Dietary Patterns, Metabolic Markers and Subjective Sleep Measures in Resident Physicians

Maria Carliana Mota1, Daurea Abadia De-Souza2, Luana Thomazetto Rossato3, Catarina Mendes Silva3, Maria Bernadete Jeha Araújo4, Sérgio Tufik5, Marco Túlio de Mello6, and Cibele Aparecida Crispim1

1Post Graduate Program in Health Sciences, Faculty of Medicine, Federal University of Uberlândia, Minas Gerais, Brazil, 2Department of Internal Medicine, Faculty of Medicine, Federal University of Uberlândia, Minas Gerais, Brazil, 3Nutrition course, Faculty of Medicine, Federal University of Uberlândia, Minas Gerais, Brazil, 4Department of Pediatrics, Faculty of Medicine, Federal University of Uberlândia, Minas Gerais, Brazil, 5Department of Psychobiology, Sleep Institute, Federal University of São Paulo, São Paulo, Brazil, and 6Department of Psychobiology, Federal University of São Paulo, São Paulo, Brazil

Shiftwork is common in medical training and is necessary for 24-h hospital coverage. Shiftwork poses difficulties not only because of the loss of actual sleep hours but also because it can affect other factors related to lifestyle, such as food intake, physical activity level, and, therefore, metabolic patterns. However, few studies have investigated the nutritional and metabolic profiles of medical personnel receiving training who are participating in shiftwork. The aim of the present study was to identify the possible negative effects of food intake, anthropometric variables, and metabolic and sleep patterns of resident physicians and establish the differences between genders. The study included 72 resident physicians (52 women and 20 men) who underwent the following assessments: nutritional assessment (3-day dietary recall evaluated by the Adapted Healthy Eating Index), anthropometric variables (height, weight, body mass index, and waist circumference), fasting metabolism (lipids, cortisol, high-sensitivity C-reactive protein [hs-CRP], glucose, and insulin), physical activity level (Baecke questionnaire), sleep quality (Pittsburgh Sleep Quality Index; PSQI), and sleepiness (Epworth Sleepiness Scale; ESS). We observed a high frequency of residents who were overweight or obese (65% for men and 21% for women; p = 0.004). Men displayed significantly greater body mass index (BMI) values (p = 0.002) and self-reported weight gain after the beginning of residency (p = 0.008) than women. Poor diet was observed for both genders, including the low intake of vegetables and fruits and the high intake of sweets, saturated fat, cholesterol, and caffeine. The PSQI global scores indicated significant differences between genders (5.9 vs. 7.5 for women and men, respectively; p = 0.01). Women had significantly higher mean high-density lipoprotein cholesterol (HDL-C; p < 0.005), hs-CRP (p = 0.04), and cortisol (p = 0.009) values than men. The elevated prevalence of hypertriglyceridemia and abnormal values of low-density lipoprotein cholesterol (LDL-C; >100 mg/dL) were observed in most individuals. Higher than recommended hs-CRP levels were observed in 66% of the examined resident physicians. Based on current recommendations, a high prevalence of low sleep quality and excessive daytime sleepiness was identified. These observations indicate the need to monitor health status and develop actions to reassess the workload of medical residency and the need for permission to perform extra night shifts for medical residents to avoid worsening health problems in these individuals.

**Keywords:** Metabolic variables, nutrition, residency training, shiftwork, sleep

**INTRODUCTION**

Shiftwork is associated with a higher frequency of nutritional and metabolic disorders, such as insulin resistance (Padilha et al., 2010), diabetes mellitus (Di Lorenzo et al., 2003), dyslipidemia (Karlsson et al., 2003), metabolic syndrome (Li et al., 2011; Pietroiusti et al., 2010), obesity (Lennernäs et al., 1994; Macagnan et al., 2012; Van Amelootso et al., 1999), and altered nutritional metabolism (Esquirol et al., 2009; Tucker et al., 2012). In this context, some studies have indicated that the quality of food intake is significantly lowered by shiftwork (Crispim et al., 2011; de Assis et al., 2003; Esquirol et al., 2009; Geliebter et al., 2000; Pasqua & Moreno, 2004; Waterhouse et al., 1997, 2003). In addition, studies indicate that shiftwork is associated with the greater occurrence of snacking (de Assis et al., 2003). Shiftwork is common in medical training and is necessary for 24-h hospital coverage. Shiftwork poses difficulties not only because of the loss of actual sleep hours but also because it can affect other factors related to lifestyle, such as food intake, physical activity level, and, therefore, metabolic patterns. However, few studies have investigated the nutritional and metabolic profiles of medical personnel receiving training who are participating in shiftwork. The aim of the present study was to identify the possible negative effects of food intake, anthropometric variables, and metabolic and sleep patterns of resident physicians and establish the differences between genders. The study included 72 resident physicians (52 women and 20 men) who underwent the following assessments: nutritional assessment (3-day dietary recall evaluated by the Adapted Healthy Eating Index), anthropometric variables (height, weight, body mass index, and waist circumference), fasting metabolism (lipids, cortisol, high-sensitivity C-reactive protein [hs-CRP], glucose, and insulin), physical activity level (Baecke questionnaire), sleep quality (Pittsburgh Sleep Quality Index; PSQI), and sleepiness (Epworth Sleepiness Scale; ESS). We observed a high frequency of residents who were overweight or obese (65% for men and 21% for women; p = 0.004). Men displayed significantly greater body mass index (BMI) values (p = 0.002) and self-reported weight gain after the beginning of residency (p = 0.008) than women. Poor diet was observed for both genders, including the low intake of vegetables and fruits and the high intake of sweets, saturated fat, cholesterol, and caffeine. The PSQI global scores indicated significant differences between genders (5.9 vs. 7.5 for women and men, respectively; p = 0.01). Women had significantly higher mean high-density lipoprotein cholesterol (HDL-C; p < 0.005), hs-CRP (p = 0.04), and cortisol (p = 0.009) values than men. The elevated prevalence of hypertriglyceridemia and abnormal values of low-density lipoprotein cholesterol (LDL-C; >100 mg/dL) were observed in most individuals. Higher than recommended hs-CRP levels were observed in 66% of the examined resident physicians. Based on current recommendations, a high prevalence of low sleep quality and excessive daytime sleepiness was identified. These observations indicate the need to monitor health status and develop actions to reassess the workload of medical residency and the need for permission to perform extra night shifts for medical residents to avoid worsening health problems in these individuals.

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**Keywords:** Metabolic variables, nutrition, residency training, shiftwork, sleep
2003; Waterhouse et al., 2003), higher caloric intake (Akerstedt & Wright, 2009), and increased consumption of saturated fat and foods with a high glycemic index (Lennernäs et al., 1994).

Medical residency is a type of atypical shiftwork because the residents sometimes work successive shifts. For example, after working a night shift, a medical doctor tends to have a full shift the following day. Numerous studies have documented the adverse effects of resident physicians’ work patterns on their own safety and well-being, as well as on patient safety (Fletcher et al., 2005; Lefebvre, 2012; Veasey et al., 2002). Some evidence has pointed to significant damage to quality of life (Sangi-Haghpeykar et al., 2009; Wang et al., 2012) and sleep patterns (Howard et al., 2002; Papp et al., 2004; Stoller et al., 2005). However, the examination of the health of young medical doctors, especially the analysis of their food intake and metabolic patterns, has rarely been reported in the literature.

We hypothesized that physicians in residency programs have a poor diet, along with anthropometric and metabolic abnormalities, in addition to sleep pattern problems. Thus, the aim of the present study was to identify the possible negative effects of residency shift-work on the food intake, anthropometric variables, and the metabolic and sleep patterns of resident physicians and establish the differences between genders.

MATERIALS AND METHODS

Participants and Ethics

All medical residents (n = 195) at the Clinical Hospital of the Federal University of Uberlândia, Minas Gerais, Brazil, were invited to participate in the study. Assessments were conducted from September 2011 to April 2012. The study volunteers were enrolled in medical residency program at the hospital, with a labor regime of 60 h per week, including a weekly 12-h shift. The residents in the study joined the residency program at least 7 mos prior to the start of the study. The study included 72 medical residents who self-reported as healthy (52 women and 20 men). The residents represented four specialties: internal medicine (n = 33), pediatrics (n = 18), obstetrics and gynecology (n = 14), and surgery (n = 7). The participants completed a sleep, nutritional, and metabolic assessment.

The recruitment method consisted of approaching directors to inform the residents of the hospital about the study and to invite all members of each medical specialty to participate. All participating sites obtained institutional review board approval and participants provided full, written informed consent. This study was approved by the Ethics Committee of the Federal University of Uberlândia (protocol number 480/10) and was conducted in accordance with the international ethical standards outlined in Portaluppi et al. (2010). The participants had the option to leave the study at any time.

Evaluations

Anthropometric Variables

Height and weight were measured, and body mass index (BMI; kg/m²) was calculated. Waist circumference was measured as the minimum girth between the iliac crest and lower costal margin. A BMI ≥25 kg/m² The and waist circumference (WC) >94 cm for men and >80 cm for women were considered abnormal (World Health Organization [WHO], 2000).

Food Intake Evaluation

Food intake was determined through a self-administered food diary that was kept over the course of three nonsuccessive days, including a day shift, a night shift, and a day off. The volunteers were instructed to provide as much detail as possible on the food and fluids consumed, including brand names and recipes for home-cooked foods. Portion sizes were estimated using common household measurements such as cups, glasses, bowls, teaspoons, and tablespoons, in addition to individual food items/units. The volunteers discussed their reported food intake with a qualified nutritionist, and the information was amended to include additional explanations and details, thus improving the accuracy of the information obtained. An analysis of the energy intake (EI) and nutrient intake was performed using Virtual Nutri version 1.0 software (University of São Paulo, Brazil, 1996). The cholesterol intake was adjusted per 1000 kcal of total energy intake (Willett et al., 1998).

The data were evaluated using the Adapted Healthy Eating Index (AHEI) (Mota et al., 2008). To this end, the reported foods were converted into portions according to the energy content of the food groups and the Adapted Food Pyramid (Philippi et al., 1999). The AHEI assesses 12 components of the diet. Eight components refer to the groups of the Adapted Food Pyramid. Three components refer to specific nutrients: total fat, saturated fat, and cholesterol. One component assesses diet variety. Each component receives a score ranging from 0 to 10 according to the adequacy of intake compared with the recommendation. As the intake becomes closer to the recommended amount, a higher score is given to the component. Intermediate scores were calculated proportionately. For example, if the recommended level of servings was 8 and an individual consumed 4 servings, the component score for the individual was 5 points. For the groups of the Adapted Food Pyramid, it was observed that the proper range with respect to cereals would be 5 to 9 servings; vegetables, 4 to 5 servings; fruits, 3 to 5 servings; meat and eggs, 1 to 2 servings; milk and dairy products, 2 to 3 servings; beans, 1 serving; oils and fats, 1 to 2 servings; and sugars, 1 to 2 servings. Fat intakes less than or equal to 30% of the total calories were assigned a score of 10 points. The score declined to 0 when the proportion of fat to total calories reached 45%. A score of 10 points was assigned to saturated fat intakes of less than 10%.
of total calories. Zero points were assigned when the saturated fat intake reached a level of 15% of the total calories. The maximum point value (10) for cholesterol was assigned when its intake was at a level of 300 mg or less. Zero point was assigned when intake reached a level of 450 mg or more. Intakes between 30% and 45% of fat to total calories, between 10% and 15% of saturated fat, and cholesterol between 300 and 450 mg were scored proportionately. For diet variety, a maximum score was assigned if seven items or more different food items were consumed over a 1-day period. A score of 0 was given if four or fewer different items were eaten. From the sum of all components, the diets were classified as follows: good quality (over 100 points), needs improvement (71–100 points), and poor quality (under 71 points) (Mota et al., 2008).

**Physical Activity**
Physical activity was assessed using the Baecke questionnaire (BQ) (Baecke et al., 1982). This questionnaire consists of 16 items, from which three indexes are calculated: the work index refers to physical activity at work; the sport index refers to sports participation during leisure time; and the leisure-time index refers to physical activity during leisure time, excluding sport activities. Each section has a maximum score of 5 points, with a maximum of 15 points for the total activity index. The total activity is the sum of the three indices.

**Sleep Variables**
Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). The PSQI includes 19 items and yields a score from 0 (good quality) to 21 (poor quality). A total sum greater than 5 indicates poor sleep quality. Sleep onset latency and sleep efficiency, defined as the actual sleep time divided by the time spent in bed, are also obtained using the PSQI (Buysse et al., 1989). Daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS), a widely used and reliable predictor of daytime sleepiness. The ESS is an eight-item, self-administered questionnaire that is designed to provide a measure of a subject’s propensity to fall asleep in a variety of situations. A total score of 8 indicated excessive sleepiness (Johns, 1991).

**Metabolic Evaluation**
Of the 72 resident physicians, 10 (4 men and 6 women) did not complete the metabolic evaluation. After 12 h of fasting, the serum glucose, insulin, lipid and lipoprotein (triglycerides, low-density lipoprotein cholesterol [LDL-C], high-density lipoprotein cholesterol [HDL-C], and total cholesterol [TC]), cortisol, and high-sensitivity C-reactive protein (hs-CRP) concentrations of the medical residents were determined. The collection of blood samples was performed by a nurse in the Clinical Analysis Laboratory of Clinical Hospital of Federal University of Uberlândia. The samples were centrifuged and frozen at –80°C for analysis in the Laboratory of Clinical Analysis of the Associação Fundo de Incentivo a Psicofarmacologia.

Serum triglyceride and cholesterol levels were measured using enzymatic assays. HDL-C and LDL-C were measured using direct immunoturbidimetric assays (Pars-Azmun, Tehran, Iran). The hs-CRP concentrations were measured using an automatic immunonephelometer with a sensitivity of 0.02 mg/dL (Behring NA latex CRP; Behring Institute, Dresden, Germany).

Blood glucose was determined via the glucose-oxidase method (Siemens, Chicago, IL, USA). Subject cortisol and insulin concentrations were measured using a commercial enzyme-linked immunosorbent assay (ELISA) kit (Siemens). Insulin resistance was estimated using the homeostasis model for the assessment of insulin resistance (HOMA-IR), using the following formula described by Matthews et al. (1985): fasting plasma insulin (μIU/L) × fasting plasma glucose (mmol/L) / 22.5.

The results of the metabolic evaluations for glucose, lipid, and lipoprotein were compared with the levels recommended by the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (NCEP ATP III, 2002). The hs-CRP, insulin, cortisol, and HOMA-IR values were compared with those recommended by the American Heart Association/Centers for Disease Control and Prevention (Pearson et al., 2003), Hodge et al. (1996), Arafah (2006), and Geloneze et al. (2009).

**Statistical Analysis**
Initially, we tested the normality of the data using the Kolmogorov-Smirnov test. The values are presented as the means and standard deviation. Student’s t test for independent samples was used in the comparisons between genders. Pearson’s chi-square test was used to compare proportion variables. Statistical tests with $p<0.05$ were accepted as significant. The data were analyzed using the Statistica 7.0 software (StatSoft, Tulsa, OK, USA).

**RESULTS**
The means of the sociodemographic, anthropometric, physical activity, sleep, and metabolic variables are shown in Table 1. Men reported greater weight gain after the beginning of residency and had significantly greater BMI. Men had a significantly higher mean total BQ score and sports index than the women ($p<0.05$). The mean sleep duration of both groups was 6.5 h per night and was significantly different between women and men (6.7 vs. 6.1 h, respectively; $p=0.03$). The mean PSQI global score was higher than 5 for both genders, which indicates poor-quality sleep, and there were significant differences between genders for these values (5.9 vs. 7.5 for women and men, respectively; $p=0.01$). Women had...
significantly higher mean HDL-C, hs-CRP, and cortisol values compared with men ($p < 0.01$).

The frequency (%) of nutritional, physical activity, and sleep pattern problems of the resident physicians is shown in Table 2. These results demonstrate that 33.4% of all volunteers were classified as overweight or obese (65% of men and 21% of women; $p = 0.0004$). When asked about weight gained after the start of residency, 58.3% reported an increase in body weight (63.5% and 45%, for women and men, respectively; $p = 0.04$). However, men reported more weight gain than women (6.4 vs. 4.0 kg, respectively; $p = 0.008$).

Figure 1 shows the frequency (%) of resident physicians with metabolic variable values above the recommended values. Men had a significantly higher prevalence of hypertriglyceridemia than women (25% vs. 6.5% for men and women, respectively; $p = 0.04$). No significant differences were observed in the frequency of total cholesterol, LDL-C, hs-CRP, and HOMA-IR values above the recommended levels. Only men had concentrations below the recommended levels for HDL-C (25%). Cortisol levels above the recommended levels were identified only among women (34.8%).

### TABLE 1. Anthropometric, physical activity, sleep, and metabolic variables of resident physicians according to gender.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All ($n = 72$)</th>
<th>Women ($n = 52$)</th>
<th>Men ($n = 20$)</th>
<th>$p^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anthropometric variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.9 ± 3.4</td>
<td>22.9 ± 3.4</td>
<td>25.6 ± 2.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Weight gain (kg)**</td>
<td>3.9 ± 2.2</td>
<td>4.0 ± 2.2</td>
<td>6.4 ± 3.8</td>
<td>0.008</td>
</tr>
<tr>
<td>Total BQ score</td>
<td>7.1 ± 1.0</td>
<td>7.0 ± 0.9</td>
<td>7.4 ± 1.0</td>
<td>0.04</td>
</tr>
<tr>
<td>Occupational index</td>
<td>3.0 ± 0.3</td>
<td>3.0 ± 0.3</td>
<td>3.1 ± 0.4</td>
<td>0.35</td>
</tr>
<tr>
<td>Sports index</td>
<td>1.9 ± 0.6</td>
<td>1.8 ± 0.6</td>
<td>2.2 ± 0.6</td>
<td>0.009</td>
</tr>
<tr>
<td>Leisure and locomotion index</td>
<td>2.1 ± 0.5</td>
<td>2.1 ± 0.5</td>
<td>2.2 ± 0.4</td>
<td>0.64</td>
</tr>
<tr>
<td><strong>Sleep variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleeping duration (hours)</td>
<td>6.5 ± 1.1</td>
<td>6.7 ± 1.1</td>
<td>6.1 ± 0.9</td>
<td>0.03</td>
</tr>
<tr>
<td>ESS</td>
<td>11.0 ± 3.9</td>
<td>11.1 ± 3.6</td>
<td>11.0 ± 1.6</td>
<td>0.94</td>
</tr>
<tr>
<td>PSQI</td>
<td>6.2 ± 2.5</td>
<td>5.9 ± 2.4</td>
<td>7.5 ± 2.2</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Metabolic variables</strong>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>89.0 ± 3.9</td>
<td>89.5 ± 7.4</td>
<td>87.8 ± 6.4</td>
<td>0.42</td>
</tr>
<tr>
<td>Cholesterol (mg/dL)</td>
<td>173.2 ± 12.0</td>
<td>173.0 ± 12.9</td>
<td>173.0 ± 30.4</td>
<td>0.92</td>
</tr>
<tr>
<td>HDL-C (mg/dL)</td>
<td>58.3 ± 13.6</td>
<td>62.6 ± 12.8</td>
<td>46.1 ± 6.9</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>LDL-C (mg/dL)</td>
<td>96.3 ± 29.4</td>
<td>92.8 ± 29.1</td>
<td>106.5 ± 28.4</td>
<td>0.10</td>
</tr>
<tr>
<td>Triglyceride (mg/dL)</td>
<td>93.4 ± 39.8</td>
<td>89.0 ± 37.0</td>
<td>105.9 ± 44.2</td>
<td>0.14</td>
</tr>
<tr>
<td>hs-CRP (µg/dL)</td>
<td>2.8 ± 0.4</td>
<td>3.4 ± 3.7</td>
<td>1.4 ± 0.8</td>
<td>0.037</td>
</tr>
<tr>
<td>Cortisol (µg/L)</td>
<td>17.7 ± 6.4</td>
<td>19.0 ± 6.7</td>
<td>14.3 ± 3.2</td>
<td>0.009</td>
</tr>
<tr>
<td>Insulin (µIU/L)</td>
<td>7.9 ± 4.3</td>
<td>7.9 ± 4.6</td>
<td>7.6 ± 3.3</td>
<td>0.78</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>1.7 ± 1.0</td>
<td>1.8 ± 1.1</td>
<td>1.6 ± 0.7</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Additional weekly working hours: hours worked beyond the time dedicated to medical residency.

WC = waist circumference; BMI = body mass index; ESS = Epworth Sleepiness Scale; PSQI = Pittsburgh Sleep Quality Index; BQ = Baecke questionnaire; LDL-C = low-density lipoprotein cholesterol; HDL-C = high-density lipoprotein cholesterol; hs-CRP = high-sensitivity C-reactive protein; HOMA-IR = homeostatic model assessment.

*Comparison using Student’s $t$ test ($p < 0.05$).
**After the beginning of residency.
***Women ($n = 46$), men ($n = 16$).

### TABLE 2. Frequency (%) of problems in the nutritional and sleep patterns among resident physicians according to gender.

<table>
<thead>
<tr>
<th>Problem</th>
<th>All ($n = 72$)</th>
<th>Women ($n = 52$)</th>
<th>Men ($n = 20$)</th>
<th>$p^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI &gt;25 kg/m²</td>
<td>33.4</td>
<td>21.1</td>
<td>65.0</td>
<td>0.0004</td>
</tr>
<tr>
<td>WC &gt;94 cm</td>
<td>33.3</td>
<td>36.5</td>
<td>35.0</td>
<td>0.88</td>
</tr>
<tr>
<td>Reported gaining weight**</td>
<td>58.3</td>
<td>63.5</td>
<td>45.0</td>
<td>0.04</td>
</tr>
<tr>
<td>Negative changes in eating habits**</td>
<td>80.5</td>
<td>82.7</td>
<td>75.0</td>
<td>0.46</td>
</tr>
<tr>
<td>Caffeine intake</td>
<td>56.9</td>
<td>55.7</td>
<td>60.0</td>
<td>0.74</td>
</tr>
<tr>
<td>(&gt;3 servings per day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHEI diet needing improvements</td>
<td>77.8</td>
<td>80.8</td>
<td>70.0</td>
<td>0.84</td>
</tr>
<tr>
<td>Diet of poor quality</td>
<td>15.3</td>
<td>13.5</td>
<td>20.0</td>
<td>0.68</td>
</tr>
<tr>
<td>ESS Mild</td>
<td>31.9</td>
<td>34.6</td>
<td>25.0</td>
<td>0.16</td>
</tr>
<tr>
<td>Moderate</td>
<td>38.9</td>
<td>36.5</td>
<td>45.0</td>
<td>0.86</td>
</tr>
<tr>
<td>Severe</td>
<td>12.5</td>
<td>13.5</td>
<td>10.0</td>
<td>0.27</td>
</tr>
<tr>
<td>PSQI had sleep</td>
<td>76.4</td>
<td>73.0</td>
<td>85.0</td>
<td>0.28</td>
</tr>
</tbody>
</table>

WC = waist circumference; BMI = Body mass index; ESS = Epworth Sleepiness Scale; PSQI = Pittsburgh Sleep Quality Index; AHEI = Adjusted Healthy Eating Index.

*Comparison using Pearson’s chi-square test ($p < 0.05$).
**Autoreported after the beginning of the residency.
***Women >80 cm and men >94 cm.
The energy, macronutrient and cholesterol intake of the resident physicians according to gender is shown in Table 3. Higher caloric intakes (2227.4 ± 727.5 vs. 1845.7 ± 713.2; \( p = 0.04 \)) were observed among men compared with women. Other nutritional variables were not significantly different between genders. No significant differences were observed in the energy, macronutrient, and cholesterol intake in for the day shift, night shift, and day-off periods.

Table 4 presents the analysis of food consumption according to the AHEI. The average overall score was 82.6, indicating a diet that “needs improvement.” Of the 12 components in the AHEI, all resident physicians received scores lower than 6 for 5 of the components (i.e., vegetables, fruits, beans, dairy, and saturated fat). Significant differences between genders were identified in some components of the AHEI. Scores for beans (5.3 and 7.2 for women and men, respectively; \( p = 0.02 \)) and dairy products (5.1 for women and 7.0 for men; \( p = 0.001 \)) were lower among women. Men presented lower cholesterol scores (9.4 and 7.5 for women and men, respectively; \( p = 0.002 \)) and oil scores (6.2 for men and 8.8 for women; \( p = 0.002 \)) compared with women \( (p<0.05) \). The AHEI scores for men and women resulted in the following classifications: 20% and 13.5% were classified as having a “poor quality” diet, respectively; 10% and 5.8% were classified as having a “good quality” diet, respectively; and 70% and 80.8% were classified as a “needs improvement” diet, respectively. These results were not significantly different between men and women.

**DISCUSSION**

The present study evaluated the nutritional, sleep, and metabolic patterns in resident physicians in a Brazilian...
TABLE 4. Components and global score for Adjusted Healthy Eating Index (AHEI) of resident physicians according to gender.

<table>
<thead>
<tr>
<th>Dietary component</th>
<th>All (n = 72)</th>
<th>Women (n = 52)</th>
<th>Men (n = 20)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals, breads and pasta</td>
<td>7.4 ± 2.3</td>
<td>7.4 ± 2.4</td>
<td>7.4 ± 2.1</td>
<td>0.91</td>
</tr>
<tr>
<td>Vegetables</td>
<td>4.8 ± 2.8</td>
<td>4.8 ± 3.0</td>
<td>5.0 ± 2.6</td>
<td>0.80</td>
</tr>
<tr>
<td>Fruits</td>
<td>4.8 ± 3.8</td>
<td>4.5 ± 3.7</td>
<td>5.5 ± 4.1</td>
<td>0.31</td>
</tr>
<tr>
<td>Beans</td>
<td>5.8 ± 3.2</td>
<td>5.3 ± 3.2</td>
<td>7.2 ± 2.9</td>
<td>0.02</td>
</tr>
<tr>
<td>Meat</td>
<td>9.1 ± 1.9</td>
<td>8.9 ± 2.0</td>
<td>9.6 ± 1.6</td>
<td>0.16</td>
</tr>
<tr>
<td>Dairy</td>
<td>5.6 ± 3.2</td>
<td>5.1 ± 3.0</td>
<td>7.0 ± 3.3</td>
<td>0.01</td>
</tr>
<tr>
<td>Oils</td>
<td>8.1 ± 3.3</td>
<td>8.8 ± 2.5</td>
<td>6.2 ± 4.2</td>
<td>0.002</td>
</tr>
<tr>
<td>Sweets</td>
<td>5.3 ± 4.1</td>
<td>5.4 ± 4.3</td>
<td>5.2 ± 3.8</td>
<td>0.90</td>
</tr>
<tr>
<td>Saturated fat</td>
<td>5.7 ± 3.8</td>
<td>5.9 ± 3.7</td>
<td>5.2 ± 4.1</td>
<td>0.54</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>8.8 ± 2.4</td>
<td>9.4 ± 1.6</td>
<td>7.5 ± 3.4</td>
<td>0.002</td>
</tr>
<tr>
<td>Total fat</td>
<td>6.8 ± 2.4</td>
<td>7.0 ± 2.4</td>
<td>6.2 ± 2.2</td>
<td>0.22</td>
</tr>
<tr>
<td>Diversity</td>
<td>10.0 ± 0.0</td>
<td>10.0 ± 0.0</td>
<td>10.0 ± 0.0</td>
<td>**</td>
</tr>
<tr>
<td>Overall score</td>
<td>82.6 ± 12.0</td>
<td>82.6 ± 11.4</td>
<td>82.4 ± 15.0</td>
<td>0.93</td>
</tr>
</tbody>
</table>

The AHEI assesses 12 components of the diet: 8 refer to the groups of the Adapted Food Pyramid (Philippi et al., 1999); 3 refer to specific nutrients: total fat, saturated fat, and cholesterol; and 1 assesses diet variety. Each component receives a score ranging from 0 to 10 according to the adequacy of intake compared with the recommendation; the closer the intake is to the recommended amount, the greater the score given to the component. Volunteers with consumption or intakes between the maximum and minimum ranges or amounts were assigned scores proportionately. From the sum of all components, diets are classified as follows: good quality (over 100 points), needs improvement (71–100 points), and poor quality (under 71 points) (Mota et al., 2008).

*Comparison using Student’s t test (p < 0.05).

**All volunteers received the maximum score for the “diversity” component.

hospital. A high proportion of inappropriate feeding practices, being overweight, inadequate sleep patterns, and metabolic abnormalities among the physicians evaluated was observed. These results confirmed our initial hypothesis that the residency program can lead to nutritional and metabolic problems, in addition to changes in sleep patterns. Despite their high educational level and although they address the health of the population, the medical residents assessed in the present study demonstrated they were not exempt from a lifestyle with health and nutritional effects that has been reported in developing countries. Undoubtedly, the effects of shiftwork, a type of work that is notoriously associated with nutritional problems, should also be considered in these results.

Despite the small number of men participating in the study, the results indicate that the prevalence of being overweight was higher among the residents (65%) than among the Brazilian population of the same gender and age group (46.3%) (Brazilian Institute of Geography and Statistics, 2010). For women, the prevalence observed in this study (21.1%) was lower than among the Brazilian female population of the same age (35.7%) (Brazilian Institute of Geography and Statistics, 2010). Population studies indicate that young women (<30 yrs) (Heitmann, 2000) with higher educational levels (more than 8 yrs) (Monteiro et al., 2001; Velásquez-Meléndez et al., 2004), characteristics also presented by women of this study, have a lower risk of obesity or being overweight. This lower risk can be explained by the expected associations between education level and access to diet and nutritional knowledge, concern with weight control, and standards of physical attractiveness (Monteiro et al., 2001). Importantly, the proportion of overweight individuals observed in this study was higher than observed in medical residents of the United States (Mihalopoulos & Berenson, 2008) (n = 56, 25% for the men) and France (Hage et al., 2010) (n = 109, 44.1% of men and 9.8% of women). We also observed a high proportion of individuals who reported gaining weight after starting residency (63.5% and 45% of women and men, respectively) (Table 2). The mean weight gain in this period was 6.1 and 4.0 kg for men and women, respectively. These results are concerning, especially considering that the individuals are young and the short period of time since they started their residency (mean of 1.72 yrs).

The negative influence of the residency period on eating behavior, as observed by the high intake of foods with high energy density and the low consumption of healthy foods among doctors, has also been identified in other studies of resident physicians (Perry & Osborne, 2003; Rye et al., 2012). In the present study, the AHEI analysis indicated that a minority of individuals had a good-quality diet (7%), and 80.5% of respondents reported negative changes in eating habits after the beginning of their residency. Unfortunately, negative effects on food behavior have been previously shown in shiftworkers (de Assis et al., 2003; Lennermåns et al., 1994; Waterhouse et al., 2003) and in resident physicians (Perry & Osborne, 2003). This behavior is partially justified by the need to change the time and place of meals to adapt to professional activities, which can often
predispose a worker to the consumption of fast and cold foods (Waterhouse et al., 1997, 2003). These adaptations can change the perceptions of satiety and appetite (Crispim et al., 2007), which may adversely modify shiftworker eating behavior.

The higher frequency of the excessive intake of foods and beverages containing caffeine observed in the present study has been reported in other studies as a strategy against excessive sleepiness in resident physicians (Papp et al., 2004; Stoller et al., 2005). Caffeine, when used in the early evening, increases alertness and improves psychomotor performance overnight mainly between 22:30 and 1:20 h and can be consumed in the later hours of a night shift (Akerstedt, 1995; Walsh et al., 1995). However, when ingested close to a worker’s rest period, this habit is especially detrimental to shiftworkers because the effect of caffeine lasts for a few hours and can cause sleep difficulties and worsen sleep quality (Barbalho et al., 2001). Although we did not assess the exact time of caffeine consumption by the residents in the present study, other evidence has demonstrated that consumption tends to occur throughout the day (Stoller et al., 2005).

The usual sleep duration observed in the present study was lower than the recommendation for adults (Chamorro et al., 2011), especially among men (6.1 h). In addition, the results obtained in the ESS and PSQI evaluations (Tables 1 and 2) demonstrated deteriorated sleep patterns. The mean values of PSQI assigned to both genders (5.88 for women and 7.00 for men; p = 0.08) were above the limits recommended by Buysse et al. (1989) (<5), indicating poor sleep quality. Furthermore, over 80% of the participants had some degree of excessive daytime sleepiness. These levels of sleepiness are much higher than in other studies (Papp et al., 2004; Rosen et al., 2004).

The excessive daytime sleepiness and/or a poor sleep quality identified in this study are in agreement with the results of other studies with medical residents. These problems are associated with fatigue and can have negative effects on multiple dimensions of resident professional lives, including learning and cognition, professionalism, and task performance (Lefebvre, 2012; Stoller et al., 2005; Veasey et al., 2002; Wang et al., 2012). In a sense, the problems related to the sleep habits of physicians can be considered more important than those observed for other professions because after working a night shift, for example, doctors tend to work the entire next day, whereas other types of shiftworkers are allowed a period of rest. This difference may partially explain the significant sleep habit problems observed in the present study and in other studies of medical residents (Carvallo et al., 2005; Papp et al., 2004).

The total BQ score and the sport index and leisure and locomotion index scores of residents were lower than those observed in other populations of the same age assessed using the same questionnaire (Iribarren et al., 2004; Santos et al., 2011). Perry & Osborne (2003) observed a significant reduction in the time spent exercising, with respect to the hours of exercise per day and days spent exercising per week, when comparing the frequencies reported before and after starting residency training. The fatigue resulting from the sleep deprivation and/or lack of time due to the work schedule may be related to the high rates of physical inactivity among physicians. Papp et al. (2004) indicated that the poor quality of sleep reported by more than 75% of medical residents can cause higher levels of fatigue and decreased predisposition to physical exercise. Moreover, the long work hours may directly reduce time for physical activity because it competes with other demands and perhaps indirectly via fatigue, making exercise less attractive (Fogelholm et al., 2007). These factors, in addition to inappropriate eating behavior, may have promoted the weight gain reported by the resident physicians in the present study.

The lipid profile revealed that men had lower average HDL-C (p < 0.005), and no inadequacies were observed in any woman with respect to this metabolic variable. A higher prevalence of lower HDL-C among men has also been identified in other studies (Lakka et al., 2002; Salori et al., 2007), including studies of medical residents (Gutgessell et al., 1997). There are several factors that contribute to low HDL-C, including elevated serum triglycerides, obesity, and being overweight (NCEP ATP III, 2002), which may explain the results presented in this study. The men also had a higher proportion of inappropriate values of total cholesterol and LDL-C (Figure 1), which is consistent with previous research on shiftworker populations (Di Lorenzo et al., 2003; Esquirol et al., 2009; Karlsson et al., 2003). The average levels of LDL-C among the men (106.5 mg/dL) were higher than recommended by the NCEP ATP III (2002). The prevalence of abnormal values of LDL-C was not significantly different between genders (Figure 1), but a high prevalence of LDL-C above the recommended levels (>100 mg/dL) was identified in this study in both genders (43%). This finding may be associated with the mean of cholesterol intake (Table 3) and percentage of total fat saturated, which were above the recommendations for both men and women (Table 4). According to the NCEP ATP III (2002), high intakes of saturated fatty acids and cholesterol directly raise LDL-C concentrations.

Cortisol is the major adaptive signaling regulator of stress. Research has shown that shiftworkers who have high levels of stress or increased workload often exhibit increased cortisol levels (De Vente et al., 2003). It is important to consider the deleterious effects of this long-term hormonal profile in young professionals. This metabolic response may reflect decreased efficacy of negative-feedback regulation of the hypothalamo-pituitary-adrenal (HPA) axis (Plat et al., 1999), which is associated with insulin resistance (Lehrke et al., 2008). The higher cortisol levels identified among women in
the present study were consistent with the findings of Nakajima et al. (2012), who studied emergency care providers. Richardsen & Burke (1991) postulated that higher cortisol levels among women were associated with a combined effect of gender and responsibility at home, which could raise the level of stress.

The level of hs-CRP has been widely used as an indicator of cardiovascular risk (Danesh et al., 1998, 2000; Puttonen et al., 2011). Poanta et al. (2010) identified 14% (16/118) of resident physicians with elevated levels of hs-CRP, a lower proportion than those identified in the present study (66.2%). The mean hs-CRP values were higher in women compared with men (3.4 ± 3.7 vs. 1.4 ± 0.8, respectively; \( p = 0.03 \)). Similar to the present study, Puttonen et al. (2011) observed higher hs-CRP levels in women who worked two shifts than in men. Based on these data, it can be suggested that women exposed to shiftwork may be at greater risk of developing cardiovascular disease. However, further studies on the association between hs-CRP levels and cardiovascular disease in shiftworkers should be performed.

In Brazil, the National Commission of Medical Residency is establishing a scheme to work 60 h a week, with one day off per week. However, it is permissible for the resident physicians to work at another institution. In this study, 62.5% of participants reported working elsewhere, with this work being conducted at night and/or on weekends. The average number of additional work hours added to the residency schedule results in a total of 75.9 and 80.5 h per week for women and men, respectively. The long and extended hours during on-call periods have been described as a time-honored tradition in most residency programs (Veasey et al., 2002). In other professions, extended working hours have been identified as a risk factor for sleep disorders, weight gain, and the development of obesity (Di Milia & Mummery, 2009). Another point to consider concerns the limitations imposed by the work routine on physical activity, either because of fatigue or the limited amount of time that is available (Di Milia & Mummery, 2009; Fogelhom et al., 2007). Excess work can also limit social conviviality, thus impacting personal relationships (Papp et al., 2004; Perry & Osborne, 2003).

Another important factor is that the physicians have good access to information, knowledge, and awareness regarding the health consequences of lifestyle changes, and these areas are thus generally expected to be high among clinicians, who are often observed as role models (Ramachandran et al., 2008). The lifestyle led by the medical professionals can therefore influence their patients and providing benefits not only for their own health but also for the people being served. However, there is no evidence concerning the real influence of physician attitudes about the relative health of their patients.

There are some limitations in our study. The study design was cross-sectional, and the results are based on only 72 residents, with a small number of men. Studies with larger sample sizes would allow us to identify important issues in this population that work such long hours. Another limitation was that not all participants completed the metabolic variable evaluation. Furthermore, most evaluations were performed using questionnaires, which, although accepted and validated in other studies, are subjective and dependent on the memory and motivation of the participants. The food record, used to assess the food intake pattern, is likely to be subject to underreporting, especially in obese individuals (Meng et al., 2013; Murakami et al., 2012). However, the rules governing medical residency programs in Brazil are national standards. Thus, although our results are based on a single residency program in Brazil, the generalization of our results to all Brazilian resident physicians can be considered.

A high prevalence of problems in sleep patterns, food intake, and being overweight was observed among the residents of both genders, especially in men. Women had a higher prevalence of inadequate parameters in relation to inflammatory status, and men had a higher prevalence of inadequate lipid-profile-related parameters. These observations indicate the need for the monitoring and tracking of health status to minimize the negative effects attributed to this dynamic work-study experience. Intervention studies could provide information that could be used to provide better advice for improving the health and well-being of all individuals. It is also essential to review the working hours of doctors-in-training to improve their working conditions and to prevent future health problems in these individuals.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

REFERENCES

National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood


