Prevalence and determinants of obesity and dietary habits among adults in rural area, Chile

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SUMMARY **This study was undertaken to examine the prevalence of obesity and its determinants among adults in a rural area of Chile. A community-based cross-sectional study was conducted in April-June 2004 in San Carlos (8th region). Height, weight, and waist and hip circumferences were measured for 603 adults (female 447, male 156) aged 20-64 years, and data on socio-economic factors, dietary intake, and dietary habits were obtained by questionnaire interviews. The prevalence of obese individuals was 45.2% among females and 30.1% among males, whereas that of overweight individuals was higher among males than females. Obesity was associated with socio-economic factors for females but not for males. With regard to diet, different patterns between females and males were observed in terms of frequency of food intake, as well as in dietary habits. Our findings of a high prevalence of obese/overweight individuals, together with the characteristics of their diets including changes in the cooking process, suggest that nutrition transition is underway in rural regions as well. Appropriate interventions, therefore, should be introduced to control obesity among women and to enhance health awareness among men throughout the country.**

Key Words: Obesity, overweight, socio-economic, nutrition transition, Chile

Introduction

Obesity is known to be the most significant nutritional disorder in developed countries. There are estimated to be 1 billion overweight adults, of which at least 300 million are obese, worldwide (*1*). Being obese or overweight is regarded as a major risk for serious lifestyle-related diseases, including Diabetes Mellitus (DM), hypertension, and cardiovascular diseases. Moreover, additional burdens of obesity on the limited national health budget cannot be ignored (*e.g.* 5.5-7.0% in the US) (*2*,*3*). The problem of obesity is now emerging in developing countries as well, where malnutrition and infectious diseases used to be the most serious problems. As a country achieves economic development, the diet and physical activity patterns of its citizens change greatly. This phenomenon, observed in countries with economies in transition, is known as "nutrition transition" (*4*).

Like other countries in Latin America, Chile is undergoing a nutrition transition (*5*). A nutrition transition is defined as a change in diet and lifestyles, leading to a significant impact on the nutritional status of the population. Dietary changes include the increased consumption of fat, sugar, and animal food products and decreased cereal and fiber intake (*6-8*). Likewise, changes in diet, from a traditional to a "Western" one, and in physical activity patterns have resulted in the increased prevalence of obesity and lifestyle-related diseases in Chile (*9*,*10*). In light of these circumstances, the Ministry of Health started to invest in the control of obesity for children and pregnant women in 1998 (*11*)

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and later for adults in 1999 (*12*). And yet the country' s obesity rates remain high. According to the latest National Health Survey, the prevalence of overweight individuals was 33% for females and 43% for males, and that of obese individuals was 27% and 19%, respectively (*13*). So far, studies on the obesity of adults in this country have tended to concentrate on urban areas like the metropolitan Santiago area and data on other provinces including rural areas are scarce.

This study therefore, aims to examine the prevalence of obesity and investigate its determinants and dietary habits among adults in rural Chile.

Materials and methods

A community-based cross-sectional study was undertaken from April to June 2004 in San Carlos in the Ñuble Province of the 8th region (of a total 13 regions) in Chile. The 8th region is located 376.2 km south from Santiago (population: 6,061,185), and San Carlos is in the northern part of the region (population: 50,139) (*14,15*). About 44% of the population is engaged in agriculture, mainly farming and cultivating wheat (*15*). Out of a total of 78 districts, the central district and 13 suburb districts were chosen for this study to represent the diverse geographical characteristics of San Carlos. All households in each district were visited individually by interviewers who fully explained the study objective and procedures, and then one person aged 20-64 years per household, excluding pregnant and lactating women, was chosen, upon receipt of consent, to participate. A total of 603 adults (447 females and 156 males) were recruited.

During the household visits, anthropometric measurements were taken for all 603 adults. Height was measured to the nearest 0.1 cm using a portable stadiometer (Seca 214, Seca, Germany). Weight was measured using a digital bathroom scale (Seca 880, Seca, Germany) with capacity of 200 kg × 100 g. All of the sampled adults were weighed barefoot wearing light clothing. In order to assess fatness of each study subject, Body Mass Index (BMI) was calculated as weight (kg) divided by height squared (m^2), and subjects were categorized into four groups: underweight (< 18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (≥ 30 kg/m^2) (*16*). Using a plastic tape measure, waist and hip circumferences were also measured as an independent indicator of visceral obesity. An individual is considered at risk of obesity when women have a waist circumference greater than 88 cm and men have one greater than 102 cm (*16*). The waist to hip ratio was calculated by dividing the waist circumference by the hip circumference, and study subjects with a ratio greater than 1.0 were considered at risk. Pregnant and lactating women were excluded from the sampling.

Socio-economic and behavioral (*e.g.* age, residence, marital status, occupation, education, income) were obtained by the interviews using the structured questionnaires. Residence was categorized as suburb ("population < 2,000" or "population of 1001-2000 with less than 50% of those working in industries/service") or central ("population ≥ 2,000" or "population of 1001-2000 with more than 50% of those working in industries/service"). The minimum monthly wage in Chile (120,000 pesos) was used to classify income levels. This study used the "frequency of exercise" as a variable to estimate an individual's physical activity level. A food frequency questionnaire (FFQ) was used to obtain dietary data. The frequency of major food items consumed during the past year was included in order to investigate the characteristics and habits of participants' diets. Dietary habits were asked to investigate the factors affecting their food intake. A focus group discussion was held with 12 housewives as participants in order to obtain information on dietary changes.

All of the data were entered and analyzed with SPSS version 14.0. Software called "*Minuta*" was used to calculate nutrition composition, which was derived from the Chilean food composition table of the Institute of Nutrition and Food Technology (INTA) (*17*). Univariate analyses were performed to examine the association between BMI and socio-economic and behavioral characteristics and food intake. In a *t*-test, χ^2 test, and F-test a cut-off of 0.05 was used as the level of statistical significance.

All subjects gave informed consent, and the study protocol was approved by the ethical committee of the University of Tokyo and the University of Chile and the Chilean Ministry of Health's health council for the 8th region.

Results

Table 1 shows socio-economic characteristics of study subjects. Distributions of age, residence, and marital status among females and males were almost the same. Types of occupation differed, however, with more males than females being employed. Other occupations include vendor, student, and unemployed. "Income" means the total monthly income of the family, which was higher among the families of male respondents than of female respondents (Median: 130,000 pesos *vs.* 115,000 pesos; $p = 0.002$). The proportion of study subjects who were illiterate or had a primary level (1-8 years) was higher among females (46.1%) than males (35.9%).

The prevalence of overweight or obese individuals was 38.5% and 45.2% for females, and 51.3% and 30.1% for males, respectively (Table 2). There was a significant difference between females and males ($p = 0.009$) in the distribution of BMI. The proportion of overweight individuals was higher among males

Table 1. Characteristics of study subjects

	Female (n = 447)	Male (n = 156)
	n (%)	n (%)
Age, years		
20 - 29	77 (17.2)	33 (21.2)
30 - 39	106 (23.7)	39 (25.0)
40 - 49	141 (31.6)	40 (25.6)
≥ 50	123 (27.5)	44 (28.2)
Residence		
Suburb	170 (38.0)	54 (34.6)
Central	277 (62.0)	102 (65.4)
Marital status		
Married	260 (58.2)	96 (61.5)
Single	91 (20.4)	36 (23.1)
Widowed	26 (5.8)	1 (0.7)
Separated	31 (6.9)	8 (5.1)
Living together	39 (8.7)	13 (8.3)
No answer	0 (0.0)	2 (1.3)
Occupation		
Farmer	1 (0.2)	26 (16.7)
Housewife	264 (59.1)	0 (0.0)
Employee	78 (17.4)	68 (43.6)
Other	104 (23.3)	62 (39.7)
Education		
Illiterate	14 (3.1)	4 (2.6)
Primary	192 (43.0)	52 (33.3)
Secondary	173 (38.7)	60 (38.5)
High schoolor university	68 (15.2)	24 (15.4)
No answer	0 (0.0)	16 (10.2)
	Median (Inter-quartile range)	Median (Inter-quartile range)
Income, pesos[a]	115.000 (110.000)	130.000 (110.000)[b]

[a] US$1 = 608 pesos (April 2004); [b] Mann-Whitney test, $p < 0.01$.

Table 2. Anthropometric characteristics of study subjects

	Female (n = 447)	Male (n = 156)
	n (%)	n (%)
BMI[a]		
Underweight	1 (0.2)	0 (0.0)**
Normal	72 (16.1)	29 (18.6)
Overweight	172 (38.5)	80 (51.3)
Obese	202 (45.2)	47 (30.1)
Waist circumference		
Normal	156 (34.9)	121 (77.6)***
At risk[b]	291 (65.1)	35 (22.4)
Waist to hip ratio		
Normal	412 (92.2)	131 (84.0)**
At risk[c]	35 (7.8)	25 (16.0)
	Mean (SD)	Mean (SD)
Height, cm	154.3 (6.4)	166.9 (7.1)***
Weight, kg	71.2 (12.8)	78.6 (12.2)***
Waist circumference, cm	93.2 (12.8)	94.1 (10.3)

[a] Only one female was underweight and she was not included in the χ^2 test; [b] ≥ 88 cm for females and ≥ 102 cm for males; [c] ≥ 1.0 for females and males. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

(51.3%) than females (38.5%), though obese individuals were more prevalent among females (45.2%) than males (30.1%). The proportion of females with a waist circumference at risk was higher than males (65.1%, 22.4%; $p < 0.001$), though the reverse trend was observed in terms of waist-to-hip ratio (7.8%, 16.0%; $p = 0.003$).

Tables 3 and 4 show the prevalence of obesity among females and males, respectively, according to socio-economic and behavioral characteristics. Only one female was underweight (Table 2), hence her data were excluded from the analysis in Table 3. Age, residence, marital status, education, income, smoking, and parity were associated with obesity for females ($p < 0.05$ for each), whereas only age ($p < 0.001$) and smoking ($p < 0.05$) were significant factors for males. Regardless of gender, older persons were more likely to be obese than younger ones. Obese individuals were more prevalent in suburb (54.7%) than central (39.5%) areas among females, though no geographical difference was observed among males in this rural region. Subjects who were illiterate or had a primary school education were more likely to be obese than those with higher education (≥ 9 years) (female: 54.9% *vs*. 37.1%; $p < 0.001$, male: 39.3% *vs*. 22.6%; $p = 0.088$). Among the families of female subjects, those with low incomes (< 120,000 pesos) had a higher prevalence of obesity (49.3%) than those with high incomes (≥ 120,000 pesos) (39.8%) ($p = 0.007$). Parity was also a significant factor, and women who had delivered three or more times had a higher proportion of obesity (54.0%) in comparison to those who delivered fewer than three times (once or twice 40.9%, never 24.0%; $p < 0.001$). Next, the association between obesity and behavioral factors was examined. The proportion of obese individuals was the highest for those who had never smoked or had stopped smoking among females (50.3%). With regard to physical activity, a rather small proportion of study subjects in all BMI categories exercised for 30 min more than three times per week. There was no statistically significant association between physical activity level and obesity.

The mean frequency of intake per week for selected food items is listed in Tables 5 and 6 by BMI and gender. There was no significant difference in food frequency between BMIs. Intake of bread, potatoes, vegetables, and fruit was more frequent, followed by rice, beef, chicken, margarine, juice, and carbonated drinks for both genders. The intake of fish, seafood, mushrooms, and alcohol was low. The mean frequency of intake of beef and chicken was more than once a week, but the mean frequency of intake of fish was less than once a week regardless of gender. For males, intake of juice and carbonated drinks was two or three times a week, but intake of milk was two times a week. Although data are not shown in the tables, comparison of females and males indicated that intake of bread, potatoes, cheese, pork, mutton, processed meat, eggs, carbonated drinks, and alcohol was more frequent for males than females ($p < 0.05$ for each), while females consumed yogurt, seaweed, fruit, and jam more frequently than males ($p < 0.05$ for each).

Dietary habits were also asked in this study (Table 7 and 8). More than 70% of the subjects took breakfast everyday, and more than 80% of the normal females and overweight males did so. Regardless of gender, there

Table 3. Prevalence of obesity according to socio-economic and behavioral characteristics (females)

		Normal (n = 72)	Overweight (n = 172)	Obese (n = 202)
		n (%)	n (%)	n (%)
Age, years	< 43	51 (23.1)	92 (41.6)	78 (35.3)***
	≥ 43	21 (9.3)	80 (35.6)	124 (55.1)
Residence	Suburb	17 (10.0)	60 (35.3)	93 (54.7)**
	Central	55 (19.9)	112 (40.6)	109 (39.5)
Marital status	Married	36 (13.8)	101 (38.9)	123 (47.3)*
	Single	25 (27.8)	30 (33.3)	35 (38.9)
	Widowed	4 (15.4)	14 (53.8)	8 (30.8)
	Separated	1 (3.2)	14 (45.2)	16 (51.6)
	Living together	6 (15.4)	13 (33.3)	20 (51.3)
Occupation	Farmer	0 (0.0)	0 (0.0)	1 (100.0)
	Housewife	35 (13.2)	105 (39.8)	124 (47.0)
	Employee	20 (25.6)	31 (39.8)	27 (34.6)
	Other	17 (16.5)	36 (35.0)	50 (48.5)
Education	≤ Primary	18 (8.7)	75 (36.4)	113 (54.9)***
	≥ Secondary	54 (22.5)	97 (40.4)	89 (37.1)
Income, pesos[a]	< 120.000	32 (11.8)	105 (38.9)	133 (49.3)**
	≥ 120.000	38 (22.9)	62 (37.3)	66 (39.8)
Smoking	Everyday	19 (22.6)	36 (42.9)	29 (34.5)**
	Sometimes	13 (25.0)	22 (42.3)	17 (32.7)
	Don't smoke, quit	40 (12.9)	114 (36.8)	156 (50.3)
Exercise[b]	Yes	7 (16.7)	19 (45.2)	16 (38.1)
	No	65 (16.1)	153 (38.0)	185 (45.9)
Parity	0	20 (40.0)	18 (36.0)	12 (24.0)***
	1 - 2	28 (15.5)	79 (43.6)	74 (40.9)
	≥ 3	24 (11.2)	75 (34.9)	116 (53.9)

[a] US$1 = 608 pesos (April 2004); [b] More than 3 times a week, more than 30 min; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4. Prevalence of obesity according to socio-economic and behavioral characteristics (males)

		Normal (n = 29)	Overweight (n = 80)	Obese (n = 47)
		n (%)	n (%)	n (%)
Age, years	< 43	21 (26.6)	42 (53.2)	16 (20.2)**
	≥ 43	8 (10.4)	38 (49.3)	31 (40.3)
Residence	Suburb	10 (18.5)	28 (51.9)	16 (29.6)
	Central	19 (18.6)	52 (51.0)	31 (30.4)
Marital status	Married	14 (14.6)	49 (51.0)	33 (34.4)
	Single	12 (33.3)	17 (47.2)	7 (19.5)
	Widowed	0 (0.0)	0 (0.0)	1 (100.0)
	Separated	1 (12.5)	7 (87.5)	0 (0.0)
	Living together	2 (15.4)	6 (46.1)	5 (38.5)
Occupation	Farmer	6 (23.1)	12 (46.1)	8 (30.8)
	Housewife	0 (0.0)	0 (0.0)	0 (0.0)
	Employee	10 (12.8)	35 (55.3)	23 (31.9)
	Other	13 (30.6)	33 (44.4)	16 (25.0)
Education	≤ Primary	8 (14.3)	26 (46.4)	22 (39.3)
	≥ Secondary	19 (22.6)	46 (54.8)	19 (22.6)
Income, pesos[a]	< 120.000	17 (23.3)	35 (47.9)	21 (28.8)
	≥ 120.000	12 (15.4)	44 (56.4)	22 (28.2)
Smoking	Everyday	6 (21.4)	18 (64.3)	4 (14.3)*
	Sometimes	9 (31.0)	9 (31.0)	11 (38.0)
	Don't smoke, quit	14 (14.6)	52 (54.2)	30 (31.2)
Exercise[b]	Yes	2 (12.5)	8 (50.0)	6 (37.5)
	No	27 (19.4)	72 (51.8)	40 (28.8)

[a] US$1 = 608 pesos (April 2004); [b] More than 3 times a week, more than 30 min; * $p < 0.05$; ** $p < 0.01$.

was no statistically significant association between eating out for lunch/dinner or having a snack and BMI. The percentage of individuals who ate out for lunch and dinner was higher among males than females but there was an opposite trend regarding having snacks. Dietary habits were closely associated with factors affecting food purchases: regardless of gender, the most important factor for the present purchase was found to be "price,"

Table 5. Mean (SD) of food frequency per week according to BMI (females)

	Normal (n = 72)	Overweight (n = 171)	Obese (n = 202)
	n (%)	n (%)	n (%)
Cereals			
Bread	6.6 (1.3)	6.8 (1.1)	6.9 (0.7)
Noodles	1.8 (1.2)	1.8 (1.1)	1.9 (1.3)
Rice	2.1 (1.0)	2.2 (1.0)	2.4 (1.3)
Potatoes	3.6 (2.1)[a]	4.0 (2.1)	4.4 (2.1)[a]*
Legumes	1.3 (0.9)	1.5 (0.8)	1.4 (0.8)
Dairy products			
Milk	2.8 (2.8)	2.4 (2.7)	2.4 (2.8)
Yogurt	1.7 (2.0)	1.6 (1.9)	1.3 (1.8)
Unripe cheese	1.2 (1.5)	1.3 (1.6)	1.1 (1.5)
Cheese	2.0 (1.8)	1.6 (1.6)	1.4 (1.4)
Meat			
Beef	2.1 (1.5)	2.1 (1.5)	2.1 (1.6)
Pork	0.9 (0.8)	1.2 (0.9)	1.2 (0.9)
Mutton	0.2 (0.4)	0.1 (0.3)	0.1 (0.4)
Chicken	1.8 (0.9)	2.0 (1.2)	2.0 (1.3)
Other (rabbit, wild bird)	0.2 (0.4)	0.2 (0.5)	0.3 (0.6)
Viscera	0.3 (0.4)[ab]	0.5 (0.6)[b]*	0.5 (0.7)[a]*
Processed meat	1.5 (1.3)	1.4 (1.2)	1.4 (1.3)
Eggs	2.1 (1.5)	1.8 (1.3)	1.9 (1.7)
Fish and seafood			
Fish	0.7 (0.5)	0.8 (0.6)	0.8 (0.7)
Canned fish	1.1 (0.7)	1.2 (0.8)	1.2 (0.9)
Seafood	0.2 (0.5)	0.4 (0.6)	0.3 (0.5)
Seaweed	0.4 (0.9)	0.4 (0.7)	0.4 (0.6)
Vegetables and fruits			
Vegetables	5.6 (2.3)	6.0 (1.9)	5.8 (2.1)
Mushrooms	0.1 (0.3)	0.1 (0.4)	0.1 (0.3)
Fruit	4.9 (2.5)	5.4 (2.2)	5.5 (2.2)
Fats and oils			
Butter	1.2 (2.3)	1.2 (2.3)	1.2 (2.4)
Margarine	2.7 (2.9)	2.6 (2.9)	2.2 (2.6)
Mayonnaise	1.3 (1.6)	1.2 (1.2)	1.0 (1.2)
Sugar and sweets			
Jam	2.4 (2.2)	2.3 (2.1)	1.8 (2.0)
Sweets	2.8 (2.6)[ab]	2.0 (2.2)[b]*	1.7 (2.3)[a]**
Beverages			
Juice	2.6 (2.9)	2.1 (2.7)	1.9 (2.6)
Carbonated drinks	2.5 (2.3)	2.2 (2.0)	2.4 (2.4)
Alcohol	0.5 (0.8)	0.5 (0.8)	0.3 (0.7)

[a] Significant between normal and obese; [b] Significant between normal and overweight; Bonferroni correction following ANOVA
* $p < 0.05$; ** $p < 0.01$.

followed by freshness (though not significantly different, obese female subjects tended to choose price more than subjects with other BMIs). With regard to factors affecting future purchases, a relatively high proportion of participants answered "nutrition." Since price was quoted as the most significant factor for food purchases, average food prices were surveyed at three markets in San Carlos (Table 9).

During the focus group discussion, the participants discussed the differences in past and present diets. They stated that they had consumed milk, soup, legumes, and fruits during their childhood while they mentioned that their latest children consumed yogurt, sweets, french fries, and hot dogs. Overall, the cooking process was also found to have changed, with "fried" now being favored over boiling/cooking (*e.g.* french fries *vs.* boiled potatoes). A question about when and how dietary patterns have changed received the following responses:

"Our diet changed as technology advanced, and then ready-made and processed food began to appear on the market."

"Since TV sets have increased, we had more chances to eat the foods advertised in commercials. Sometimes my children prefer to have the foods shown on TV rather than the meals I cook."

Discussion

Although there are many studies on obesity in Chile, little is known about rural areas, especially with respect to the influences of socio-economic and dietary factors. This study confirmed the high prevalence of obesity in a rural province of Chile (female: 45.2%, male: 30.1%), finding it to be much higher than national average (female 27%, male 19%). Females had a higher proportion of obesity than males, especially in suburb areas. Similar results were found in several Latin American countries like Brazil and Peru and two previous studies of the Chilean cities of Santiago and Valparaiso (*18*). One of the possible explanations for females being more likely to be obese is biological differences (*19*). Humans carry a number of genes

Table 6. Mean (SD) of food frequency per week according to BMI (males)

	Normal (n = 29)	Overweight (n = 80)	Obese (n = 47)
	n (%)	n (%)	n (%)
Cereals			
Bread	7.0 (0.0)	6.9 (0.6)	6.8 (0.8)
Noodles	1.9 (1.1)	2.0 (1.1)	1.7 (1.2)
Rice	2.2 (1.1)	2.6 (1.3) [c]	1.9 (1.1)[c]**
Potatoes	4.3 (2.2)	4.8 (2.2)	4.5 (2.4)
Legumes	1.2 (0.7)	1.5 (0.9)	1.3 (0.8)
Dairy products			
Milk	2.3 (2.6)	2.2 (2.5)	2.0 (2.5)
Yogurt	1.1 (1.2)	1.0 (1.4)	1.0 (1.6)
Unripe cheese	0.8 (1.0)	1.2 (1.5)	1.1 (1.4)
Cheese	2.5 (2.2)	1.8 (1.9)	1.9 (1.6)
Meat			
Beef	1.4 (1.0)[b]	2.4 (1.7)[b]**	2.3 (1.8)
Pork	1.0 (0.8)	1.5 (1.3)	1.5 (0.9)
Mutton	0.3 (0.5)	0.2 (0.4)	0.4 (0.8)
Chicken	1.9 (1.2)	2.0 (1.3)	1.6 (0.7)
Other (rabbit, wild bird)	0.3 (0.5)	0.5 (1.0)	0.3 (0.8)
Viscera	0.4 (0.5)	0.5 (0.6)	0.4 (0.5)
Processed meat	2.0 (1.4)	1.8 (1.6)	1.7 (1.5)
Eggs	1.8 (1.2)	2.4 (1.5)	2.4 (1.9)
Fish and seafood			
Fish	0.9 (0.4)	0.9 (0.5)	0.7 (0.5)
Canned fish	1.4 (1.2)	1.2 (0.9)	1.2 (0.9)
Seafood	0.2 (0.4)	0.4 (0.5)	0.3 (0.5)
Seaweed	0.3 (0.5)	0.4 (0.6)	0.2 (0.4)
Vegetables and fruits			
Vegetables	5.2 (2.4)	5.9 (2.0)	5.8 (2.2)
Mushrooms	0.0 (0.2)	0.2 (0.4)	0.2 (0.6)
Fruit	4.5 (2.6)	4.9 (2.3)	5.0 (2.5)
Fats and oils			
Butter	0.9 (1.6)	1.6 (1.7)	1.5 (2.4)
Margarine	2.7 (2.7)	2.4 (2.8)	2.5 (2.8)
Mayonnaise	1.6 (1.8)	1.2 (1.6)	1.0 (1.3)
Sugar and sweets			
Jam	1.3 (1.1)	1.8 (1.9)	1.7 (2.0)
Sweets	2.1 (2.6)	1.5 (2.2)	1.3 (2.0)
Beverages			
Juice	3.4 (2.8)	2.3 (2.6)	2.5 (2.9)
Carbonated drinks	3.4 (2.4)	3.6 (2.7)	3.0 (2.5)
Alcohol	0.8 (0.6)	1.0 (1.4)	0.9 (1.1)

[b] Significant between normal and overweight; [c] Significant between overweight and obese; Bonferroni correction following ANOVA ** $p < 0.01$.

Table 7. Prevalence of obesity according to dietary habits (females)

		Normal (n = 72)	Overweight (n = 172)	Obese (n = 202)
		n (%)	n (%)	n (%)
Breakfast	Don't eat	6 (8.3)	6 (3.5)	8 (4.0)
	Sometimes	7 (9.7)	35 (20.6)	45 (22.4)
	Everyday	59 (82.0)	129 (75.9)	148 (73.6)
Eat out for lunch, no. of times[a]	0	38 (52.8)	89 (52.7)	113 (55.9)
	< 3	27 (37.5)	62 (36.7)	67 (33.2)
	≥ 4	7 (9.7)	18 (10.6)	22 (10.9)
Eat out for dinner, no. of times[b]	0	40 (55.6)	123 (71.6)	153 (76.1)**
	< 3	26 (36.1)	46 (26.7)	43 (21.4)
	≥ 4	6 (8.3)	3 (1.7)	5 (2.5)
Have a snack, no. of times[c]	0	37 (51.4)	82 (47.7)	114 (56.4)
	≥ 1	35 (48.6)	90 (52.3)	88 (43.6)
Have you heard of dietary fiber?	Yes	58 (80.6)	131 (76.2)	151 (74.8)
	No	14 (19.4)	41 (23.8)	51 (25.2)
What do you think is most important when buy food?	Price	34 (16.8)	59 (29.2)	109 (63.7)
	Freshness	12 (11.0)	49 (45.0)	48 (28.1)
	Nutrition	1 (16.7)	1 (16.7)	4 (2.3)
	Other	2 (6.4)	19 (61.3)	10 (5.9)
In the future, what will be most important for you when buy food?	Price	19 (38.8)	38 (29.7)	70 (40.2)
	Freshness	14 (28.6)	43 (33.6)	46 (26.4)
	Nutrition	11 (22.4)	28 (21.9)	42 (24.2)
	Other	5 (10.2)	19 (14.8)	16 (9.2)

[a] Frequency of eating out for lunch per week; [b] Frequency of eating out for dinner per week; [c] Frequency of having snacks per day; ** $p < 0.01$.

Table 8. Prevalence of obesity according to dietary habits (males)

		Normal (n = 29)	Overweight (n = 80)	Obese (n = 47)
		n (%)	n (%)	n (%)
Breakfast	Don't eat	3 (10.7)	3 (3.8)	4 (8.7)
	Sometimes	4 (14.3)	11 (13.9)	6 (13.0)
	Everyday	21 (75.0)	65 (82.3)	36 (78.3)
Eat out for lunch, no. of times[a]	0	6 (20.7)	40 (51.9)	23 (50.0)*
	< 3	20 (69.0)	25 (32.5)	17 (37.0)
	≥ 4	3 (10.3)	12 (15.6)	6 (13.0)
Eat out for dinner, no. of times[b]	0	8 (27.6)	56 (71.8)	32 (71.1)
	< 3	17 (58.6)	16 (20.5)	9 (20.0)
	≥ 4	4 (13.8)	6 (7.7)	4 (8.9)
Have a snack, no. of times[c]	0	17 (58.6)	52 (65.0)	32 (68.1)
	≥ 1	12 (41.4)	28 (35.0)	15 (31.9)
Have you heard of dietary fiber?	Yes	23 (79.3)	49 (62.0)	28 (60.9)
	No	6 (20.7)	30 (38.0)	18 (39.1)
What do you think is most important when buy food?	Price	9 (56.3)	28 (59.6)	13 (56.6)
	Freshness	6 (37.5)	14 (29.8)	5 (21.7)
	Nutrition	0 (0.0)	1 (2.1)	0 (0.0)
	Other	1 (6.2)	4 (8.5)	5 (21.7)
In the future, what will be most important for you when buy food?	Price	7 (43.8)	19 (40.4)	9 (37.5)
	Freshness	5 (31.3)	15 (31.9)	6 (25.0)
	Nutrition	1 (6.2)	8 (17.0)	5 (20.8)
	Other	3 (18.7)	5 (10.7)	4 (16.7)

[a] Frequency of eating out for lunch per week; [b] Frequency of eating out for dinner per week; [c] Frequency of having snacks per day; * $p < 0.05$.

Table 9. List of market food prices

Food		Unit	Price (pesos)[a]
Cereals	Bread	1 kg	580
	Noodles	1 kg	598
	Rice	1 kg	687
Potatoes		1 kg	100
Beans		1 kg	980
Dairy products	Milk	1 L	490
	Powdered Milk	130 g + water (L) = 1 L	375
	Low fat powdered milk	130 g + water (L) = 1 L	408
	Yogurt	165 g	117
	Low fat yogurt	165 g	190
	Unripe cheese	250 g	695
	Cheese	250 g	555
Meat and eggs	Beef	1 kg	2406
	Pork	1 kg	1352
	Chicken	1 kg	1015
	Sausage	1 dozen	804
	Eggs	1 dozen	680
Fish and seafood	Fish	1 kg	2390
	Canned fish	425 g	463
	Seafood (with shell)	1 kg	650
	Canned seafood	110 g	805
Vegetables		1 kg	175 - 450
Fruits		1 kg	200 - 500
Fats and oils	Butter	250 g	662
	Margarine	250 g	479
	Low fat margarine	250 g	500
	Mayonnaise	250 g	308
	Low fat mayonnaise	250 g	411
Sweets	Jam	250 g	374
	Low sugar jam	250 g	376
Beverages	Powdered juice	45 g + water (L) = 1 L	116
	Low sugar juice	45 g + water (L) = 1 L	116
	Carbonated drinks	1 L	330
	Low calorie carbonated drinks	1 L	338

Visits were made to three supermarkets in San Carlos; The price is the average of the three supermarkets; [a] US$1 = 608 pesos (April 2004).

related to body size, and environmental factors would also affect the phenotypic expression of these genes (*20*). Another important determinant of obesity of females was parity. This finding was compatible to a study by Bastian *et al*. (*21*), which showed that the risk of being obese in later life would increase according to the number of children one had.

One of the interesting findings of the current study

is that there was a significant association between BMI and some socio-economic factors for females (Table 3) but not for males (Table 4). A similar trend was observed in a previous study (*22*). In the current study, males had fewer restrictions on access to food, with more chances to eat out for dinner; they were probably influenced less by socio-economic factors than females. Peña *et al*. suggested that the association between obesity and socio-economic characteristics may be influenced by cultural and social background, though in most cases this is not readily apparent (*7*). In a patriarchal society, the intra-household food distribution may be in favor of males.

Contrary to general understanding, subjects with a lower level of physical activity were not necessarily obese in this study. The proportion of those who exercised for more than 30 min three times or more per week was 9.7% (58/600), and thus it was quite difficult to make the statistical comparison. Moreover, this study did not measure actual energy expenditure, so caution is needed when interpreting the results. A National Health Survey noted that the proportion of persons with a low level of physical activity was quite high (*13*). Enhancing awareness of the importance of increasing one's physical activity is therefore crucial.

With regard to diet, no association between frequency of food intake and BMI was found. The possibility of under-reporting of dietary intake of obese subjects was noted in an earlier study (*23*), which might have contributed to the obese subjects having a lower frequency of intake in sugar-rich foods such as sweets and juice than those with a normal BMI.

Another important finding in this study was the possible association between the factors affecting food purchases and frequency of food intake. Comparison of the factors affecting present and future food purchases indicated that the highest proportion answered "price" for both present and future purchases, whereas those who answered "nutrition" increased for future purchases. This shows awareness of the importance of nutrition among the study population, though in actuality individuals would place priority on price. Obese female subjects tended to attach importance to price for their present purchases. Characteristics of obese female subjects like having a family and income constraints might have contributed this priority as well as decision of cooking process. These subjects are thus unable to place a priority on purchase aspects besides price.

Results for food frequency suggested the impact of price. Table 9 shows the list of market food prices. Of course, the frequency of food intake is not simply due to price. The current dietary guideline in Chile recommends the intake of dairy products and fish (*24*). Comparing fish and meat indicates people eat more pork and chicken (1352 pesos, 1015 pesos per 1 kg respectively) which is relatively cheaper than fish (2390 pesos per 1 kg), though beef is an exception (2406 pesos per 1 kg). Another food recommended in the dietary guideline is dairy products including milk. For males, the frequency of intake of milk was about two times a week and intake of juice and carbonated drinks was two or three times a week. In terms of price, milk is more expensive than juice and carbonated drinks, and low fat milk is even more expensive. Similar trends were observed in a previous study where persons with low socio-economic status would consume only what they could afford (*25*,*26*). Ironically, most of the foods affordable to poor populations tend to be energy-dense and high-fat (*27*) and the current study also found that food items recommended by dietary guidelines were rather expensive. An essential aspect to promoting healthy food choices is that recommended foods do not increase the costs for the population. Combined with nutrition education, price controls as have been reported in Mauritius and Finland may play an important role, (*28*,*29*). The current study also suggests that in addition to price the availability at the shop negatively affects access to recommended foods (*e.g*. there were only three fish shops, while meat was available at many shops).

Since Chile is a country about 4000 km long from north to south, the crops cultivated and livestock raised, as well as the availability of markets for other foods, may differ greatly by region. Establishing area-specific strategies, including the dietary guidelines, to control obesity and related diseases is therefore essential. A good model for this may be the Japanese Ministry of Health, Labor, and Welfare's (former the Ministry of Health and Welfare) "Health Japan 21 (Kenkou Nippon 21)," which set out Japanese public health targets for the year 2010, as it employs different aims/strategies by region (*30*).

In conclusion, the current findings of a high prevalence of obese/overweight individuals, together with the characteristics of their diets including changes in the cooking process, suggest that a nutrition transition is underway in rural areas as well. Although assessing actual changes in BMI during the course of a nutrition transition is difficult to do with a cross-sectional study, the findings of this study illustrate the significance of obesity in the area studied. Latin Americans are known to be more likely to have greater body fat for the same BMI than whites in the US and Europe and therefore to have a higher likelihood of experiencing related diseases at lower BMI levels (*31*). Although a lower prevalence of obesity was observed for males, the high frequency of eating out must be curbed and low awareness of dietary fiber must be remedied to prevent an increase in overweight individuals and to enhance health awareness among males. In addition, future nutrition policy should take regional difference into consideration and should be established in collaboration with relevant sectors (*e.g*. health, education, agriculture,

economic) as well as with the mass media.

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