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Association of Dietary Patterns with Obesity and Hypertension among Staff Members of Rajarata University, Sri Lanka

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ABSTRACT

Background: There is a significant association between dietary patterns and higher risks for hypertension and obesity. However, studies assessing the relationship between dietary patterns and health outcomes are few.
Objectives: It was aimed to investigate the association of dietary patterns with obesity and hypertension among the academic and non-academic staff of Rajarata University of Sri Lanka.
Materials & Methods: The study sample consisted of 145 academics and 165 non-academics, aged between 20 to 65 years. Interviewer-administered validated questionnaire was used to collect information on dietary patterns. Anthropometric measurements and systolic blood pressure (SBP), diastolic blood pressure (DBP) were measured using standard procedures. Body mass index (BMI) and waist circumference (WC) cut-off values for Asians were used to determine obesity.
Results: The mean BMI of the study group was 23.6±4.1 kgm-2 and the mean WC was 84.9±10.7 cm. The prevalence of overweight and obesity among academics and non-academics were 21.9% and 2.3% and 27.1% and 3.9% respectively. Further, 23.2% of academics and 28.7% of non-academics had centrally obesity. Prevalence of hypertension in the study sample was 14.5% while mean SBP and DBP were 114.9±16 and 75±10.8 mmHg respectively. Consumption of raw unpolished rice, white bread, meat, fried food, fast and processed food, coconut oil and egg had a significant positive influence ($p<0.05$) on central obesity while fish consumption showed a significant negative relationship ($p<0.05$) with central obesity, hypertension, overweight and obesity. Moreover, black tea and fruit consumption were positively associated ($p<0.05$) with overweight and obesity.
Conclusion: These data suggest that certain dietary factors associated with the obesity and hypertension, independent of other lifestyle variables such as physical inactivity, duration of sleep, smoking and alcohol consumption.

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INTRODUCTION

Obesity has already become a serious public health problem and associated with numerous complications, including hyperlipidemia, hypertension, arteriosclerosis and other chronic diseases (Pietrucha et al., 2011). Waist circumference (WC) often serves as an index for abdominal obesity, and body mass index (BMI) is the most used indicator to evaluate the status of general obesity (Cong et al., 2022). Obesity occurs due to high energy intake, mainly in the form of carbohydrate and fat along with physical inactivity, leading to the accumulation of fat in the body (Bartkowiak et al., 2021). Hypertension refers to a clinical syndrome characterized by elevated arterial blood pressure (Kametas et al., 2022). The prevalence rate of hypertension is increasing year by year, with more than 1.3 billion people suffering from hypertension worldwide at present (Ogunniyi et al., 2021). Lifestyle factors, including diets with excessive sodium and low potassium, heavy alcohol consumption and excessive intake of saturated fatty acids, can raise blood pressure (Hall et al., 2019). The level of income also plays a significant role in shaping an individual's dietary habits and overall lifestyle choices. Higher income levels often provide greater access to a variety of food options, including processed and convenience foods, which can contribute to unhealthy dietary patterns. Additionally, individuals with higher incomes have more money to spend on dining out or purchasing fast food, which may result in an increased intake of calorie-dense and nutrient-poor meals. On the other hand, lower income individuals' food purchases would be lower in overall nutritional quality. Thus, income disparity can influence the overall health outcome of an individual. A study reported that low income is associated with a poor quality dietary intake when compared to those with higher income, lower income individuals consume fewer fruits and vegetables, more sugar-sweetened beverages and have lower overall diet quality (Frazao et al., 2007). However, studies assessing the relationship between dietary patterns and health outcomes are few. In Sri Lanka, employees in the state university sector are generally categorized as a high-income group, with a predominantly sedentary working environment. Additionally, they have different dietary patterns, which can contribute to adverse health outcomes over time. The study involved comparing academic and non-academic staff members with respect to their lifestyle patterns. Since they are in a different type of working environment, their lifestyle patterns also may differ with each other. The aim of the present study was to determine the prevalence of obesity, hypertension and the underlying dietary factors associated with those conditions among the staff members of Rajarata University of Sri Lanka.

MATERIALS & METHODS

Research design and population

A cross-sectional descriptive study was conducted on a study sample of 145 academic and 165 non-academic staff members (n=310) from Rajarata University of Sri Lanka, aged between 20 and 65 years. Those who were previously diagnosed with ischaemic heart diseases, diabetes, hypertension, or other chronic illnesses were excluded. All participants in the study signed an informed consent form. Approval was obtained from the ethics review committee of the Faculty of Medicine, University of Peradeniya, Sri Lanka (2017/EC/08).

Data collection

On weekdays, data was gathered at convenient times during working hours from 10 to 15 members per day. Since the university has a multicultural community, we collected information in English, Sinhala, and Tamil as needed.

Anthropometric measurements

Height, weight and WC were measured according to the WHO guidelines (WHO, 1995). Height was measured by a stadiometer to the nearest millimeter. Weight was measured by a digital scale to the nearest 100 g. The WC

was measured midway between the lowest rib and the superior border of the iliac crest in the mid axillary line, with a non-stretchable measuring tape at the end of normal expiration to the nearest millimeter and BMI was calculated. BMI cut-off values for Asians defined by WHO (Basset, 2000) were used in the present study as underweight (BMI <18.5 kg/m2), normal (BMI 18.5-22.9 kg/m2), overweight (BMI 23-29.9 kg/m2) and obese (BMI ≥30 kg/m2) to define global obesity. Central obesity was defined as WC >90 cm for males and >80 cm for females according to Asian cut-off values (Koh et al., 2010).

Dietary patterns

Preliminarily, a 24-hour dietary recall was conducted by interviewing randomly selected 10 members of the staff from each department using dietary recall of all the foods and beverages consumed during the previous 24 hours in detail. This was conducted for two weekdays and a weekend. Based on the food items resulting, a self-administered Food Frequency Questionnaire (FFQ) with 19 food items was developed to collect information related to the diet generally consumed during the previous month. The FFQ consists of a list of foods, and the respondent was asked to indicate the frequency of each food eaten daily, weekly, or monthly.

Hypertension

Two readings of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken on the right arm of each subject in a sitting position after 10 minutes' rest using a standard clinical Mercury manometer (0125B Accoson Dekamet Mercury Sphygmomanometer, UK). The mean value of the two readings was taken as the blood pressure (BP) of the participant. A systolic blood pressure (SBP) of ≥140 mmHg or a diastolic blood pressure (DBP) of ≥90 mmHg was considered as the cut-off level to determine the presence of hypertension. (Mancia et al., 2023).

Statistical analysis

Data were analyzed using SAS 9.3 (SAS Institute Inc., CARY NC). Prevalence rates were calculated with frequency. Descriptive statistics of age were calculated using univariate procedure. Adequacy of the model was checked using Catmod procedure. Generalized logistic regression model using logistic procedure was performed to assess the associations of dietary patterns with obesity and hypertension. Effect of each variable was tested after adjusting for other confounding variables such as lifestyle patterns (physical activity, sleeping score, smoking and alcohol consumption), blood sugar level and lipid profile. A probability value of <0.05 was considered significant.

RESULTS

Out of the 310 respondents, 60.3% were females and 39.6% were males in 17% of males and 29.6% of females in academic staff, and 22.5% of males and 30.6% females in non-academic staff, respectively. Basic information, including socio-demographic characteristics are summarized in Table 1.

Prevalence of overweight and obesity

The prevalence rates of overweight and obesity in males and females in the study group were 23.9%, 1.3% and 25.2%, 4.8% respectively.

There were no statistically significant differences in the prevalence of overweight or obesity between academic and non-academic staff or between genders (p>0.05). This suggests that weight status distribution is similar across occupational and gender groups within the study population (Table 2). Also, it showed that the proportion of females in both the overweight and obese categories was higher than males. Further, the prevalence of overweight and obesity was higher among non-academic staff (27.1% and 3.9% respectively) as compared to academic staff (21.9% and 2.3% respectively), though not significantly different (p>0.05). Only 18.4% of academics and 15.5% of non-academics were within the

normal weight range. Meanwhile, non-academics were reported to have a higher prevalence of underweight (6.8%) as compared to academics (4.2%).

Prevalence of central obesity

The prevalence of central obesity in the study sample was 51.9% among whom 20.3% males and 31.6% females were centrally obese. However, the prevalence of central obesity among males and females was not significantly different ($p>0.05$). Further, there was no significant difference ($p>0.05$) in the prevalence of central obesity between academic and non-academic staff.

Table 1. Basic characteristics of the study sample

Variable	Mean value (±SD)		
	Study group	Male	Female
Age (years)	33 ± 9.3	37 ± 10.2	30 ± 7.5
Body mass index (kg/m^2)	23.6 ± 4.1	24.3 ± 3.8	23.2 ± 4.3
Waist circumference (cm)	84.9 ± 10.7	90.3 ± 9.2	81.3 ± 10.3
Systolic blood pressure (Hg mm)	114.9 ± 16.0	123.8 ± 18.5	108.5 ± 12.8
Diastolic blood pressure (Hg mm)	75.0 ± 10.8	79.7 ± 10.9	72.6 ± 13.5

Table 2. Prevalence of overweight and obesity in the study group

Staff Category	Gender	Sample Size (n)	Overweight (%)	Obesity (%)
Academic	Male	53	24.1	0.7
	Female	92	22.7	4.1
Non-academic	Male	70	23.6	1.8
	Female	95	27.3	5.6
p-value			0.653	0.583

* $p>0.05$

Prevalence of hypertension

The prevalence of hypertension in the study sample was 14.5% with 11.3% of males and 3.2% of females. It revealed that the prevalence of hypertension among males was significantly higher ($p<0.05$) than among females. In addition to that, the prevalence of hypertension in non-academics was significantly higher ($p<0.05$) than in academics (Figure 1).

Consumption of different food items between academic and non-academic staff

Based on the food frequency questionnaire, significant differences were observed between academics and non-academics in the consumption of certain food categories. Based on the FFQ, consumption of certain food categories was significantly different between academics and non-academics. The consumption of fast and processed foods ($p=0.02$), pulses ($p=0.002$), and fish ($p=0.03$) was significantly higher among academics, while consumption of raw rice ($p=0.04$), other carbohydrate-rich foods ($p=0.001$), vegetables ($p=0.008$), and milk/milk products ($p=0.03$) was significantly higher among non-academics. Moreover, almost all participants consumed

carbohydrate-based foods, mainly rice, as their daily staple food (Table 3).

Table 3. General consumption of different food items by academic and non-academic staff during the previous months

Food item	Academics (n=145) (%)	Non-academics (n=165) (%)	*p*- value
Raw rice	27	34.6	0.048*
Parboiled rice	42	42.5	0.898
Other carbohydrates rich foods	94.7	97.1	0.001*
Pulses	40.5	32.3	0.002*
Vegetables	128.4	144.9	0.008*
Green leaves	27.5	27.8	0.900
Fruits	22.3	22	0.903
Fish	36.7	31.1	0.032*
Milk/milk products	32.8	38.6	0.036*
Meat/meat products	14.5	13.8	0.607
Eggs	9.48	10.51	0.315
Nuts	4.6	3.92	0.506
Sweets and desserts	19.7	17.3	0.235
Coffee	4.6	5.4	0.618
Black tea	37.4	32	0.089
Fast/processed foods	4.49	2.49	0.022*
Fried foods	21.6	20.6	0.745
Coconut oil	46	44.3	0.565
Vegetable oil	1.88	2.9	0.372
Coconut milk	77.2	80.7	0.448

** $p<0.05$, Carbohydrates: bread, kottu*

Dietary factors associated with overweight and obesity

The consumption of food items such as fruit, black tea, coconut oil, hoppers, and margarine was positively associated with overweight and obesity (Table 4), while fish, milk, noodles, and parboiled rice showed a negative association. The consumption of ten food items showed no association with overweight and obesity.

Moreover, the results revealed that bread (p=0.001), raw unpolished rice (p=0.036), and kottu (p=0.025) were significantly and positively associated with central obesity, whereas fish, pulses, and coffee showed a negative association.

Food items associated with hypertension

Consumption of black tea had a significant negative influence ($p<0.05$; odds ratio<1) on hypertension, indicating its role in reducing blood pressure (Table 5). Meanwhile, raw unpolished rice, hoppers, and vegetable oil showed a positive influence ($p<0.05$; odds ratio>1) on hypertension.

Table 4. Food items associated with overweight and obesity

Food item	*p*-value	Odds ratio (OR)
Whole study group		
Regression	0.001	
Fruit	0.001	1.0411
Black tea	0.043	1.0104
Fish	0.002	0.9825
Milk	0.047	0.9891
Noodles	0.043	0.8954
Academic		
Regression	0.048	
Fruit	0.005	1.0342
Coconut oil	0.038	1.0200
Black tea	0.016	1.0186
Milk	0.020	0.9794
Non-academic		
Regression	0.001	
Fruit	0.001	1.0460
Hoppers	0.019	1.1075
Margarine	0.029	1.1592
Parboiled polished rice	0.033	0.9832

$p<0.05$

Table 5. Food items associated with hypertension

Food item	p-value	Odds ratio
Whole population		
Regression	0.049	
Raw unpolished rice	0.042	1.0290
Hoppers	0.025	1.0761
Black tea	0.044	0.6529
Fish	0.007	0.9778
Academic		
Regression	0.001	
Parboiled polished rice	0.026	0.0231
Vegetable oil	0.034	1.1109
Fish	0.003	0.9465
Non-academic		
Regression	0.001	
Hoppers	0.011	1.1109
Nuts	0.008	0.0917
Black tea	0.003	0.6893

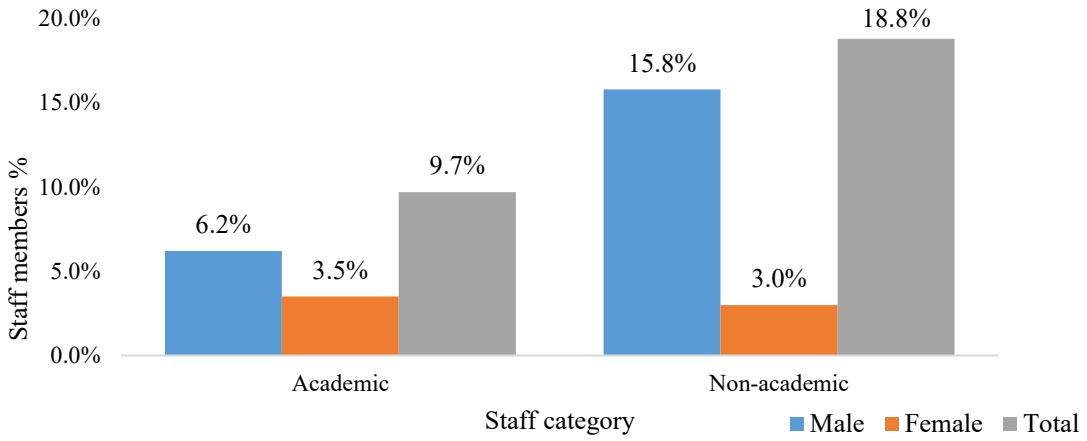

Figure 1. Prevalence of hypertension in academics and non-academics.

DISCUSSION

The present study gives an overall idea about the prevalence of hypertension, overweight, global and central obesity among the workforce at a state university in Sri Lanka. It revealed that the regular consumption of certain dietary items increases the risk of overweight, obesity and hypertension.

The sociodemographic characteristics of the study sample were largely comparable to both national and global data. Mean BMI of the study sample was 23.6 ± 4.1 kg/m2 which is marginally higher than the cut-off for overweight in Asians (23-29.9 kg/m2), indicating overweight. Global obesity is assessed using BMI, and elevated BMI predicts the increased risk for NCDs and all cause of mortality (GBD 2015 Obesity Collaborators, 2017). However, BMI alone does not provide complete information on body fat distribution, which reflects the metabolic risk (Ross et al., 2020). The mean WC values of the group indicate that both males and females are at the risk of abdominal obesity based on the International Diabetes Federation cutoff values on waist circumference for determining abdominal obesity (WC - male ≥ 90 cm and female ≥ 80 cm) (Somasundaram et al., 2014). Current study revealed that more than half of the study sample (55.1%) were overweight and obese aligning with both Sri Lankan and global prevalence rates.Anational level study reported overweight, obesity, and abdominal obesity prevalence as 25.2%, 9.2%, and 26.2%, respectively (Katulanda et al., 2010). In 2013, prevalence of overweight and obesity among Sri Lankan adults were 17.1% and 28.8% respectively (Arachchige et al., 2013) with and increasing trend.

In the present study, females were overweight/obese than males. Similar to the present findings, Arachchige et al. (2013) reported 30.8% prevalence of central obesity among Sri Lankan adults and lower rates were observed in males compared to women (Arachchige et al., 2013). Similarly, in the United States, Cynthia et al., (2015), reported that the prevalence of global obesity was higher in women (38.3%) than in men (34.3%) during, 2011-2014.

According to the current study, non-academic staff showed increased rate of obesity than academic staff. There is scarcity of data specifically comparing academic and non-academic staff of universities. A study done in Saudi Arabia reported that more than half of university employees had three or more NCD risk factors, i.e., 64% were overweight or obese, 22.1% had hypertension, and 21.5% had diabetes (Amin et al., 2014). Another study showed that 72% of a Saudi university employees and their families were overweight or obese (Alzeidan et al., 2016).

In this study, consumption of carbohydrates such as white bread, kottu and raw unpolished

rice had a significant positive influence on central obesity. Fast and processed foods also had a significant positive influence on central obesity. A diet rich in carbohydrates with refined or high-glycemic index increase the risk of obesity and diabetes. Similar observations across countries over time have suggested that increased consumption of refined carbohydrates and sugar may contribute to the weight gain and NCDs (Pressler et al., 2022).

On the other hand, Fish and pulses were negatively correlated with central obesity in both academics and non-academics and it corroborates that high intake of fish and pulses may reduce risk of central obesity. This finding supports the evidence that suggest fish rich in omega-3 fatty acids which are known to help reducing inflammation and fat accumulation lowers the cardiovascular risk (Das et al., 2017). Pulses which are high in fibre, protein, but low in energy density and glycemic index help in weight control (Albete et al., 2010).

Both academics and non-academics reported a low percentage of fruit consumption as 22.3% and 22% respectively. Indeed, there are previous studies supporting the current finding of lower daily intake of fruits among Sri Lankans (only 0.4 portions/day) which is well below the national recommendations (Jayawardena et al., 2013). Existing literature revealed that, consuming fruits has been linked to a reduced risk of obesity, improved psychological well-being, and enhanced gut health (Saxe-Custack et al., 2019). In contrast, unhealthy eating patterns, such as a lack of fruits and vegetables, contribute to the development of conditions like diabetes, obesity, and cardiovascular diseases (Schröder, 2007).

Further, current study revealed that the prevalence of hypertension among males was significantly higher than females. Males showed higher systolic and diastolic blood pressure than females. Similarly, in a national study that has been carried out in Sri Lanka in 2005-2006, Katulanda et al. (2014) reported that mean SBP and DBP values were higher in males than females. They further reported that, the age adjusted prevalence of hypertension was 23.4% among males (Katulanda et al., 2014), which is twice the rate observed in the present study. This difference may be attributed to the smaller sample cohort size of the current study.

Moreover, consumption of nuts was negatively associated with hypertension among non-academics. In a study, Djousse et al. (2009) reported that nut consumption has been associated with a lower risk of type 2 diabetes and weight gain. Since obesity and abnormal glucose metabolism contribute to the development of hypertension, it is possible that nut consumption may lower the risk of hypertension (Djousse et al., 2009). Guo et al. (2015) found that nuts are low in sodium and contain a variety of nutrients including unsaturated fatty acids, minerals such as magnesium and potassium, fibre, antioxidants, and vitamins that are associated with a lower risk of hypertension, especially at >2 servings/week (Guo et al., 2015). Literature also showed a negative correlation between fish intake and blood pressure which could probably be due to the fact that omega-3 fatty acid's ability to relax blood vessels and improve blood flow, contributing to lower blood pressure. Similarly, another study reported that regular intake of fish may reduce blood pressure levels in hypertension (Erkkila et al., 2008).

CONCLUSIONS

In conclusion, the prevalence of overweight and obesity, central obesity and hypertension among university staff is high. Specifically, the prevalence of overweight and obesity, and central obesity is generally high among females compared to the males. Certain dietary factors predict the risk of obesity and hypertension, independent of other lifestyle variables. We recommend larger studies using standard tools of dietary intake estimation to better understand the relationship between the modern dietary pattern and NCD risk factors in the workforce.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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