



## Trabajo Original

Epidemiología y dietética

### Prevalence of overweight, obesity, abdominal-obesity and short stature of adult population of Rosario, Argentina

*Prevalencia de sobrepeso, obesidad, obesidad abdominal y baja estatura de la población adulta de Rosario, Argentina*

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#### Abstract

**Introduction:** The aim of this work was to assess the prevalence of overweight, obesity, abdominal-obesity and short stature among Rosario (Argentina) adult population.

**Materials and methods:** A cross-sectional nutritional survey was carried out in Rosario (2012-2013). A random sample (n = 1194) of adult population (18-70 years old) was interviewed. Anthropometric measurements and a general questionnaire incorporating questions related to socio-demographic and lifestyle characteristics, education level and physical activity were used.

**Results:** The current study detected a high prevalence of overweight and obesity among adult population in Rosario. The prevalence of overweight was 32.7% (43.9% in men and 27.6% in women,  $p < 0.001$ ), of obesity was 23.5% (21.6% in men and 24.3% in women), and of abdominal obesity was 57.5% (63.5% in men vs. 54.8% in women,  $p < 0.005$ ). Multivariate analysis showed that the prevalence of overweight/obesity and abdominal obesity increased according the age and abdominal obesity decreased with high physical activity in men. In women prevalence of overweight/obesity, and abdominal obesity increased with age, marital status (married or coupled), presence of at least one child at home and low educational level.

**Conclusion:** The prevalence of short stature was higher in women (16.4% vs. 8.4%,  $p < 0.001$ ) and was related with age, overweight and abdominal obesity.

#### Key words:

Overweight. Obesity.  
Short stature. Adult.  
Rosario.

#### Resumen

**Introducción:** el objetivo de este trabajo fue evaluar la prevalencia de sobrepeso, obesidad, obesidad abdominal y baja estatura entre la población adulta de Rosario (Argentina).

**Material y métodos:** se llevó a cabo un estudio nutricional transversal en Rosario (2012-2013), entrevistando una muestra aleatoria (n = 1.194) de la población adulta (18-70 años). Se realizaron mediciones antropométricas y un cuestionario general de características sociodemográficas, estilo de vida, nivel de educación y actividad física.

**Resultados:** este estudio encontró una alta prevalencia de sobrepeso y obesidad entre la población adulta en Rosario. La prevalencia de sobrepeso fue del 32,7% (43,9% en hombres y 27,6% en las mujeres,  $p < 0,001$ ), de obesidad fue 23,5% (21,6% en hombres y 24,3% en las mujeres) y de obesidad abdominal fue de 57,5% (63,5% en los hombres y 54,8% en las mujeres,  $p < 0,005$ ). El análisis multivariado mostró que la prevalencia de sobrepeso/obesidad y obesidad abdominal aumentó según la edad y la obesidad abdominal se redujo en hombres con elevada práctica de actividad física. En las mujeres, la prevalencia de sobrepeso/obesidad y obesidad abdominal aumentó con la edad, el estado civil (casado o en pareja), la presencia de al menos un niño en casa y bajo nivel educativo.

**Conclusión:** la prevalencia de talla baja fue mayor en las mujeres (16,4% vs. 8,4%,  $p < 0,001$ ) y estaba relacionada con la edad, el sobrepeso y la obesidad abdominal.

#### Palabras clave:

Sobrepeso. Obesidad.  
Baja estatura. Adulto.  
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## INTRODUCTION

During the last century, industrialization, urbanization, economic development and the globalization have led to changes in the diet and lifestyle of people, with deep consequences on the health and nutritional status of the population. The economic transition that followed the industrialization came associated with demographic, epidemiological and nutritional transitions that have impacted producing important nutritional changes in urban and rural households, due to a multiplicity of factors that have influenced the lifestyle and food consumption patterns (1,2).

The World Health Organization (WHO) recognizes high blood pressure, tobacco use, high blood glucose, physical inactivity, and overweight and obesity as the leading global risk for mortality in the world. Overweight and obesity are responsible for 5% of deaths globally. A high body mass index (BMI) is a risk factor which account for cardiovascular and ischemic heart disease, the leading cause of death worldwide (3). WHO has defined obesity as the epidemic of the 21<sup>st</sup> century, which has high impact on morbidity and mortality, health and quality of life. The worldwide prevalence of obesity has almost doubled between 1980 and 2008 (4). Latin America has changed from a condition of high prevalence of low weight and deficit of growth towards a scenario marked by an increase in obesity and chronic diseases such as cardiovascular diseases, diabetes and cancer (5-8). Levels of overweight and obesity across low- and middle-income countries have approached levels found in higher-income countries (9).

The aim of this work was to assess the prevalence of overweight, obesity, abdominal-obesity and short stature among Rosario (Argentina) adult population.

## MATERIALS AND METHODS

### STUDY DESIGN

The present study is a population based cross-sectional nutritional survey carried out in the Rosario city (Argentina) between October 2012 and June 2013.

### SAMPLE

The target population consisted of all inhabitants living in Rosario aged 18-70 years. The theoretical sample size was calculated take into account the prevalence of overweight and obesity (53.0%), inadequate energy intake (57.0%), low physical activity (51%) of Argentinian National Nutritional Survey (10) and the prevalence of overweight and obesity (53.4%), smoking habit (27.1%) and daily consumption of fruits (35.7%) and vegetables (37.6%) of Argentinian National Risk Factors Survey (11) and then was adjusted according to the Rosario census (12). The sample was set at a minimum of 365 men and 374 women in order to provide a specific relative preci-

sion of 5% (type I error = 0.05; type error II = 0.10) and 95% of confidence. The sampling technique included stratification according to age and sex of inhabitants, and random selection within subgroups in each Rosario Municipal District Centers (MCD) located in the six areas of the city (center, north, south, east, southwest, northwest) being the primary sampling units, and individuals within these district comprising the final sample units. Participants were recruited by opportunistic sampling at all Municipal District Centers (MCD) of Rosario. The final sample size was 1194 individuals, 373 men and 827 women. Pregnant and lactating women were excluded.

### ETHICS

The project was approved by the Committee of Ethics in Research of the Public Health Secretary of Rosario Municipality (Resolution no. 1816/2010) on September 5, 2012, and authorized by the Sub Secretariat General of the Rosario Municipality.

All the aspects involved in the development of this project be undertaken by adhering to national and international regulations and the criteria referred to in the principles contained in the Declaration of Helsinki and of the law on secret statistical no. 17622 which guarantees the anonymity of the participants and the confidentiality of the information during the processing of the data. Each participant signed an informed consent prior to the survey.

### ANTHROPOMETRIC MEASUREMENTS

Body weight was determined using a digital scale (OMROM® HBF - 500INT, Kyoto, Japan) to the nearest 100 g. The subjects were weighed in bare feet and minimum clothes wear, which was accounted for by subtracting the weight of the clothing that had not been removed, taking standard reference values. Height was determined using a portable anthropometer (CAM®, Buenos Aires, Argentina) to the nearest millimeter, with the subject standing, back to stadiometer, in bare feet, with the subject's head in the Frankfurt plane (the line from the auditory meatus to the lower border of the eye orbit). Waist circumference was determined using an inextensible and flexible measuring tape (Sanny medical®, SN- 40, Jaipur, India) to the nearest millimeter, and was measured with the subject of foot, on the horizontal plane equidistant between the bottom edge of the last rib and iliac crest, after an inspiration and deep exhalation, both were measured without clothes. Anthropometric measurements were performed by well-trained students of the last year of nutrition carrier in order to avoid the inter-observer coefficients of variation. According to the WHO classification the prevalence of overweight (BMI 25 to 29.9 kg/m<sup>2</sup>) and obesity (BMI ≥ 30 kg/m<sup>2</sup>) was calculated. Waist-to-height ratio (WHtR) was also calculated, and a cut-off of 0.5 was used to define abdominal obesity for men and women (13). Short stature in adulthood was defined as height < 153 cm among females and < 164 cm among males, according to the percentile 10 of national references (14).

## GENERAL QUESTIONNAIRE

A questionnaire incorporating the following questions was used: age, marital status (single; married/coupled; unmarried/divorced/widowed), living with at least one children (yes; no), education level (grouped according to complete years of formal education: low,  $\leq 7$  years; medium, 8-11 years; high  $\geq 12$  years), professional profile (grouped into student; unemployed; employed), smoking habits (yes; no), alcohol intake (yes; no) were utilized.

Physical activity level was evaluated according to the guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) (15) in the short form (SF) to Argentina. The IPAQ-SF assesses four domains of physical activity over the previous week, including vigorous activity (*i.e.* activities that make breathing much harder than normal), moderate activity (*i.e.* activities that make breathing somewhat harder than normal), walking and time spent sitting. Data from the IPAQ-SF were scored as per the IPAQ-SF scoring protocol and classified into three categories (low; moderate; high) (16) according to the total time and METs (Estimated Metabolic Equivalents) by week.

## STATISTICAL METHODS

Analyses were performed using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA) and STATA version 12.1 (StataCorp, College Station, Texas, USA). Differences between group means were tested by an unpaired Students' *t*-test. Logistic regression models with the calculations of corresponding odds ratio (OR) and 95% confidence interval (CI) were used to examine the possible association between socio-demographic and lifestyle characteristics (independent variables) and overweight/obesity, abdominal-obesity and short stature (dependent variables). Multivariate analysis with adjustment for age was first carried out for all the socio-demographic and lifestyle variables that could be associated with the frequency of overweight/obesity, abdominal obesity and short stature. Multivariate analyses with adjustment for all variables were also used to examine the effect of the sociodemographic and lifestyle variables on the prevalence of overweight/obesity, abdominal obesity and short stature. Level of significance for acceptance was  $p < 0.05$ .

## RESULTS

Table I shows the characteristics of participants. Married or coupled was the most representative marital status in both sexes. More than half of participants lived with children. There were more men employed and more students among women. Smoking habit didn't show differences between sexes while alcohol consumption was higher in men. Women were less active than men.

The overall prevalence of overweight and obesity estimated for the adult population of Rosario was 32.7% (CI 95% 30.1-35.4) and 23.5% (CI 95% 21.1-25.9%) respectively (Table II). Overweight was higher in men than women (43.9 vs. 27.6%,

$p < 0.001$ ) while obesity was similar in both (21.6% vs. 24.3%). The prevalence of abdominal obesity (WtHR  $> 0.5$ ) was 57.5%, higher in men than women (63.5% vs. 54.8%,  $p < 0.005$ ).

Weight, height and waist circumference showed significant differences between men and women of all age groups; weight and waist circumference increased with age, while height decreased. The mean BMI was lower than 25 kg/m<sup>2</sup> only in 18-30 y.o. subjects, with no differences between sexes. The prevalence of overweight was higher in men at all studied ages, while the prevalence of obesity didn't show differences between sexes. Abdominal obesity increased according to age and was higher among men (Table II).

Overweight/obesity and abdominal obesity in men showed positive relation only with age (Table III). The risk of overweight/obesity tripled between age groups; the risk of abdominal obesity was 2.85 times higher at age 31-50 years and 9.08 times at age 51-70 years in comparison to the youngest group (18-30 years). Both showed significant differences after adjustment by all explanatory variables. Abdominal obesity had negative association with physical activity level. There were not significant differences in the prevalence of overweight/obesity and abdominal obesity according to the socio-demographic and lifestyle characteristics (Table III).

In women overweight/obesity and abdominal obesity were related with age, marital status, presence of children at home and educational level. The age was the variable that showed a greater relationship with overweight/obesity and abdominal obesity. From a group to the following one, the prevalence increased 2-3 fold, being significant after adjusting for all covariates; the same scenario was observed among men. Married or coupled women showed higher risk. Although the risk of abdominal obesity remained after adjustment for all covariates, the risk of overweight/obesity disappeared after adjustment by all explanatory variables. The risk of overweight/obesity and abdominal obesity, after adjustment by age, was double in women with at least one child at home. The prevalence of overweight/obesity and abdominal obesity decreased according to the increase of educational level. The risk of overweight/obesity, adjusted by all covariates, was lower 65% in women with medium level and 81% among those with high education level, whereas the risk of abdominal obesity was lower four times in women with medium education level and nine times in women with high level; this association was different after adjustment for all the explanatory variables. Abdominal obesity was higher in non-smokers women and in those that not consume alcohol. Women with medium physical activity level showed the highest risk of abdominal obesity, being significant after adjustment by all explanatory variables (Table IV).

The prevalence of short stature was 16.4% in women and 8.4% in men ( $p < 0.001$ ). Men with less education ( $p = 0.031$ ) and unemployed ( $p = 0.016$ ) showed higher prevalence of height below p10, while in women the prevalence of short stature increased according to age ( $p = 0.001$ ), decreased according to the educational level ( $p = 0.005$ ), was lower in single women ( $p = 0.009$ ), higher in women who did not consume alcohol ( $p = 0.007$ ) and decreased according to the increase of physical

**Table I. Socio-demographic characteristics of study participants**

	Total (n = 1,194)	Men (n = 371)	Women (n = 823)	p*
%		31.1	68.9	
Age (years)†	39.5 ± 15.0	39.7 ± 14.7	39.4 ± 15.1	0.710
18 - 30	39.3	37.7	40.0	
31 - 50	34.3	35.8	33.7	
51 - 70	26.4	26.4	26.4	
Educational level (%)‡				0.140
Low	24.8	21.6	26.2	
Medium	60.8	62.0	60.3	
High	14.4	16.4	13.5	
Marital status (%)‡				0.024
Single	37.6	41.0	36.1	
Married or coupled	52.7	52.6	52.7	
Separated, divorced, widowed	9.7	6.5	11.2	
Living with children (%)‡				< 0.001
None	43.2	33.4	47.6	
At least one child at home	56.8	66.6	52.4	
Professional profile (%)‡				< 0.001
Student	10.1	7.0	11.6	
Unemployed	22.0	12.7	26.3	
Employed	67.8	80.3	62.2	
Smoking habits (%)‡				0.251
No	78.0	76.0	78.9	
Yes	22.0	24.0	21.1	
Alcohol consumption (%)‡				< 0.001
No	32.3	20.2	37.8	
Yes	67.7	79.8	62.2	
PA level (%)‡				< 0.001
Low	51.9	46.4	54.4	
Medium	31.9	30.5	32.6	
High	16.2	23.2	13.0	

Data were expressed as †mean ± standard deviation, and ‡%; \*Gender differences were tested by means of  $\chi^2$ .

activity practice ( $p = 0.027$ ). Women with overweight and abdominal obesity showed higher prevalence of short stature. The risk of short stature in women, adjusted by age, was higher according to the age, to the lower education level, to the alcohol consumption, and to overweight and abdominal obesity. After adjustment for all explanatory variables, age, abdominal obesity and medium physical activity level showed association with short stature (Table V).

## DISCUSSION

The present results reveal the magnitude of overweight/obesity and abdominal obesity among adult population of Ros-

ario, Argentina. Levels of overweight and obesity across low- and middle-income countries showed similar levels to those found in higher-income countries, particularly in the Middle East, North Africa, Latin America and the Caribbean[9]. The observed prevalence of overweight and obesity (32.7% and 23.5% respectively) is closely related with the observed at the Argentinian national level in successive years that was conducted by the National Survey of Risk Factors for No Communicable Diseases (NSRF) (11,17,18). The prevalence of overweight and obesity in 2005 was 34.4% and 14.6% (11); in 2009 35.4% and 18.0% (17); in 2013 37.1% and 20.8% (18), respectively. The higher prevalence of overweight observed in men (43.9 vs. 27.6%,  $p < 0.0001$ ) also matches to the NSRF at Argentinian national level (43.2% in men and

**Table II.** Anthropometric characteristics, overweight, obesity and abdominal-obesity prevalence among adult population<sup>1,2</sup>

	Men		Women		p <sup>2</sup>
	n	mean ± SD, %	n	mean ± SD, %	
<i>Weight (kg)†</i>	371	81.6 ± 14.7	823	67.9 ± 15.5	< 0.001
18-30 years-old	140	75.1 ± 12.6	329	62.3 ± 13.1	< 0.001
31-50 years-old	133	85.0 ± 14.5	277	70.9 ± 16.5	< 0.001
51-70 years-old	98	86.5 ± 14.7	217	72.6 ± 14.9	< 0.001
<i>Height (cm)†</i>	371	173.6 ± 7.1	823	160.0 ± 6.5	< 0.001
18-30 years-old	140	174.3 ± 7.2	329	161.5 ± 6.0	< 0.001
31-50 years-old	133	174.3 ± 6.9	277	159.8 ± 6.7	< 0.001
51-70 years-old	98	171.7 ± 6.9	217	158.2 ± 6.4	< 0.001
<i>BMI (kg/m<sup>2</sup>)†</i>	371	27.1 ± 4.6	823	26.6 ± 6.3	0.136
18-30 years-old	140	24.6 ± 3.5	329	23.9 ± 5.0	0.073
31-50 years-old	133	28.0 ± 4.6	277	27.8 ± 6.7	0.788
51-70 years-old	98	29.3 ± 4.6	217	29.1 ± 6.0	0.687
<i>Prevalence of overweight (%)‡</i>	371	43.9	823	27.6	< 0.001
18-30 years-old	140	35.7	329	19.5	< 0.001
31-50 years-old	133	48.9	277	30.3	< 0.001
51-70 years-old	98	49.0	217	36.4	0.035
<i>Prevalence of obesity (%)‡</i>	371	21.6	823	24.3	0.301
18-30 years-old	140	7.1	329	10.9	0.206
31-50 years-old	133	25.6	277	30.0	0.356
51-70 years-old	98	36.7	217	37.3	0.920
<i>Waist circumference (cm)†</i>	370	93.3 ± 13.7	818	84.5 ± 15.6	< 0.001
18-30 years-old	140	84.7 ± 9.8	329	76.9 ± 12.8	< 0.001
31-50 years-old	133	95.2 ± 11.7	274	87.1 ± 15.7	< 0.001
51-70 years-old	97	103.1 ± 13.5	215	92.8 ± 13.9	< 0.001
<i>WHR†</i>	370	0.54 ± 0.08	818	0.53 ± 0.10	0.112
18-30 years-old	140	0.49 ± 0.05	329	0.48 ± 0.08	0.165
31-50 years-old	133	0.55 ± 0.07	274	0.55 ± 0.10	0.945
51-70 years-old	97	0.60 ± 0.08	215	0.59 ± 0.09	0.209
<i>Prevalence of abdominal-obesity (%)‡</i>	370	63.5	818	54.8	0.005
18-30 years-old	140	37.1	329	30.1	0.135
31-50 years-old	133	71.4	274	62.8	0.085
51-70 years-old	97	90.7	215	82.3	0.055

BMI: body mass index; WHtR: waist-to-height ratio. <sup>1</sup>Data were expressed as †mean ± standard deviation, and ‡%. <sup>2</sup>Gender differences were tested by an †unpaired Students' t-test, and by ‡χ<sup>2</sup>.

28.4% in women) and in Santa Fe province (45.8% in men and 27.0% in women) (17). Obesity prevalence was no different between sexes, being slightly higher in women (21.6% in men and 24.3% in women), although the NRFS showed a higher prevalence in men at Argentinian national level (19.1% vs. 17.1%) and in Santa Fe province (20.5% vs. 19.7%) (17).

The association between sociodemographic and lifestyle factors and overweight/obesity and abdominal obesity in Rosario adult population showed that age is one of the strength factors associated with the prevalence, whereas in women the educational level was strongly associated with overweight/obesity and abdominal obesity. NSRF showed that the prevalence of overweight and

**Table III.** Socio-demographic and lifestyle characteristics among men classified as overweight/obesity (BMI  $\geq 25$  kg/m<sup>2</sup>) and abdominal-obese (WHT<sub>r</sub>  $\geq 0.5$ )<sup>1,2</sup>

	Overweight/obesity				Abdominal-obesity			
	BMI < 25 kg/m <sup>2</sup>	BMI $\geq 25$ kg/m <sup>2</sup>	Age-adjusted OR <sup>1</sup> (95% CI)	Additionally-adjusted OR <sup>2</sup> (95% CI)	WHT <sub>r</sub> < 0.5	WHT <sub>r</sub> $\geq 0.5$	Age-adjusted OR <sup>1</sup> (95% CI)	Additionally-adjusted OR <sup>2</sup> (95% CI)
<i>Age group</i>								
18-30 years-old	57.1	42.9	1.00 (ref.)	1.00 (ref.)	62.9	37.1	1.00 (ref.)	1.00 (ref.)
31-50 years-old	25.6	74.4	3.88 (2.32-6.49)***	2.97 (1.57-5.63)**	28.6	71.4	4.23 (2.54-7.04)***	2.85 (1.50-5.41)**
51-70 years-old	14.3	85.7	8.00 (4.15-15.44)***	6.72 (2.92-15.44)***	9.3	90.7	16.55 (7.69-35.62)***	9.08 (3.69-22.33)***
<i>Marital status</i>								
Single	50.0	50.0	1.00 (ref.)	1.00 (ref.)	57.2	42.8	1.00 (ref.)	1.00 (ref.)
Married/coupled	24.1	75.9	1.26 (0.71-2.23)	1.02 (0.51-2.04)	22.7	77.3	1.32 (0.73-2.38)	1.41 (0.69-2.88)
Unmarried/divorced/widowed	20.8	79.2	1.06 (0.33-3.40)	1.07 (0.33-3.49)	16.7	83.3	1.12 (0.31-4.07)	1.76 (0.49-6.27)
<i>Living with children</i>								
None	41.7	58.3	1.00 (ref.)	1.00 (ref.)	44.5	55.5	1.00 (ref.)	1.00 (ref.)
At least one child at home	20.2	79.8	1.56 (0.88-2.75)	1.38 (0.69-2.74)	20.3	79.7	1.25 (0.68-2.30)	1.36 (0.66-2.82)
<i>Educational level</i>								
Low	23.8	76.3	1.00 (ref.)	1.00 (ref.)	25.0	75.0	1.00 (ref.)	1.00 (ref.)
Medium	38.7	61.3	0.64 (0.34-1.20)	0.63 (0.34-1.20)	41.5	58.5	0.63 (0.32-1.23)	0.62 (0.32-1.20)
High	32.8	67.2	0.57 (0.25-1.26)	0.49 (0.21-1.12)	32.8	67.2	0.53 (0.23-1.25)	0.60 (0.25-1.43)
<i>Professional profile</i>								
Student	61.5	38.5	1.00 (ref.)	1.00 (ref.)	65.4	34.6	1.00 (ref.)	1.00 (ref.)
Unemployed	36.2	63.8	1.00 (0.19-1.88)	0.78 (0.25-2.40)	28.3	71.7	0.79 (0.23-2.67)	1.10 (0.33-3.66)
Employed	31.9	68.1	1.32 (0.55-3.16)	1.47 (0.59-3.62)	35.2	64.8	0.90 (0.36-2.24)	0.60 (0.25-1.43)
<i>Smoking habit</i>								
No	32.1	67.9	1.00 (ref.)	1.00 (ref.)	36.0	64.0	1.00 (ref.)	1.00 (ref.)
Yes	40.6	59.4	0.84 (0.51-1.38)	0.77 (0.45-1.30)	37.7	62.3	1.29 (0.76-2.21)	1.19 (0.68-2.06)
<i>Alcohol consumption</i>								
No	33.3	66.7	1.00 (ref.)	1.00 (ref.)	34.7	65.3	1.00 (ref.)	1.00 (ref.)
Yes	34.8	65.2	0.97 (0.55-1.74)	1.04 (0.57-1.90)	36.9	63.1	0.96 (0.52-1.77)	1.06 (0.56-2.00)
<i>PA level</i>								
Low	29.7	70.3	1.00 (ref.)	1.00 (ref.)	28.7	71.3	1.00 (ref.)	1.00 (ref.)
Medium	34.5	65.5	0.86 (0.50-1.50)	0.86 (0.49-1.51)	30.1	69.9	1.09 (0.60-1.98)	1.08 (0.60-1.96)
High	44.2	55.8	0.85 (0.48-1.53)	0.76 (0.42-1.38)	60.5	39.5	0.42 (0.22-0.77)**	0.37 (0.20-0.68)**

BMI: body mass index; WHT<sub>r</sub>: waist-to-height ratio; OR: odds ratio; CI: confidence interval; PA: physical activity.

<sup>1</sup>Univariate analysis (logistic regression analysis considering the effect of one explanatory variable). \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

<sup>2</sup>Multivariate analyses (multiple logistic regressions considering the simultaneous effect of all the explanatory variables). \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

obesity at Argentinian national level was rising according to the age (17.9% and 3.9% at 18 to 24y to 41.7% and 22.8% at 60 to 64y, overweight and obesity respectively) (11).

In Argentina, previous studies have seen that among women, higher education was associated with better risk factor profiles for non-communicable diseases in all areas and more strongly in more urban than in less urban areas (19). Rosario is an urban city, according to the last census in Rosario live 1193605 inhabitants, and 739025 are 20 to 69 year old adults (12), becoming the third city with most population in Argentina. The NSRF (17) showed that

obesity were the most prevalent in women with low educational level. Between 2005 and 2009, the prevalence of obesity in women with low education increased 7.5 points (23.6% in 2005 to 31.1% in 2009) while in high education just increased 1.7 points (10.1% to 11.8%). However, in men the increase of obesity was around 4 points in all educational levels (20). In Latin America women with higher levels of education showed the lowest levels of obesity (21-24). Maternal overweight and obesity are associated with maternal morbidity, preterm birth, and increased infant mortality (25). Prevalence of overweight (BMI  $\geq 25$  kg/m<sup>2</sup>) and obesity (BMI  $\geq 30$  kg/m<sup>2</sup>)

**Table IV. Socio-demographic and lifestyle characteristics among women classified as overweight/obesity (BMI ≥ 25 kg/m<sup>2</sup>) and abdominal-obese (WHtR ≥ 0.5)<sup>1,2</sup>**

	Overweight/obesity				Abdominal-obesity			
	BMI < 25 kg/m <sup>2</sup>	BMI ≥ 25 kg/m <sup>2</sup>	Age-adjusted OR <sup>1</sup> (95% CI)	Additionally-adjusted OR <sup>2</sup> (95% CI)	WHtR < 0.5	WHtR ≥ 0.5	Age-adjusted OR <sup>1</sup> (95% CI)	Additionally-adjusted OR <sup>2</sup> (95% CI)
<i>Age group</i>								
18-30 years-old	69.6	30.4	1.00 (ref.)	1.00 (ref.)	69.9	30.1	1.00 (ref.)	1.00 (ref.)
31-50 years-old	39.7	60.3	3.48 (2.48-4.87)***	2.29 (1.49-3.52)***	37.2	62.8	3.92 (2.79-5.50)***	2.40 (1.53-3.76)***
51-70 years-old	26.3	73.7	6.43 (4.38-9.43)***	4.34 (2.67-7.06)***	17.7	82.3	10.82 (7.09-16.51)***	7.00 (4.10-11.97)***
<i>Marital status</i>								
Single	67.0	33.0	1.00 (ref.)	1.00 (ref.)	68.6	31.4	1.00 (ref.)	1.00 (ref.)
Married/coupled	38.5	61.5	1.75 (1.23-2.50)**	1.49 (0.99-2.24)	33.0	67.0	2.14 (1.49-3.09)***	2.02 (1.32-3.09)**
Unmarried/divorced/ widowed	32.6	67.4	1.25 (0.68-2.27)	1.32 (0.71-2.45)	27.2	72.8	1.30 (0.69-2.46)	1.49 (0.77-2.89)
<i>Living with children</i>								
None	60.8	39.2	1.00 (ref.)	1.00 (ref.)	59.3	40.7	1.00 (ref.)	1.00 (ref.)
At least one child at home	34.2	65.8	1.98 (1.45-2.71)***	1.32 (0.90-1.92)	29.6	70.4	2.08 (1.50-2.88)***	1.21 (0.81-1.82)
<i>Educational level</i>								
Low	25.0	75.0	1.00 (ref.)	1.00 (ref.)	18.7	81.3	1.00 (ref.)	1.00 (ref.)
Medium	54.4	45.6	0.31 (0.21-0.45)***	0.35 (0.24-0.53)***	52.1	47.9	0.22 (0.14-0.33)***	0.26 (0.17-0.42)***
High	64.9	35.1	0.17 (0.10-0.29)***	0.19 (0.11-0.33)***	65.8	34.2	0.10 (0.05-0.17)***	0.11 (0.06-0.20)***
<i>Professional profile</i>								
Student	69.5	30.5	1.00 (ref.)	1.00 (ref.)	70.5	29.5	1.00 (ref.)	1.00 (ref.)
Unemployed	33.8	66.2	1.53 (0.85-2.73)	1.12 (0.60-2.07)	26.2	73.8	1.94 (1.07-3.53)*	1.34 (0.70-2.58)
Employed	50.3	49.7	1.06 (0.64-1.76)	1.17 (0.68-2.04)	48.6	51.4	0.98 (0.58-1.65)	1.32 (0.74-2.36)
<i>Smoking habit</i>								
No	47.0	53.0	1.00 (ref.)	1.00 (ref.)	43.3	56.7	1.00 (ref.)	1.00 (ref.)
Yes	51.4	48.6	0.93 (0.67-1.31)	0.79 (0.55-1.12)	51.0	49.0	0.80 (0.57-1.14)	0.63 (0.43-0.92)*
<i>Alcohol consumption</i>								
No	33.3	66.7	1.00 (ref.)	1.00 (ref.)	37.5	62.5	1.00 (ref.)	1.00 (ref.)
Yes	34.8	65.2	0.74 (0.54-1.00)	0.94 (0.68-1.30)	49.9	50.1	0.64 (0.46-0.88)**	0.92 (0.65-1.30)
<i>PA level</i>								
Low	48.2	51.8	1.00 (ref.)	1.00 (ref.)	46.5	53.5	1.00 (ref.)	1.00 (ref.)
Medium	46.3	53.7	1.07 (0.77-1.49)	1.07 (0.76-1.50)	38.3	61.7	1.48 (1.05-2.09)*	1.51 (1.05-2.18)*
High	52.3	47.7	1.06 (0.68-1.66)	1.28 (0.79-2.06)	57.0	43.0	0.82 (0.52-1.31)	1.01 (0.61-1.67)

BMI: body mass index; WHtR: waist-to-height ratio; OR: odds ratio; CI: confidence interval; PA: physical activity.

<sup>1</sup>Univariate analysis (logistic regression analysis considering the effect of one explanatory variable). \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

has been rising in all regions, together reaching more than 70% in the Americas and the Caribbean and more than 40% in Africa by 2008 (26,27), but Americas showed the highest proportion of overweight and obese women (25).

It is well recognized that WHtR is a good predictor for morbidity and mortality (28). Even though BMI is commonly used as a measure of overall adiposity and classify risk level to various chronic illnesses (29,32), growing evidence suggests that a central (abdominal) fat distribution pattern, evidenced by a higher waist circumference or WHtR, might be a better measure of risk (33-41). Growing and strong evidence supports the use of the WHtR as a more sensitive measurement than BMI as an early warning of

health risks (42-44) and it could be more closely associated with central obesity than BMI (45) and even better than waist circumference by the adjustment to different statures (46,47). The risk level in the current study was rated to WHtR ≥ 0.50, according this cut off point the prevalence of abdominal obesity was 57.5%. The risk level across gender was also increased, with WHtR of 63.5% and 54.8% among men and women, respectively, with men to have more central obesity than women (p < 0.005). In Argentina, population-based studies which used WHtR to estimate central obesity were not found. In Bahia (Brazil) the observed prevalence was 65,3% among women and 44,5% in men (48), while in Florianópolis (Brasil) was 38,9% and 50,5%, respectively (49).

**Table V.** Socio-demographic and lifestyle characteristics among adult population classified as short stature (< p10)<sup>1,2</sup>

	Men				Women			
	Height < p10	Height ≥ p10	Age-adjusted OR <sup>1</sup> (95% CI)	Additionally-adjusted OR <sup>2</sup> (95% CI)	Height < p10	Height ≥ p10	Age-adjusted OR <sup>1</sup> (95% CI)	Additionally-adjusted OR <sup>2</sup> (95% CI)
<i>Age group</i>								
18-30 years-old	7.1	92.9	1.00 (ref.)	1.00 (ref.)	9.7	90.3	1.00 (ref.)	1.00 (ref.)
31-50 years-old	6.8	93.2	0.94 (0.37-2.40)	1.09 (0.33-3.64)	17.3	82.7	1.95 (1.21-3.14)**	1.56 (0.85-2.87)
51-70 years-old	12.2	87.8	1.81 (0.75-4.38)	1.36 (0.37-4.99)	25.3	74.7	3.15 (1.96-5.07)***	2.01 (1.06-3.81)*
<i>Marital status</i>								
Single	8.6	91.4	1.00 (ref.)	1.00 (ref.)	12.1	87.9	1.00 (ref.)	1.00 (ref.)
Married/coupled	7.7	92.3	0.52 (0.20-1.38)	0.38 (0.11-1.31)	17.5	82.5	1.00 (0.62-1.62)	0.91 (0.53-1.56)
Unmarried/divorced/widowed	12.5	87.5	0.78 (0.17-3.56)	0.72 (0.13-3.94)	25.0	75.0	1.12 (0.56-2.26)	1.22 (0.59-2.51)
<i>Living with children</i>								
None	8.9	91.1	1.00 (ref.)	1.00 (ref.)	18.6	81.4	1.00 (ref.)	1.00 (ref.)
At least one child at home	8.1	91.9	0.93 (0.42-2.06)	1.84 (0.63-5.35)	14.4	85.6	1.04 (0.71-1.54)	0.76 (0.48-1.20)
<i>Educational level</i>								
Low	15.0	85.0	1.00 (ref.)	1.00 (ref.)	23.1	76.9	1.00 (ref.)	1.00 (ref.)
Medium	7.4	92.6	0.50 (0.22-1.12)	0.47 (0.20-1.11)	14.7	85.3	0.66 (0.44-0.99)*	0.73 (0.46-1.15)
High	3.3	96.7	0.20 (0.04-0.91)*	0.26 (0.05-1.28)	10.8	89.2	0.44 (0.22-0.87)*	0.57 (0.27-1.21)
<i>Professional profile</i>								
Student	7.7	92.3	1.00 (ref.)	1.00 (ref.)	9.5	90.5	1.00 (ref.)	1.00 (ref.)
Unemployed	19.1	80.9	2.14 (0.36-12.70)	2.66 (0.43-16.45)	19.0	81.0	1.04 (0.44-2.45)	0.94 (0.38-2.29)
Employed	6.7	93.3	0.72 (0.15-3.52)	1.10 (0.20-5.98)	16.6	83.4	1.16 (0.54-2.50)	1.30 (0.57-2.97)
<i>Smoking habit</i>								
No	8.7	91.3	1.00 (ref.)	1.00 (ref.)	8.7	91.3	1.00 (ref.)	1.00 (ref.)
Yes	7.5	92.5	0.93 (0.40-2.18)	1.03 (0.42-2.55)	7.5	92.5	1.02 (0.66-1.58)	1.08 (0.69-1.70)
<i>Alcohol consumption</i>								
No	12.0	88.0	1.00 (ref.)	1.00 (ref.)	20.9	79.1	1.00 (ref.)	1.00 (ref.)
Yes	7.4	92.6	0.59 (0.26-1.35)	0.66 (0.27-1.56)	13.7	86.3	0.64 (0.44-0.93)*	0.70 (0.47-1.04)
<i>PA level</i>								
Low	8.7	91.3	1.00 (ref.)	1.00 (ref.)	19.4	80.6	1.00 (ref.)	1.00 (ref.)
Medium	11.5	88.5	1.38 (0.63-3.03)	1.12 (0.48-2.62)	13.8	86.2	0.65 (0.43-0.99)*	0.60 (0.38-0.92)*
High	3.5	96.5	0.43 (0.12-1.56)	0.39 (0.10-1.48)	10.3	89.7	0.54 (0.28-1.06)	0.57 (0.29-1.14)
<i>BMI (kg/m<sup>2</sup>)</i>								
< 25	7.0	93.0	1.00 (ref.)	1.00 (ref.)	10.9	89.1	1.00 (ref.)	1.00 (ref.)
≥ 25	9.1	90.9	1.08 (0.46-2.56)	0.98 (0.28-3.43)	21.5	78.5	1.74 (1.14-2.64)*	0.85 (0.47-1.53)
<i>WHtR</i>								
< 0.5	5.9	94.1	1.00 (ref.)	1.00 (ref.)	8.4	91.6	1.00 (ref.)	1.00 (ref.)
≥ 0.5	9.8	90.2	1.40 (0.55-3.60)	1.35 (0.36-5.04)	22.8	77.2	2.53 (1.59-4.03)***	2.83 (1.47-5.46)**

BMI: body mass index; WHtR: waist-to-height ratio; PA: physical activity.

<sup>1</sup>Multivariate analysis (multiple logistic regression analysis considering the effect of one explanatory variable adjusted for age (continuous)). \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

<sup>2</sup>Multivariate analyses (multiple logistic regressions considering the simultaneous effect of all the explanatory variables). \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

In Chile the prevalence of WHtR among people of rural area was 57.6% in women and 51% in men (50), while in other Chilean study considering WHtR > 0.55, 55.6% of adult population were abdominally obese (51).

Women showed higher prevalence of short stature, although the prevalence decreases according to age increase, which could be related to better living conditions that those underwent by the Argentinian population in the past decades. In last five dec-



ades the life expectancy increased 11 years (65 years in 1960 and 76 years in 2012 in whole population, and from 68.2 years to 79.8 years in female (52)), and the mortality under 5 years dropped from 73.3 per 1000 in 1969 to 13.3 per 1000 in 2013 (52). The improvement of health care and health conditions has contributed to reduce the prevalence of short stature in women, which is in conjunction with the decrease of iron deficiency anaemia and hence the risk of death of the mother at delivery. Maternal short stature is a risk factor for caesarean delivery, and largely related to cephalopelvic disproportion (53). It is well known that maternal height influences offspring linear growth over the growing period, which includes genetic and non-genetic factors, including nutrition-related intergenerational influences on growth that prevent the attainment of genetic height potential in low- and middle-income countries (54-57).

Short stature was associated with overweight and abdominal obesity in women but not in men, several studies have shown that short adult stature, a marker for early undernutrition, is a risk factor for obesity among women, but not men (58-64).

## STRENGTHS AND LIMITATIONS OF THE STUDY

This is the first study that analyzes nutritional status and food habits of adult population of Rosario (Argentina). The main strength of the present study includes a large population-based sample that provides greater support for generalization, and take the sample in the six districts of the city ensures the inclusion of individuals of different geographical points. The use of anthropometric measurements in replacement of the self-report is other advantage of the present study. However, this article also has several limitations. First, the cross-sectional study design reduced the ability to show causality compared with longitudinal studies. Second, questionnaires have inherent limitations, mainly because they are subjective in nature.

## CONCLUSIONS

The current study was able to detect a high prevalence of overweight and obesity among adult population in Rosario, increasing the risk of many health conditions that may imply high health care expenses in the next future. Short stature, a marker for early undernutrition, was most prevalent among women than in men, with lower prevalence among younger women.

Argentina, like other countries in the region, is now in a post nutritional transition stage, with high prevalence of overweight and obesity. Then, the nutrition policy, which has been successful in reducing undernutrition in the past decades, now it should be focused in to decrease the prevalence of obesity with integral strategies which should include nutrition in early life and during reproductive age, as well to promote physical activity, food and nutrition education, and industry and marketing food regulation.

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