging on

individuals to achieve an ideal body type, it is as much a culture bound syndrome as is anorexia nervosa. Fijian society provides an interesting paradox because two contradictory forces are at work. Traditional Fijian body ideals view large body shapes and sizes as healthy for both men and women (Becker 1995). Eating large amounts of food in Fiji, and Polynesia is encouraged, especially during feasting, and a large body shape reflects positively on both the family and the community (Becker 1995; Bell 1931; Hocart 1929; Jones 2009; Thompson 1940). However, recent research suggests that this appears to be changing in the face of globalization where exposure to Western media encourages women to be underweight (Becker et al. 2007; Harrison 2000; Tiggemann 2003). Ironically, the shifting middle ground here is a healthy weight. Traditional culture encourages a culture-bound value on obesity while acculturation substitutes a culture-bound value on thinness. Exposure to television and images and ideals associated with popular magazines and the internet may cause a shift away from traditional values and result in disordered eating. Therefore, promoting healthy weights in Fijian society will first require a deeper understanding of how complex and competing belief systems affect eating behaviors. For example, in Fiji a person's body is traditionally viewed as a direct reflection of how well family and community care and provide for this person, rather than as a reflection of the individual (Becker 1995). In this study, the researchers examine body image, body weight, and health correlates on the island of Nayau.

METHODS

The researchers used a mixed methods approach using both qualitative and quantitative data collection. Qualitative research involved participant observation and informal interviews. Most of the research was conducted in the village of Salia, one of three villages on the island. Participant observation involved engaging with the villagers in their activities of daily living, particularly those related to subsistence activities and food preparation. They also collected kinship information and conducted numerous formal and semi-structured interviews

on topics including religious beliefs, social organization, and fishing and farming.

The quantitative methods used involved BMI's, random spot checks, body image surveys, and records on health data from the island clinic. The body mass index (BMI; in kg/m²) measures were calculated based on weight and height (Deurenberg et al. 1998). BMIs are a commonly used method to measure levels of overweight and obesity cross-culturally, for it has several advantages in field settings. First, since it involves very simple technology, they can be done without the need for electricity or carrying equipment into remote locations. Another advantage is that because they have been used all over the world, it provides a measure that can be compared over many diverse populations.

Random spot checking originated as an adaptation of the method in primatology of "instantaneous scan sampling" (Altmann 1974) that was used to quantify the amount of time that non-human primates spent in various activities. Such time allocation studies were soon seen by ethnographers as a valuable method to apply to quantifying relative time spent in daily activities for human groups (for example, Gross 1984; Gross et al. 1979; Hill et al. 1984; Hurtado et al. 1985; Johnson 1975). The researchers selected from the Nayau group a representative sample of ten adults according to age and sex and conducted random spot checks during daylight hours for one week.

Both summers, the researchers conducted body image surveys using silhouettes. Stunkard et al. (1983) first introduced the use of body silhouettes as a way to test the reliability of perceived body image against actual body size. The silhouette palette provides a series of graded outlines of figures, from thin to obese. However, silhouette studies since been used more broadly to evaluate perceptions of ideal body types. The researchers' silhouettes were drawn by a scientific illustrator with images representing five body types ranging from extremely underweight to extremely obese. Female informants were asked to identify which of the five figures were the most attractive and the least attractive, who was the happiest and the unhappiest, who had the happiest home and the unhappiest home. The questions were asked in both the Fijian language and in English. Most

Nayauans learn English in school, but they primarily communicate in their native Fijian.

RESULTS

Food and Culture

Participant observation on Nayau centered on food and eating, the activities that dominate their day. The traditional Nayau diet is based on fish and root crops. In public, male/female avoidance is practiced and activities of daily living are sexually segregated. As Jones (2009) described, the island itself is spatially gendered. The sphere of women involves work around the household and fishing in the shallow waters of the reef. The workspace of the men surrounds that of the women. By sea, they fish in the outer deep sea waters and by land, they grow crops in gardens away from the household. Women tend to snack all day and men and women eat together for regular large meals.

Meals are symbolically ordered by status and sex. Men sit at the head of the table and women sit at the foot. Food is also gendered, with fish-heads being for men and fish-tails for women. At mealtime, family members constantly encourage one another to *kanavaka levu*, meaning to eat well and eat a lot. When passing by someone's home, the typical greeting is *Lako mai! Kana!*, meaning, to come in and eat.

The people of Nayau are beginning to incorporate Western processed foods into their diets. The researchers surveyed the households in our host village of Salia and found that all households were incorporating Western foods to some degree into their diet including canned fish, flour, sugar, crackers, ramen noodles, coffee, tea, and some sweets. They are limited in being able to purchase food because they do not participate extensively in a cash economy. Men process copra, the dried kernel of the coconut, and sell it to the larger islands. Women's main source of cash income is making of *masi*, a traditional barkcloth made from paper mulberry, which is decorated and sent to the main islands to be sold to tourists.

The researchers conducted a modified "focus group" with a group of women to ask them about changes in diet. They agreed that they preferred their own traditional foods over that of Western foods. The key reason they gave for buying food was that it was quick, easy, and convenient. Although canned fish did not taste as good as

fresh fish, they could make a meal without having to go fishing in the reef and without needing to gut, scale, and cook the fish. The researchers observed bread being frequently consumed in households. Cake is also being used as a ceremonial food and may be a status food. Cakes are baked and distributed for any and all special occasions. However, the researchers' presence on the island itself represented such a significant occasion and the presence of Westerners may have influenced diet during our stay.

The major bulk foods that are imported to the island are white flour, white rice, and sugar. The researchers extrapolated from records on the island store and estimate that the average adult Fijian was consuming approximately 47 kg of white flour, 14 kg pounds of white rice, for a total of approximately 61 kg of processed grains per year. In 2005, Americans consume approximately 87 kg of wheat flour, rice, corn, oat, and barley products; however in 1970, Americans consumed approximately 62 kg per person (Wells and Buzby 2008). So people on Nayau are now consuming grains, in the form of processed white flour and rice, at approximately the same rates that Americans were 40 years ago. Sugar consumption is considerably lower on Nayau, with an average of 14 kg per year. According to the USDA, Americans consumed an average of 64 kg pounds per person of added sugar per year in 2005 (Wells and Buzby 2008). This translates into approximately 29 gm per day for Fijians and 143 gm per day for Americans. The American Heart Association puts the rate a little lower at approximately 106 gm per day (Johnson et al. 2009). The American Heart Association suggests that added sugar should be limited to 24 gm per day for women and 43 gm per day for men. Thus, sugar consumption on Nayau appears to be within the American recommended guidelines, but far lower than actual American consumption.

Table 1: Overweight, obesity percentages

	Overweight	Obese	Both
Nayau Fiji	28.0 %	38.0%	66.0%
U.S.	34.2 %	33.8%	68.0%

Body Mass Index (BMI) measures are listed in Table 1. These indicated that Nayau Fijians and Americans had similar rates of combined overweight/obesity, but Nayauans had higher

rates of obesity than Americans. Overweight is defined as having a BMI of 25.0 – 29.9 and obesity is defined as having a BMI ≥ 30.0 . The researchers collected 40 BMIs from the village of Salia. For Nayau, 28% of adults were overweight and 38.8% were obese for a total of 66% being either overweight or obese in 2007-2008. In a 2010 study in the U.S., 34.2% of adults were overweight and 33.8% were obese for a total of 68% being either overweight or obese (Flegal et al. 2010).

Activity Patterns

Random spot checks were conducted to document the amount of time that Nayau adults spent in varied activities during daylight hours (Fig. 2). The researchers collected 750 random spot checks which were collapsed into the two categories of physically active (gardening, fishing, etc.) and sedentary (resting, socializing, etc.). They found that Nayau adults spend 69.7% of the daytime hours engaged in physical activity. A recent study found that U.S. adults spent approximately 18.9% of the day physically active (Jago et al. 2010). Thus Nayau Fijians spend more than three and a half times more of their day active than does an average American adult.

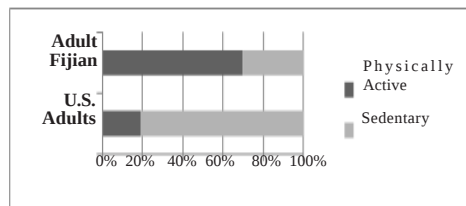


Fig. 2. Activity patterns

Body Silhouette Studies

In the summers of 2009-2010, the researchers conducted body silhouette studies with 30 adult women on Salia. The five scaled figures represented extremely underweight, underweight, healthy weight, overweight, and obese women. Informants were asked to assess levels of attractiveness, personal happiness, and household happiness. The results were somewhat inconsistent. The modal choice for the “happiest” female was image 5 representing obesity and the “unhappiest” was image 1 representing extreme underweight. The modal

score for “happiest home” scored 3-4 (healthy weight to overweight) and the “unhappiest home” was image 1. The modal choice for the most attractive was image 3 and the most unattractive was image 1. While image 1 (extremely underweight) was consistently judged to be the most unattractive and the unhappiest, it is interesting that image 5 was considered the happiest while image 3 was considered the most attractive. They attribute these results to two possible causes. One, the recent introduction of Western media may be influencing traditional values regarding ideal body weight and attractiveness. However, it is also possible that because most of the women conducting the interviews themselves scaled to image 3, that they Fijian women described image as the most attractive merely to be polite to the interviewers. Nonetheless, the tendency was to ascribe positive values to overweight/obese and negative values to underweight.

Health Indicators and Obesity

The researchers obtained health statistics from the clinic on Nayau for all three villages on the island. They found that levels of diabetes are slightly higher on Nayau than in the U.S., but that Nayau rates of hypertension are significantly lower (Table 2). Adult Fijians over the age of 20 had a rate of diabetes of 13.2%. This is slightly higher than the rate of 11.3% found in U.S. adults over the age of 20 (CDC 2011). The rate of hypertension among adults over 20 on Nayau was only 8.0%, compared with the rate of 30.9% among U.S. adults over 20 (NCHC 2011). Thus, while adults have similar levels of diabetes, they have almost 1/4 the rate of hypertension of their U.S. counterparts. In addition, according to island clinic records, there were no cases of osteoporosis on Nayau while in the U.S., 2% of males and 10% of females over 50 have osteoporosis by the femur neck head (Looker et al. 2010).

Table 2: Hypertension, diabetes, and osteoporosis percentages

	Fiji	U. S.
Hypertension	8.0 %	30.9%
Diabetes (over 20)	13.2 %	11.3%
Female osteoporosis (over 50)	0 %	10%
Male osteoporosis (over 50)	0 %	2%

DISCUSSION

It is often taken for granted that obesity is a sign of poor health. The term “metabolic” syndrome is used to describe a cluster of symptoms related to obesity, particularly diabetes and hypertension; in the U.S., approximately 34% of the U.S. population over 20 years of age can be classified as meeting the requirements for the syndrome (Ervin 2009). In recent years, obesity has been labeled as a “global epidemic,” using the metaphorical language of infection and contagion to describe how it is spreading (see also Moffat 2010). Such analogies imply the assumption is made that obesity is a disease of post-industrial societies (Barsh et al. 2000), that presents in the same way in all cultural contexts, and that it presents identical threats to health and well being.

Surprisingly little research has been conducted to determine cultural differences in how obesity manifests. One notable exception is Janes (1990) work in Samoa who found that levels of hypertension differed in obese individuals in Westernized and non-Westernized communities. Samoans, like Fijians, value large body sizes as a cultural aesthetic, but hypertension is not a given consequence of obesity. He suggests that stress levels may be causal, creating higher levels of hypertension with acculturation.

Numerous studies correlate overweight/obesity with metabolic syndrome increases in both diabetes and hypertension (for example, Biswas, et al. 2011; Mokdad et al. 2003; Yamagishi 2011). Fijians on Nayau, like Samoans experience the diabetic symptom of obesity, but not the corresponding rates of hypertension found in Western and Western-influenced societies. The presence or absence of hypertension in a particular population may be the result of a combination of a number of culturally-specific factors. Potential factors that may be preventing the development of hypertension on Nayau are activity levels, diet, genetics, and stress levels.

The lack of osteoporosis is perhaps the easiest health variable to explain. A number of studies have demonstrated a correlation between high body weight and high bone mass (Gurney et al. 2003; Radak 2004; Wardlaw 1996). Essentially, for those who are overweight/obese, just moving about provides weight-bearing exercise that benefits the bones. It has also been

suggested that the production of estrogen by adipose tissue may offer some protection against osteoporosis in post-menopausal women (Kameda et al. 1997). In addition, it has also been proposed that due to the association of obesity and insulin resistance, that high levels of insulin may be involved in elevated estrogens and androgens that may increase bone mass (Reid 2002). Although low levels of physical activity have been described as an important risk factor for obesity (USDHHS 1996), the high activity levels on Nayau may offer protection against hypertension. High activity levels strengthen the heart so that it takes less effort to pump blood and less pressure is put on blood vessels (Cornelissen et al. 2010; Lovell et al. 2009).

The Fijian diet may also deter the development of hypertension. As previously described the traditional diet of the people of Nayau is based on marine resources and root crops. There are several potential factors that could account for the high rates of diabetes and the low rates of hypertension. The reliance on starchy roots as plant staples and a key source of carbohydrates could potentially be a positive factor contributing to high rates of diabetes. Fish and coconut oils may provide protection against hypertension. In addition, although the Nayauans are now incorporating raw sugar into their diet, they are not yet using added salts. Fish oil supplementation has been demonstrated to lower blood pressure in individuals with hypertension either alone (Andreassen et al. 1997; Bao et al. 1998; Bønaa et al. 1990; Knapp and Fitzgerald 1989; Meland et al. 1989) or in combination with anti-hypertensive medications (Landmark et al. 1993). A diet rich in fish oils can also lower triglyceride levels (Levinson et al. 1990; Lundershausen et al. 1994; Margolin et al. 1991; Mori et al. 1999; Toft et al. 1995) and increase HDL2 cholesterol (Mori et al. 1999; Sacks et al. 1994).

Genetics may also come into play whether this is a “thrifty” (Neel 1962) or a “drifty” (Speakman 2008) gene. Regardless, numerous studies have pointed to at least some genetic component in obesity (for example, Allison et al. 1996; Barsh et al. 2000; Bouchard et al. 1990; Maes et al. 1997; Price and Gottesman 1991). However, ultimately, the low-stress lifestyle on Nayau may play a significant role in keeping hypertension levels low. In addition, synergies may exist among the variables, including the role

of high levels of physical activity in lowering stress.

CONCLUSION

Not all obesities are alike. The majority of adults on Nayau are clinically overweight or obese. Despite the recent influence of Western media, Nayau Fijians still value large body sizes and consider these individuals to be the happiest. The health indicators associated with obesity differ between the U.S. and Fiji: rates of hypertension are more than three times lower among Fijians, but diabetes rates are similar. The lack of the hypertensive symptom of the metabolic syndrome may be due to activity levels, diet, genetics, or stress levels. Activity levels are significantly higher among Nayauans, who spend more than three times as much time in physical activity than their American counterparts. High activity levels likely also contribute to their low levels of osteoporosis. Diet may also play a role, particularly the protective benefits of fish oils. However, the importation of processed white flour, white rice, and sugar may be factors contributing to high rates of diabetes. For future research, it will be important to determine the extent to which the high rates of diabetes among Nayau Fijians are a consequence of obesity itself or more due to dietary changes. Although their sugar consumption at this time is within U.S. recommended guidelines, they are consuming white grains at a level that is on par with American consumption 40 years ago, and may rise if they continue to incorporate Western foods into their diet. White grains are largely substituting for root crops such as taro, yams, and potatoes. These "starchy" foods may have functioned similar in the diet to replacement grains. Broadly, this case study suggests that the health consequences of obesity are not a given, but may be affected by cultural ecological variables including foods availability, food choices, activity patterns, and stress levels. The culturally specific ways in which obesity manifests in different human populations and the varying health consequences depend on the cultural context. Obesity is as much a culture-bound syndrome in the U.S. as it is in Fiji. Cross-culturally, "obesities" are not all the same in either physical symptoms or cultural meanings.

RECOMMENDATIONS

Further research would be valuable in elucidating this case study of metabolic syndrome without hypertension. One important question that remains unanswered is if the diabetes on this island is a direct consequence of obesity, due to recent dietary changes, or a combination of both. Both continued long-term study of this population as well as comparison with more acculturated groups in Remote Oceania could be helpful in clarifying the relationship between diabetes, obesity, and diet. Culture-bound syndromes are typically viewed as states of illness. If "obesities" manifest differently dependent on cultural contexts, it suggests that we should broaden our use of the term and consider how cultural behaviors and meanings may also serve to limit symptoms, such as the low rates of hypertension on Nayau.

ACKNOWLEDGEMENTS

This research was funded by a grant from the National Science Foundation. We would also like to express our appreciation to the people of Nayau for welcoming us into their community.

REFERENCES

- Andreassen AK, Hartmann A, Offstad J, Geiran O, Kvernø K, Simonsen S 1997. Hypertension prophylaxis with omega-3 fatty acids in heart transplant recipients. *JACC*, 29: 1324-1331.
- Allison DB, Kaprio J, Korkeila M, Koshenvul M, Neale MC, Hayakawa K 1996. The heritable body mass index among an international sample of monozygotic twins reared apart. *Int J Obes Relat Metab Disord*, 20: 501-506.
- Altmann J 1974. Observational study of behavior: Sampling methods. *Behav*, 49: 227-267.
- Bao DQ, Mori TA, Burke V, Puddey IB, Beilin LJ 1998. Effects of dietary fish and weight reduction on ambulatory blood pressure in overweight hypertensives. *Hypertens*, 32: 710-717.
- Barsh GS, Farooqi IS, O'Rahilly S 2000. Genetics of body-weight regulation. *Nature*, 404: 644-651.
- Becker AE 1995. *Body, Self and Society: A View from Fiji*. University of Pennsylvania Press, Philadelphia.
- Becker AE, Burwell RA, Gilman SE, Herzog DB, Hamburg P 2002. Eating behaviours and attitudes following prolonged exposure to television among ethnic Fijian adolescent girls. *Br J of Psychiatry*, 180: 509-514.
- Becker AE, Fay K, Gilman SE, Striegel-Moore R 2007. Facets of acculturation and their diverse relations to body shape concern in Fiji. *Int J Eat Disord*, 40: 42-50.

- Becker AE, Keel P, Anderson-Fye EP, Thomas JJ 2004. Genes and/or Jeans?: Genetic and socio-cultural contributions to risk for eating disorders. *J Addict Dis*, 23: 81-103.
- Bell FL 1931. Place of food in the social life of central Polynesia. *Oceania*, 2: 117-135.
- Biswas A, Alvarez A, Mukherjee D 2011. Hypertension in diabetes: Optimal pharmacotherapy. *Cardiovasc and Hematolog Agents Medical Chem*, 9: 95-105.
- Bønaa KH, Bjerve KS, Straume B, Gam IT, Thelle D 1990. Effect of eicosapentaenoic and docosahexaenoic acids on blood pressure in hypertension: A population-based intervention trial from the Tromsø study. *N Engl J Med*, 322: 795-801.
- Bouchard C, Tremblay A, Després J, Nadeau A, Lupien PJ et al. 1990. The response to long-term overfeeding in identical twins. *N Engl J Med*, 322: 1477-1482.
- Centers for Disease Control 2011. National Diabetes Fact Sheet. From <http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf> (Retrieved March 5, 2011).
- Cornelissen VA, Verheyden B, Aubert AE, Fagard, RH 2010. Effects of aerobic training intensity on resting, exercise and post-exercise blood pressure, heart rate and heart-rate variability. *J Hum Hypertens*, 24: 175-182.
- Counihan CM 1999. *The Anthropology of Food and the Body: Gender, Meaning, and Power*. London: Routledge.
- Crisp AH 2002. A tale of corruption. *Br J Psychiatry*, 180: 480-482.
- Deurenberg P, Yap M, van Staveren WA 1998. Body mass index and percent body fat: A meta analysis among different ethnic groups. *Int J Obes Relat Metab Disord*, 22: 1164-1171.
- Ervin RB 2009. Prevalence of Metabolic Syndrome among Adults 20 Years of Age and Over by Sex, age, Race and Ethnicity, and Body Mass Index: U.S. 2003-2006. National Health Statistics. From <<http://www.cdc.gov/nchs/data/nhsr/nhsr013.pdf>> (Retrieved March 31, 2011).
- Flegal KM, Carroll MD, Ogden CL, Curtin LR 2010. Prevalence and trends in obesity among U.S. adults, 1999 – 2008. *JAMA*, 303: 235-241.
- Furnham A, Alibhai N 1983. Cross-cultural differences in the perception of female body shapes. *Psychol Med*, 13: 829-827.
- Garner DM, Olmstead MP, Bohr Y 1982. The eating attitudes test: Psychometric features and clinical correlates. *Psychol Med*, 12: 871-878.
- Good BJ 1992. Culture, diagnosis and comorbidity. *Cult Med Psychiatry*, 16: 427-446.
- Gordon RA 2000. *Eating Disorders: Anatomy of a Social Epidemic*. Oxford: Blackwell.
- Gross DR 1984. Time allocation: A tool for the study of cultural behavior. *Annu Rev Anthropol*, 13: 519-588.
- Gross DR, Eiten G, Flowers NM, Leoi FM, Ritter ML et al. 1979. Ecology and acculturation among native peoples of Central Brazil. *Science*, 206: 1043-1050.
- Guarnaccia PJ, Rogler LH 1999. Research on culture-bound syndromes: New directions. *Am J Psychiatry*, 156: 1322-1327.
- Guney E, Kisakol G, Ozgen G, Yilmaz C, Yilmaz R et al. 2003. Effect of weight loss on bone metabolism: Comparison of vertical banded gastroplasty and medical intervention. *Obes Surg*, 13: 383-388.
- Harrison K 2000. The body electric: Thin-ideal media and eating disorders in adolescents. *J Commun*, 50: 119-143.
- Hill JO, Peters JC 1998. Environmental contributions to the obesity epidemic. *Science*, 280: 1371-1374.
- Hill K, Hawkes K, Hurtado M, Kaplan H 1984. Seasonal variance in the diet of Aché, hunter-gatherers in Eastern Paraguay. *Hum Ecol*, 12: 101-135.
- Hocart AM 1929. The Lau Islands, Fiji. *B. P. Bishop Museum Bulletin*, 62. Honolulu, HI: Bishop Museum Press.
- Hurtado AM, Hawkes K, Hill K, Kaplan H 1985. Female subsistence strategies among Aché hunter-gatherers of Eastern Paraguay. *Hum Ecol*, 13: 1-28.
- Jago R, Fox KR, Page AS, Brockman R, Thompson JL 2010. Parent and child physical activity and sedentary time: Do active parents foster active children? *BMC Public Health*, 10: 194.
- Janes CR 1990. *Migration, Social Change, and Health: A Samoan Community in Urban California*. Stanford, CA: Stanford University Press.
- Janssen I, Katzmarzyk PT, Ross R 2004. Waist circumference and not body mass index explains obesity-related health risk. *Am J Clin Nutr*, 79: 379-384.
- Jilek WG 2001. Psychiatric Disorders: Culture-specific. *International Encyclopedia of the Social and Behavioral Sciences*. London: Elsevier Science Ltd.
- Johnson A 1975. Time allocation in a Machiguenga community. *Ethnology*, 14: 301-310.
- Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M et al. 2009. Dietary Sugars Intake and Cardiovascular Health: A Scientific Statement from the American Heart Association. Circulation. From <<http://circ.ahajournals.org/cgi/reprint/120/11/1011.pdf>> (Retrieved March 5, 2011).
- Lovell DI, Cuneo R, Gass GC 2009. Resistance training reduces the blood pressure response of older men during submaximum aerobic exercise. *Blood Press Monit*, 14: 137-144.
- Jones S 2009. *Food and Gender in Fiji: Ethnoarchaeological Explorations*. Lanham, MD: Lexington Books.
- Kameda T, Mano H, Yuasa T, Mori Y, Miyazawa K et al. 1997. Estrogen inhibits bone resorption by directly inducing apoptosis of the bone-resorbing osteoclasts. *J Exp Med*, 186: 489-495.
- Katzman MA, Gordon RA, Nasser, M 2001. *Eating Disorders and Cultures in Transition*. London: Routledge.
- Kleinman A, Eisenberg L, Good B 2006. Culture, illness, and care: Clinical lessons from anthropogenic and cross-cultural research. *Amer Psychiatric Assoc*, 4: 140-149.
- Knapp HR, FitzGerald GA 1989. The antihypertensive effects of fish oil: A controlled study of polyunsaturated fatty acid supplements in essential hypertension. *N Engl J Med*, 320: 1037-1043.
- Kumanyika S, Jeffery RW, Morabia A, Ritenbaugh C, Antipatis VJ 2002. Obesity prevention: The case for action. *Int J Obes Relat Metab Disord*, 26: 425-436.

- Landmark K, Thaulow E, Hysing J, Mundal HH, Eritsland J et al. 1993. Effects of fish oil, nifedipine and their combination on blood pressure and lipids in primary hypertension. *J Hum Hypertens*, 7: 25-32.
- Levinson PD, Isosiphidis AH, Saritelli AL, Herbert PH, Steiner M 1990. Effects of n-3 fatty acids in essential hypertension. *AJH*, 3: 754-760.
- Lieberman LS 2003. Dietary, evolutionary, and modernizing influences on the prevalence of Type 2 Diabetes. *Annu Rev Nutr*, 23: 345-377.
- Looker AC, Melton LJ, Harris TB, Borrud LG, Shepherd JA 2010. Prevalence and trends in low femur bone density among older U.S. adults: NHANES 2005-2006 compared with NHANES III. *J Bone Mineral Res*, 20: 64-71.
- Lungershausen YK, Abbey M, Nestelm PJ, Howe PR 1994. Reduction of blood pressure and plasma triglycerides by omega-3 fatty acids in treated hypertensives. *J Hypertens*, 12: 1041-1045.
- Maes HHM, Neale MC, Eaves LJ 1997. Genetic and environmental factors in relative body weight and human adiposity. *Beh Genet*, 27: 325-351.
- Margolin G, Huster G, Glueck CJ, Speirs J, Vandegrift J et al. 1991. Blood pressure lowering in elderly subjects: A double-blind crossover study of omega-3 and omega-6 fatty acids. *Am J Clin Nutr*, 53: 562-572.
- Meland E, Fugelli P, Laerum E, Rønneberg R, Sandvik L 1989. Effect of fish oil on blood pressure and blood lipids in men with mild to moderate hypertension. *Scand J Prim Health Care*, 7: 131-135.
- Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F et al. 2003. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA*, 289: 76-79.
- Moffat T 2010. The "Childhood obesity epidemic": Health crisis or social construction? *Med Anthropol Q*, 24: 1-21.
- Mori TA, Bao DQ, Burke V, Puddey IB, Watts GF et al. 1999. Dietary fish as a major component of a weight-loss diet: Effect on serum lipids, glucose, and insulin metabolism in overweight hypertensive subjects. *Am J Clin Nutr*, 70(5): 817-825.
- Morris AM, Katzman DK 2003. The impact of the media on eating disorders in children and adolescents. *Pediatr Child Health*, 8: 287-289.
- National Center for Health Statistics 2011. Health, U. S., 2010. Hyattsville, MD. From <<http://www.cdc.gov/nchs/data/health/2010.pdf#066>> (Retrieved March 5, 2011).
- National Heart, Lung, and Blood Institute 1998. Obesity Education Initiative, Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, the Evidence Report. *NIH Publication No. 98-4083*. Bethesda, MD: National Institutes of Health.
- Neel J 1962. Diabetes mellitus: A "thrifty" genotype rendered detrimental by progress? *Am J Hum Genet*, 14: 353-362.
- Powers PD, Erickson MT 1986. Body image in women and its relationship to self-image and body satisfaction. *Journal of Obesity and Weight Regulation*, 5(1): 37-50.
- Price RA, Gottesman II 1991. Body fat in identical twins reared apart: Roles for genes and environment. *Behav Genet*, 21: 1-7.
- Radak TL 2004. Caloric restriction and calcium's effect on bone metabolism and body composition in overweight and obese premenopausal women. *Nutr Rev*, 62: 468-481.
- Reid IR. 2002. Relationships among body mass, its components, and bone. *Bone*, 31: 547-555.
- Sacks FM, Hebert P, Appel LJ, Borhani NO, Applegate WB et al. 1994. The effect of fish oil on blood pressure and high-density lipoprotein-cholesterol levels in phase I of the Trials of Hypertension Prevention. *J Hypertens*, 12(2): 209-213.
- Speakman JR 2008. Thrifty vs drift gene theory of obesity. *Int J Obes Relat Metab Disord*, 32: 1611-1617.
- Stunkard AJ, Sørensen T, Schulsinger F 1983. Use of Danish adoption register for the study of obesity and thinness. In: SS Kety, LP Roland, R L Sidman, SW Matthysse (Eds.): *The Genetics of Neurological and Psychiatric Disorders*. New York: Raven Press, 60: 115-120.
- Swinburn B, Gill T, Kumanyika S 2005. Obesity prevention: A proposed framework for translating evidence into action. *Obes Rev*, 6: 23-33.
- Thompson LM 1940. Southern Lau, Fiji: An Ethnography. *B. P. Bishop Museum Bulletin* 162. Honolulu, HI: Bishop Museum Press.
- Tiggemann M 2003. Media exposure, body dissatisfaction and disordered eating: Television and magazines are not the same! *Eur Eating Disord Rev*, 11: 418: 430.
- Tiggemann M, Pickering AS 1996. Role of television in adolescent women's body dissatisfaction and drive for thinness. *Int J Eat Disord*, 20: 199-203.
- Toft I, Bønaa KH, Ingebretsen OC, Nordøy A, Jenssen T 1995. Effects of n-3 polyunsaturated fatty acids on glucose homeostasis and blood pressure in essential hypertension. *Ann Intern Med*, 123(12): 911- 918.
- U.S. Department of Health and Human Services 1996. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: USDHHS.
- Wade TD, Bulik, CM, Neale, M, Kendler KS 2000. Anorexia nervosa and major depression: Shared genetic and environmental risk factors. *Am J Psychiatry*, 157: 469-471.
- Wardlaw GM 1996. Putting body weight and osteoporosis into perspective. *Am J Clin Nutr*, 63(3): 433S-436S.
- Wells, HF, Buzby JC. 2008. Dietary Assessment of Major Trends in U.S. Food Consumption, 1970-2005. Economic Research Service, Economic Information Bulletin Number 33, USDA. From <<http://www.ers.usda.gov/Publications/EIB33/EIB33.pdf>> (Retrieved March 5, 2011).
- World Health Organization (WHO) 1995. *Physical Status: The Use and Interpretation of Anthropometry* Geneva, Switzerland: WHO Technical Report Series N. 854.
- Yamagishi SI 2011. Cardiovascular disease in recent onset diabetes mellitus. *J Cardio*, Pre-print.