

This article was downloaded by: [Professor José Fernando Moraes]

On: 22 April 2014, At: 11:42

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



## International Journal of Health Promotion and Education

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/rhpe20>

### Semester and shift of study are associated with waist circumference, waist-to-height ratio, and body mass index in Brazilian college students

José Fernando Vila Nova de Moraes<sup>ab</sup>, Marcelo Pereira Magalhães de Sales<sup>a</sup>, Ricardo Yukio Asano<sup>ac</sup>, Sérgio Rodrigues Moreira<sup>b</sup>, Ferdinando Oliveira Carvalho<sup>b</sup> & Carmen Sílvia Grubert Campbell<sup>a</sup>

<sup>a</sup> Graduate Program in Physical Education, Catholic University of Brasília (UCB), Brasília, DF, Brazil

<sup>b</sup> College of Physical Education, Federal University of Vale do São Francisco (UNIVASF), Av. José de Sá Maniçoba, s/n, Centro, 56304-205 Petrolina, PE, Brazil

<sup>c</sup> Department of Physical Education, UNIRG University Centre, Gurupi, TO, Brazil

Published online: 22 Apr 2014.

To cite this article: José Fernando Vila Nova de Moraes, Marcelo Pereira Magalhães de Sales, Ricardo Yukio Asano, Sérgio Rodrigues Moreira, Ferdinando Oliveira Carvalho & Carmen Sílvia Grubert Campbell (2014): Semester and shift of study are associated with waist circumference, waist-to-height ratio, and body mass index in Brazilian college students, *International Journal of Health Promotion and Education*, DOI: [10.1080/14635240.2014.906966](https://doi.org/10.1080/14635240.2014.906966)

To link to this article: <http://dx.doi.org/10.1080/14635240.2014.906966>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims,

proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

## Semester and shift of study are associated with waist circumference, waist-to-height ratio, and body mass index in Brazilian college students

José Fernando Vila Nova de Moraes<sup>a,b\*</sup>, Marcelo Pereira Magalhães de Sales<sup>a</sup>, Ricardo Yukio Asano<sup>a,c</sup>, Sérgio Rodrigues Moreira<sup>b</sup>, Ferdinando Oliveira Carvalho<sup>b</sup> and Carmen Sílvia Grubert Campbell<sup>a</sup>

<sup>a</sup>Graduate Program in Physical Education, Catholic University of Brasília (UCB), Brasília, DF, Brazil; <sup>b</sup>College of Physical Education, Federal University of Vale do São Francisco (UNIVASF), Av. José de Sá Maniçoba, s/n, Centro, 56304-205 Petrolina, PE, Brazil; <sup>c</sup>Department of Physical Education, UNIRG University Centre, Gurupi, TO, Brazil

(Received 22 January 2013; accepted 18 September 2013)

The present study aimed to compare body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHR) in college students of different shifts and semesters. To do so, 208 college students (96 women and 112 men) had their body mass, stature, and WC measured in order to calculate BMI and WHr. The volunteers also answered a questionnaire related to which shift of study and semester they attended. The students who studied at night, when compared to the ones that attended day classes, showed higher BMI, WC, and WHr. Students at the end of college had higher BMI and WHr when compared to students beginning college and had higher WC than those in beginning and in the middle of college. The present study's results suggest that students studying in night shift and closer to finishing college present higher BMI, WC, and WHr when compared with those studying during day time and in the initial semesters of college. Possible factors that support our findings involve the decrease in physical activity due to lack of leisure time, appropriate facilities, and motivation to exercise, and changes in feeding habits and the accumulation of work and study hours.

**Keywords:** college education; students; body mass index; waist circumference; waist-to-height ratio

### Introduction

The prevalence of overweight and obesity has increased throughout the last decades in several countries, including Brazil. According to the last research on Family Budget, performed by the Brazilian Institute of Geography and Statistics in 2008–2009, the prevalence of overweight in adults almost tripled in men (from 18.5% to 50.1%) and practically doubled in women (from 28.7% to 48.0%) since 1974. In the same period of time, the prevalence of obesity increased from 2.8% to 12.4% in men, and from 8.0% to 16.9% in women (Brasil 2010).

Several studies have associated excessive weight with the development of cardiovascular diseases, such as type-2 diabetes *mellitus*, hypertension, dyslipidemia, among others (Wongmekiat 2010; Farag and Gaballa 2011; Horwich and Fonarow 2010; Grundy 2004, Hall et al. 2010). Cardiovascular diseases are the main cause of death nowadays, and its risk factors (hypertension, high triglycerides and low density lipoprotein (LDL)-cholesterol, and low high density lipoprotein (HDL)-cholesterol) are strongly

---

\*Corresponding author. Email: [josefernando.moraes@univasf.edu.br](mailto:josefernando.moraes@univasf.edu.br)

related to excessive weight (Lakka et al. 2002). In addition, such diseases are responsible for 31% of the total of deaths from known causes in Brazil (Brasil 2005).

Easily applicable and low cost indicators with the purpose of screening for excessive weight, such as body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHR) have been widely used by researchers. Moreover, several studies have demonstrated associations between increased values of these indicators and the development of cardiovascular diseases in adults (Flint et al. 2010; Katzmarzyk et al. 2006; Årnlöv et al. 2010; Park et al. 2010; Pitanga and Lessa 2006; Haun, Pitanga, and Lessa 2009; Rodrigues, Baldo, and Mill 2010) and adolescents (Beck, Lopes, and Pitanga 2011; Guimarães, Smolarek, and Campos 2010).

Another anthropometric commonly used when referring to body composition in adults is body fat percentage (Pollock and Jackson 1984). However, in the present study, it was not possible to evaluate this variable since the students were approached and invited to participate in the study at the College's main hall. Therefore, the lack of an appropriate environment to perform such measurements precluded its use.

Admitting to college, for instance, is a moment of transition in one's life that can lead to changes in daily habits, such as physical activity, eating habits, duration of sleep, among others (Butler et al. 2004). Additionally, these changes have been associated with the risk factors mentioned earlier (Nahas, Goldfine, and Collins 2003). Moreover, the accumulation of study hours with working hours, common for night time students and those close to graduation, can result in a decrease of available time to engage in a physical exercise routine (Levitsky, Halbmaier, and Mrdjenovic 2004; Fisher et al. 2003; Pruitt and Springer 2010), placing those students at increased risk for excessive weight and cardiovascular disease.

Therefore, the aim of the present study was to compare body composition variables in college students attending to different semesters and study shifts, as well as to verify the degree of association between these variables in function of the different semesters attended.

## **Methods**

### ***Participants***

After signing an informed consent term, 208 college students (96 women and 112 men) from a private college in the city of Recife, state of Pernambuco – Brazil, participated in the study (Table 1). All procedures adopted were in accordance to law number 196/96 of the Brazilian National Health Council, which responds to ethical procedures in studies performed in humans.

### ***General procedures***

With the purpose of characterizing the volunteers in regard of their body fat, the variables measured were height (portable stadiometer with 0.1 cm precision), body mass (portable scale with 0.1 g precision), and WC (non-extendible measuring tape with 0.1 cm precision). All participants filled a registration form with data that included: age, sex, study shift (morning or night), and semester studied (from 1st to 10th). In order to perform the statistical procedures, the students were grouped in three different categories that referred to the semester they were attending, being *beginning of college* (from the 1st to the 3rd semester), *middle of college* (4th to 6th semester), and *end of college* (7th to 10th semester).

Table 1. Main characteristics of the evaluated students.

	Men (n = 112) Mean (SD)	Women (n = 96) Mean (SD)	Total (n = 208) Mean (SD)
Age (years)	24.80 (7.02)	24.43 (7.24)	24.63 (7.11)
Body mass (kg)	78.25 (12.42)*	58.50 (9.55)	69.13 (14.90)
Height (m)	1.76 (0.07)	1.63 (0.06)	1.70 (0.09)
Waist circumf. (cm)	88.84 (9.79)	78.70 (8.88)	84.14 (10.64)
BMI (kg/m <sup>2</sup> )	24.99 (3.33)	22.00 (3.23)	23.61 (3.60)
WHR	0.50 (0.05)	0.48 (0.05)	0.49 (0.06)
	Morning shift (%)	Night shift (%)	
Number of participants	31 (14.90%)	175 (81.13%)	
	Beginning of college (%)	Middle of college (%)	End of college (%)
Number of participants	108 (51.92%)	69 (33.17%)	18 (8.65%)

Notes: Waist circumf., waist circumference; BMI, body mass index; WHr, waist-to-height ratio. \* $p \leq 0.05$  to women.

Only the time spent in classroom was considered for this study. The students who studied during the morning shift attended classes from 8:00 to 12:00, while the ones from the night shift were in the classroom from 18:50 until 22:10. Usually, the first academic semester of the year in Brazil starts in February and goes until the end of June, whereas the second academic semester starts in August and ends in the beginning of December. Lastly, most college students in Brazil take between 8 and 10 semesters to graduate.

### Body composition measurements

Height was measured with the volunteer on a standing position and barefoot, with the ankles, calves, buttocks, scapula, and head leaning on the wall. The position of the head accompanied Frankfurt's plan, and stature was measured at the moment of inhaling air.

Body mass was measured while the participants wore light clothes. BMI was calculated as weight (kg)/height (m<sup>2</sup>). Overweight and obesity were defined according to the reference values adopted by the World Health Organization (WHO 2000). WC was measured at the point between the last rib and the iliac crest. The values used as cut-points were WC higher than or equal to 102 cm for men, and higher than or equal to 88 cm for women (NCEP 2001).

WHR was measured as waist (cm)/height (cm). Several studies indicate WHr as a better predictor of metabolic risk when compared to waist-to-hip ratio, BMI, WC, and skinfold thickness (Hsieh et al. 2000; Hsieh and Yoshinaga 1995; Hsia et al. 2001).

### Statistics

The normality of the data was tested using skewness and kurtosis tests, and all body composition variables (BMI, WC, and WHr) were considered normal. Independent Student's *t*-test was performed in order to compare BMI, WC, and WHr values between the morning shift and night shift students. Independent one-way ANOVA with Tukey's *post hoc* was also performed to compare and detect the differences between the variables and the stages of college (*beginning*, *middle*, and *end*).

Homogeneity of Variance was calculated through Levene's Test for Equality of Variance, showing no statistical difference. The effect size was tested through Cohen's *d*

(Cohen 1992) and eta squared ( $\eta^2$ ) for the Independent Student's *t*-test and ANOVA, respectively. Power was calculated using G\*Power 3.0.10®, showing values of 0.87 for Student's *t*-test and 0.99 for ANOVA. The level of significance adopted was  $p \leq 0.05$  and the software used for analysis was the SPSS 15.0 (SPSS Inc., Chicago, IL, USA).

## Results

Table 1 shows the main characteristics of the study's participants. Night shift students represented 81.13% of the sample. Regarding the stage of college, 51.92% ( $n = 107$ ) were in the beginning of college, 33.17% ( $n = 69$ ) were at the middle, and 8.65% ( $n = 18$ ) attended the last semesters of college. BMI classification indicated that 26.4% ( $n = 55$ ) of the students were overweight and 5.8% ( $n = 12$ ) were obese. WC was increased in 14.4% ( $n = 30$ ) of the volunteers and WHr above the cut-point was identified in 25.4% ( $n = 53$ ) of the individuals. Comparisons between sex showed that men were heavier when compared to women [ $78.25 \pm 12.42$  vs.  $58.50 \pm 9.55$ ;  $t(206) = -12.69$ ;  $p = 0.000$ ].

Independent Student's *t*-test comparing study shift and WC, BMI and WHr showed significant differences in WC [ $78.40 \pm 9.21$  vs.  $85.20 \pm 10.52$ ;  $t(203) = -3.32$ ;  $p = 0.008$  ( $d = 0.69$ )], BMI [ $21.72 \pm 3.47$  vs.  $23.84 \pm 3.92$ ;  $t(204) = -3.29$ ;  $p = 0.001$  ( $d = 0.57$ )], and WHr [ $0.47 \pm 0.05$  vs.  $0.50 \pm 0.06$ ;  $t(203) = -3.22$ ;  $p = 0.001$  ( $d = 0.54$ )], as shown in Table 2. Levene's Test for Equality of Variance showed no statistically significant differences between groups ( $p = 0.13$  for WC;  $p = 0.24$  for BMI; and  $p = 0.24$  for WHr).

The independent one-way ANOVA with Tukey's *post hoc* between stages of college and BMI, WC, and WHr showed that students at the end of college presented significantly higher WC values when compared to the ones at the *beginning* and *middle* of college ( $82.04 \pm 9.42$  and  $84.78 \pm 11.51$  vs.  $91.41 \pm 12.52$ ;  $p = 0.002$  in both cases) [ $F(2,191) = 6.51$ ;  $p = 0.002$ ; ( $\eta^2 = 0.64$ )], and higher BMI and WHr than the students at the *beginning of college* ( $22.92 \pm 3.20$  vs.  $25.44 \pm 3.56$ ;  $p = 0.019$ ) [ $F(2,192) = 4.98$ ;  $p = 0.008$ ; ( $\eta^2 = 0.49$ )] and ( $0.48 \pm 0.05$  vs.  $0.52 \pm 0.06$ ;  $p = 0.018$ ) [ $F(2,191) = 5.13$ ;  $p = 0.007$  ( $\eta^2 = 0.51$ )], respectively (Figure 1). In addition, Levene's Test for Equality of Variance showed no statistical differences between groups ( $p = 0.13$  for WC;  $p = 0.06$  for BMI; and  $p = 0.13$  for WHr).

## Discussion

The main findings of the present study indicate that both the semester and shift of study seem to significantly influence body composition variables of college students. Night shift students showed higher BMI, WC, and WHr when compared to morning shift students (Table 2). Also, students at the *end of college* presented significantly higher values of BMI and WHr when compared to the ones at the *beginning of college*, and higher WC when compared to the ones at the *beginning* and *middle of college* (Figure 1).

Table 2. Differences between WC, BMI, and WHr and study shift.

	Morning ( $n = 31$ )	Night ( $n = 175$ )
WC (cm)	78.40 (9.21)	85.20 (10.52)*
BMI (kg/m <sup>2</sup> )	21.72 (3.47)	23.84 (3.92)*
WHR	0.47 (0.05)	0.50 (0.06)*

Notes: Values shown in mean (SD). \* $p \leq 0.05$  to morning shift.

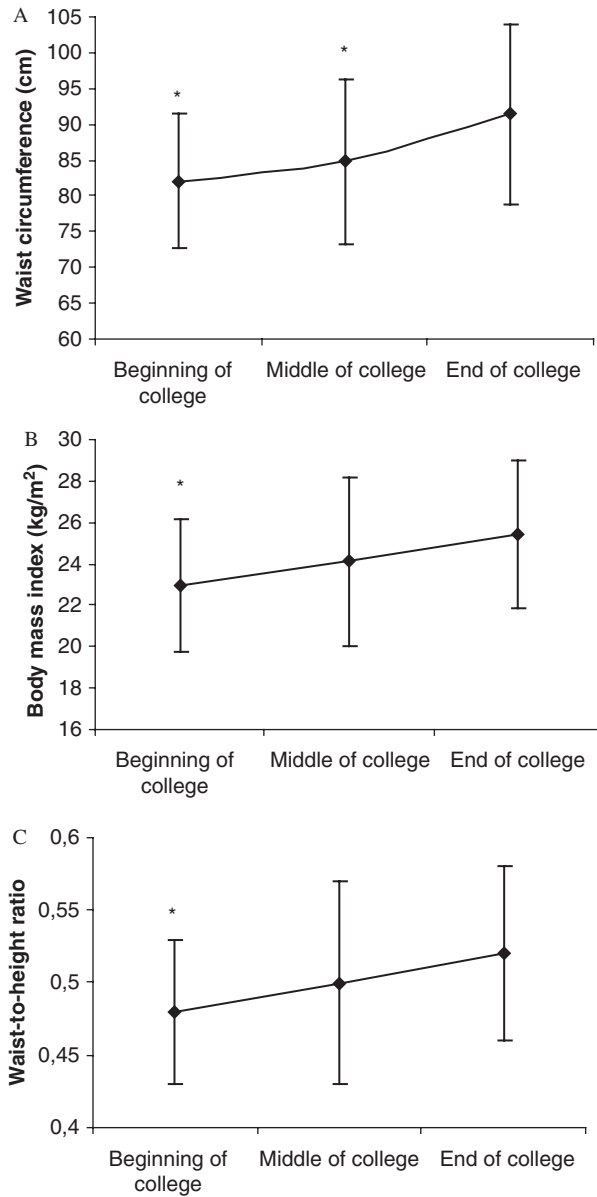


Figure 1. Mean values of WC (A), BMI (B), and WHr (C) according to the stage of college. \* $p < 0.05$  to end of college.

Several studies also showed this increase in body mass after enrollment in college, especially in the North-American population. Edmonds et al. (2008) reported an increase of 2.4 kg of body mass and 2.5 cm in WC during the first six months of college in female students. Butler et al. (2004), evaluating women in the first year of college, found significant increases in body mass, BMI, body fat, and a decrease in lean body mass. Hajhosseini et al. (2006) noticed a 3.0 kg increase in body mass and a 2.0% rise in body fat during the first 16 weeks of college in boys and girls. Hoffman et al. (2006) referred to a

3.1 kg gain in body weight during the first seven months of college among North-American students.

Anderson, Shapiro, and Lundgren (2003) detected an increase of 1.3 kg in body mass after the first two months and an augmentation of 2.6 kg at the end of the first semester of college in North-American students. Racette et al. (2005) found an increase of 4.0 kg in body mass after the first two years of college. Levitsky, Halbmaier, and Mrdjenovic (2004) reported a gain of approximately 2.0 kg in the first three months of recently enrolled college students. According to the authors, 47.0% of this increment was attributed to excessive ingestion of low nutritional value foods.

Wane, van Uffelen, and Brown (2010), in a review article, highlighted that the first year of college is one of the factors associated with an increase of body mass in women. In the present study, it was also possible to notice an increase in this variable in both men and women. Therefore, the impact of this increase during the first years of college can play an essential role in the development of obesity and its associated risk factors. In addition, the literature suggests that engaging in masters and doctorate programs can enhance the risks of developing cardiovascular diseases (Bara Filho et al. 2000).

Martins et al. (2010), evaluating Brazilian college students, found that 18.2% were overweight or obese, 10.3% had elevated WC, and 9.7% were hypertensive. Paixão, Dias, and Prado (2010) reported a prevalence of excessive weight that ranged from 5.25% to 14.63% in recently enrolled college students from the northeastern region of Brazil. According to Sacheck, Kuder, and Economos (2010), students who have more body fat also present augmented total cholesterol, LDL-cholesterol, and triglycerides. On the other hand, students more physically active show higher levels of HDL-cholesterol and decreased serum glucose.

Several factors can be associated with the decrease of physical activity after enrollment in college. According to Butler et al. (2004), the gain in body mass can be related to the decrease of physical activity due to lack of frequently participating in sports events. In addition, the reduction of free leisure time, motivation and encouragement from friends or family also appear as main factors related to body mass increase in this stage of life (Martins et al. 2010; Adbullah et al. 2005; Leslie et al. 1999; Irwin 2007).

Moreover, the decrease of physical activity can be associated to the distance from home to appropriated facilities (Sallis et al. 1990). According to Reed and Philips (2005), the intensity and duration of physical activity performed is associated to the proximity of home to this kind of facilities. In addition, the authors also state that there is an association between intensity, frequency, and duration of exercise and the amount of equipment available for this kind of activity near the student's house.

In the present study, we found that the students who attended the night shift and are closer to finish college presented higher BMI, WC, and WHr when compared to the ones studying during the morning and in the first semesters of college. According to Guedes, Santos, and Lopes (2006), the shift and semester of study have a strong impact in physical activity. This can be attributed to the accumulation of study and work hours, since the students attending the night shift and the ones closer to graduation usually work. Quadros et al. (2009) reported that night shift students have 70.0% more chances of having a sedentary lifestyle. Additionally, Pruitt and Springer (2010) stated that working 10 or more hours a week reflects in less physical activity.

In order to prevent the decrease of physical activity and healthy behavior in college students, health promotion programs can be implemented. According to Keating et al. (2005), three basic changes can be performed so this can happen, being: (1) changing current policies on the use of fitness centers and gymnasiums to provide students with the



opportunity for physical activity engagement; (2) providing extra health and fitness services to help students establish habitual physical activity patterns; and (3) changing physical education requirements to better educate students. This last aspect, in particular, is extremely important for Brazilian Universities, since students are not required to have physical education classes during graduation.

Possible limitations of the present study include (1) the utilization of BMI, WC, and WHr to characterize excessive body adiposity. Even though such parameters are not considered gold-standard methods to evaluate body composition, they have been widely used as possible predictors of the development of type-2 diabetes *mellitus*, hypertension, dyslipidemia, among others (Lin et al. 2002); (2) different group sizes for shift of study and stage of college, which could have an impact on the results shown; (3) the lack of information regarding social economic status, level of physical activity, and availability of exercising facilities close to home, which have been pointed as contributors to physical activity; and (4) the cross-sectional nature of our study. Therefore, it is recommended that studies involving the above cited variables be performed in order to better describe alterations in body composition during college.

## Conclusion

In summary, the present study concluded that students who studied in the night shift and were closer to finishing college presented higher BMI, WC, and WHr when compared to the ones that studied in the morning shift and were in the first semesters of college. Possible factors that support our findings involve the decrease in physical activity due to lack of leisure time, appropriate facilities and motivation to exercise, changes in feeding habits, and the accumulation of work and study hours.

## References

- Abdullah, A. S. M., C. M. Wong, H. K. Yam, and R. Fielding. 2005. "Factors Related to Non-Participation in Physical Activity Among the Students in Hong Kong." *International Journal of Sports Medicine* 26: 611–615.
- Anderson, D. A., J. R. Shapiro, and J. D. Lundgren. 2003. "The Freshman Year of College as a Critical Period for Weight Gain: An Initial Evaluation." *Eating Behavior* 4: 363–367.
- Ärnlov, J., E. Ingelsson, J. Sundström, and L. Lind. 2010. "Impact of Body Mass Index and the Metabolic Syndrome on the Risk of Cardiovascular Disease and Death in Middle-Aged Men." *Circulation* 121: 230–236.
- Bara Filho, M. G., S. Biesek, A. P. T. Fernandes, and C. G. S. Araújo. 2000. "Comparação do padrão de atividade física e peso corporal pregressos e atuais entre graduados e mestres em educação física." [Comparison between Previous and Actual Body Weight and Physical Activity Levels of Physical Education Undergraduates and Graduates.] *Revista Brasileira de Ciências do Esporte* 21 (2/3): 30–35.
- Beck, C. C., A. S. Lopes, and F. J. G. Pitanga. 2011. "Indicadores antropométricos como preditores da pressão arterial elevada em adolescentes." [Anthropometric Indicators as Predictors of High Blood Pressure in Adolescents.] *Arquivos Brasileiros de Cardiologia* 96 (2): 126–133.
- Brasil. 2005. *A vigilância, o controle e a prevenção das doenças crônicas não-transmissíveis: DCNT no contexto do Sistema Único de Saúde brasileiro* [Surveillance, Control and Prevention of Non-Transmissible Chronic Diseases: NTCD in the Context of the Brazilian Public Health System]. Brasília: Organização Pan-Americana da Saúde.
- Brasil. 2010. *Pesquisa de orçamentos familiares 2008–2009: antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil* [Family Budget Research 2008–2009: Anthropometry and Nutrition Status of Children, Adolescents and Adults in Brazil]. Rio de Janeiro: IBGE.

- Butler, S. M., D. R. Black, C. L. Blue, and R. J. Gretebeck. 2004. "Change in Diet, Physical Activity, and Body Weight in Female College Freshman." *American Journal of Health Behavior* 28 (1): 24–32.
- Cohen, J. 1992. "Quantitative Methods in Psychology: A Power Prime." *Psychological Bulletin* 112 (1): 155–159.
- Edmonds, M. J., K. J. Ferreira, E. A. Nikiforuk, A. K. Finnie, S. H. Leavey, A. M. Duncan, and J. A. R. Simpson. 2008. "Body Weight and Percent Body Fat Increase During the Transition from High School to University in Females." *Journal of the American Dietetic Association* 108: 1033–1037.
- Executive summary of the third report of the national cholesterol education program (NCEP). 2001. "Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)." *Journal of the American Medical Association* 285: 2486–2497.
- Farag, Y. M. K., and M. R. Gaballa. 2011. "Diabesity: An Overview of a Rising Epidemic." *Nephrology Dialysis Transplantation* 26 (1): 28–35.
- Fischer, F. M., D. C. Oliveira, M. C. T. V. Teixeira, and M. A. Amaral. 2003. "Efeito do trabalho sobre a saúde de adolescentes." [Effect of Work on Adolescent Health.] *Ciência & Saúde Coletiva* 8 (4): 973–984.
- Flint, A. J., K. M. Rexrode, F. B. Hu, R. J. Glynn, H. Caspard, J. E. Manson, W. C. Willett, and E. B. Rimm. 2010. "Body Mass Index, Waist Circumference, and Risk of Coronary Heart Disease: A Prospective Study Among Men and Women." *Obesity Research & Clinical Practice* 4: e171–e181.
- Grundy, S. M. 2004. "Obesity, Metabolic Syndrome, and Cardiovascular Disease." *Journal of Clinical Endocrinology & Metabolism* 89: 2595–2600.
- Guedes, D. P., C. A. Santos, and C. C. Lopes. 2006. "Estágios de mudança de comportamento e prática habitual de atividade física em universitários." [Stages of Behavior Change and Habitual Physical Activity in College Students.] *Revista Brasileira de Cineantropometria e Desempenho Humano* 8 (4): 5–15.
- Guimarães, R. F., A. C. Smolarek, and W. Campos. 2010. "Associação entre a cintura para estatura e as concentrações de glicemia e de colesterol de alta densidade em adolescentes." [Association between Waist-to-Height Ratio and Glucose and High Density Cholesterol Levels in Adolescents.] *EFDeportes revista digital*, ano15: n149.
- Hajhosseini, L., T. Holmes, P. Mohamadi, V. Goudarzi, L. McProud, and C. B. Hollenbeck. 2006. "Changes in Body Weight, Body Composition and Resting Metabolic Rate (RMR) in First-Year University Freshmen Students." *Journal of the American College of Nutrition* 25 (2): 123–127.
- Hall, J. E., A. A. Silva, J. M. Carmo, J. Dubinion, S. Hamza, S. Munusamy, G. Smith, and D. E. Stec. 2010. "Obesity-Induced Hypertension: Role of Sympathetic Nervous System, Leptin, and Melanocortins." *The Journal of Biological Chemistry* 285 (23): 17271–17276.
- Haun, D. R., F. J. G. Pitanga, and I. Lessa. 2009. "Razão Cintura/Estatura comparado a outros indicadores antropométricos de obesidade como preditor de risco coronariano elevado." [Waist-Height Ratio Compared to Other Indicators of Obesity as Predictors of High Coronary Risk.] *Revista da Associação Médica Brasileira* 55 (6): 705–711.
- Hoffman, D. J., P. Policastro, V. Quick, and S.-K. Lee. 2006. "Changes in Body Weight and Fat Mass of Men and Women in the First Year of College: A Study of the 'Freshman 15'." *Journal of American College Health* 55 (1): 41–45.
- Horwich, T. B., and G. C. Fonarow. 2010. "Glucose, Obesity, Metabolic Syndrome, and Diabetes – Relevance to Incidence of Heart Failure." *Journal of the American College of Cardiology* 55 (4): 283–293.
- Hsia, H. H., K. C. Huang, W. C. Lin, W. Y. Shau, and R. S. Lin. 2001. "Optimal Cut-Off Values for Obesity Using Simple Anthropometric Indexes to Predict Cardiovascular Risk Factors in Taiwan (First Asia-Oceania Conference on Obesity)." *Himankenkyu* 7: S79.
- Hsieh, S. D., H. Yoshinaga, T. Muto, Y. Sakurai, and K. Kosaka. 2000. "Health Risks Among Japanese Men with Moderate Body Mass Index." *International Journal of Obesity and Related Metabolic Disorders* 24: 358–362.
- Hsieh, S. D., and H. Yoshinaga. 1995. "Abdominal Fat Distribution and Coronary Heart Disease Risk Factors in Men – Waist/Height Ratio as a Simple and Useful Predictor." *International Journal of Obesity and Related Metabolic Disorders* 19: 585–589.
- Irwin, J. D. 2007. "The Prevalence of Physical Activity Maintenance in a Sample of University Students: A Longitudinal Study." *Journal of American College Health* 56 (1): 37–41.

- Katzmarzyk, P. T., I. Janssen, R. Ross, T. S. Church, and S. N. Blair. 2006. "The Importance of Waist Circumference in the Definition of Metabolic Syndrome." *Diabetes Care* 29: 404–409.
- Keating, X. D., J. Guan, J. C. Piñero, and D. M. Bridges. 2005. "A Meta-Analysis of College Students' Physical Activity Behaviors." *Journal of American College Health* 54 (2): 116–125.
- Lakka, H. M., D. E. Laaksonen, T. A. Lakka, L. K. Niskanen, E. Kumpusalo, J. Tuomilehto, and J. T. Salonen. 2002. "The Metabolic Syndrome and Total Cardiovascular Disease Mortality in Middle-Aged Men." *Journal of the American Medical Association* 288: 2709–2716.
- Leslie, E., N. Owen, J. Salmon, A. Bauman, J. F. Sallis, and S. K. Lo. 1999. "Insufficiently Active Australian College Students: Perceived Personal, Social, and Environmental Influences." *Preventive Medicine* 28: 20–27.
- Levitsky, D. A., C. A. Halbmaier, and G. Mrdjenovic. 2004. "The Freshman Weight Gain: A Model for the Study of the Epidemic of Obesity." *International Journal of Obesity* 28: 1435–1442.
- Lin, W. Y., L. T. Lee, C. Y. Chen, H. Lo, H. H. Hsia, I. L. Liu, R. S. Lin, W. Y. Shau, and K. C. Huang. 2002. "Optimal Cut-Off Values for Obesity: Using Simple Anthropometric Indices to Predict Cardiovascular Risk Factors in Taiwan." *International Journal of Obesity and Related Metabolic Disorders* 26 (9): 1232–1238.
- Martins, M. C. C., I. F. Ricarte, C. H. L. Rocha, R. B. Maia, V. B. Silva, A. B. Veras, and M. D. Souza Filho. 2010. "Pressão arterial, excesso de peso e nível de atividade física em estudantes de universidade pública." [Blood Pressure, Excess Weight and Level of Physical Activity in Students of a Public University.] *Arquivos Brasileiros de Cardiologia* 95 (2): 192–199.
- Nahas, M. V., B. Goldfine, and M. A. Collins. 2003. "Determinants of Physical Activity in Adolescents and Young Adults: The Basis for High School and College Physical Education to Promote Active Lifestyles." *Physical Educator* 60 (1): 42–56.
- Paixão, L. A., R. M. R. Dias, and W. L. Prado. 2010. "Estilo de vida e estado nutricional de universitários ingressantes em cursos da área de saúde do Recife/PE." [Lifestyle and Nutritional Status of University Students Studying in Health Care in Recife/PE.] *Revista Brasileira de Atividade Física e Saúde* 15 (3): 145–150.
- Park, S. B., J. E. Yun, A. Georgiades, J. A. Blumenthal, S. Y. Lee, and S. H. Jee. 2010. "Waist Circumference Predicting Cardiovascular Disease in Korean Men and Women." *Nature Precedings* (in press). <http://precedings.nature.com/documents/4609/version/1/files/npre20104609-1.pdf>
- Pitanga, F. J. G., and I. Lessa. 2006. "Razão cintura-estatura como discriminador do risco coronariano de adultos." [Waist-to-Height Ratio as a Coronary Risk Predictor Among Adults.] *Revista da Associação Médica Brasileira* 52: 157–161.
- Pollock, M. L., and A. S. Jackson. 1984. "Research Progress in Validation of Clinical Methods of Assessing Body Composition." *Medicine & Science in Sports & Exercise* 16 (6): 606–613.
- Pruitt, S. L., and A. E. Springer. 2010. "The Association of Employment and Physical Activity Among Black and White 10th and 12th Grade Students in the United States." *Journal of Physical Activity & Health* 7 (1): 26–36.
- Quadros, T. M. B., E. L. Petroski, D. A. Santos-Silva, and A. Pinheiro-Gordia. 2009. "The Prevalence of Physical Inactivity Amongst Brazilian University Students: Its Association with Sociodemographic Variables." *Revista de Salud Publica* 11 (5): 724–733.
- Racette, S. B., S. S. Deusinger, M. J. Strube, G. R. Highstein, and R. H. Deusinger. 2005. "Weight Changes, Exercise, and Dietary Patterns During Freshman and Sophomore Years of College." *Journal of American College Health* 53 (6): 245–251.
- Reed, J. A., and D. A. Phillips. 2005. "Relationships Between Physical Activity and the Proximity of Exercise Facilities and Home Exercise Equipment Used by Undergraduate University Students." *Journal of American College Health* 53 (6): 285–290.
- Rodrigues, S. L., M. P. Baldo, and J. G. Mill. 2010. "Associação entre a razão cintura-estatura e hipertensão e síndrome metabólica: Estudo de base populacional." [Association of Waist-Stature Ratio with Hypertension and Metabolic Syndrome: Population-Based Study.] *Arquivos Brasileiros de Cardiologia* 95 (2): 186–191.
- Sacheck, F. M., J. F. Kuder, and C. D. Economos. 2010. "Physical Fitness, Adiposity, and Metabolic Risk Factors in Young College Students." *Medicine & Science in Sports & Exercise* 42 (6): 1039–1044.
- Sallis, J. F., M. F. Hovell, C. R. Hofstetter, J. P. Elder, M. Hackley, C. J. Caspersen, and K. E. Powell. 1990. "Distance Between Homes and Exercise Facilities Related to Frequency of Exercise Among San Diego Residents." *Public Health Reports* 105 (2): 179–185.

- Wane, S., J. G. Z. van Uffelen, and W. Brown. 2010. "Determinants of Weight Gain in Young Women: A Review of Literature." *Journal of Women's Health* 19 (7): 1327–1340.
- WHO (World Health Organization). 2000. *Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation*, WHO Technical Report Series 894. Geneva: World Health Organization.
- Wongmekiat, O. 2010. "Insights into Mechanisms of Obesity-Induced Hypertension." *Chiang Mai Medical Journal* 40 (1): 43–51.