Association Between Perceived Stress And Obesity Among Female Undergraduate Students In The University Of Peradeniya

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Abstract:-Obesity has been widely recognized as a major health hazard due to the increased risk of heart disease, diabetes mellitus, and cancers. BMI is the most popular method of measuring obesity. However, waist circumference is a commonly used measure to evaluate the abdominal fat distribution. In Sri Lanka, female sex is recognized to be associate with overweight and obesity. Out of many well-known etiological factors, ever-increasing stress in life remains a poorly understood cause of obesity. University students are particularly subjected to stressors and possibly have a higher incidence of becoming obese and to have high abdominal obesity. This study explores the prevalence of overweight and obesity by Body Mass Index, abdominal obesity by Waist Circumference, and explores the association between the degree of perceived stress measured by perceived stress scale with BMI and waist circumference among female students at the University of Peradeniya. A total of 450, 3rd-year female students were selected randomly to represent all the faculties of theUniversity of Peradeniya. The Perceived stress scale; a

self-reporting questionnaire was administered. Anthropometric measurements were measured by using standardized equipment. Visceral fat was measured by the Bio Impedance analysis machine. Data were analysed using SPSS 20 software. Prevalence of overweight, obesity, and abdominal obesity were 19.9%, 4.1% and 10.1% respectively. There was a statistically significant association between perceived stress level and the waist circumference categories ($p<0.05$). A similar trend was seen with BMI even though it

is not significant ($p>0.05$). This study demonstrates a low prevalence of obesity among university students compared to the previously reported 7.3% of prevalence among the female population, Sri Lanka. The impact of high perceived stress; a manageable risk factor of obesity was recognized.

Keywords: Obesity, Perceived stress, University students

Introduction:

Obesity also is known as adiposity, chubbiness, corpulence, and fatness has gained considerable attention as a major health hazard. Obesity is defined as abnormal or excessive accumulation of fat that may impair health. It is defined as body mass index greater than or equal to 30 kg/m2 according to the international classification of obesity and overweight is defined as BMI above 25 kg /m^2 (World Health Organization, 2017). Worldwide obesity has increased by more than double between 1980 and 2014. It causes at least 2.8 million people to die each year and contributed to an estimated 35.8 million (2.3%) global disability-adjusted life years. In low and middle-income countries, the prevalence of obesity is twice higher among women than men (World Health Organization, 2017). In Sri Lankan adults, the percentage of overweight, obese and centrally obese categories were 25.2%, 9.2%, and 26.2%. Female sex, urban living, higher

education, higher income and being in the middle age were shown to be associated with overweight and obesity in Sri Lanka (Katulanda *et al*., 2010).

Genetics predispose to severe obesity and early onset of obesity (Shawky and Sadik, 2012). Individual behaviors and environmental factors can contribute to excess calorie intake and inadequate physical activity leads to obesity (Duffey and Popkin, 2011). Certain medical conditions such as polycystic ovary syndrome (Sam, 2007) and prescription drugs such as steroids, and antidepressants (Kulkarni and Kaur, 2001) can cause weight gain. Inadequate sleep, prenatal and post-natal influences (Gunderson, 2009), chemical exposure (Wang *et al.*, 2012) and stress (Richardson *et al.*, 2015) may affect energy balance and obesity risk. However, out of many well-known etiological factors, ever-increasing stress in life, remains a poorly understood cause of obesity.

Obese people tend to die prematurely (Global BMI Mortality Collaboration, 2016). Overweight and obesity predispose to vascular diseases (Lawlor, Lean and Sattar, 2006), diabetes mellitus (Al-Goblan, Al-Alfi and Khan, 2014), renal diseases (Eknoyan, 2011), gallbladder diseases (Amaral and Thompson, 1985) and impairs respiratory function (Lin *et al.*, 2006). They often suffer from anxiety, sleep apnea, psychosocial problems, depression and low self-esteem (Araghi *et al.*, 2013). Consequently, morbidity and mortality rates are higher among the obese people (Abdelaal, le Roux and Docherty, 2017).

In the evaluation of obesity, various methods have been used. Body mass index is the most widely used method in epidemiological studies (Nuttall, 2015). Furthermore, skinfold thickness (SFT) measurement has been used from ancient times (Gray *et al.*, 1990). Also, waist to hip ratio (WHR) and waist circumference have been done to evaluate abdominal obesity (Ahmad *et al*., 2016). Measuring waist circumference is considered as an effective method of assessment of health risks (Siren *et al.*, 2012). Also, the place of distribution of fat is an important risk factor, because fat cells have different metabolic activities depending on their locations (Jensen, 2008). In recent years, development of Bio Impedance Analysis (BIA) method, which involves assessment of the resistance of body tissues by passing an electric current of low intensity, with a fixed frequency, contributes to measuring the percentage of the different compartment of body fat (Sampei and Sigulem, 2009).

Abdominal obesity is often referring to belly fat also known as central obesity or intra-abdominal fat. It includes both subcutaneous fat that sits just under the skin and the visceral fat that sits deep in the abdominal cavity around internal organs (Hellen, 2009). Visceral adipose tissue, more metabolically active, more sensitive to lipolysis and more insulin resistant than subcutaneous adipose tissue thereby carries a greater risk of morbidity and mortality (Ibrahim, 2010).

Abdominal obesity is associated with serious adverse metabolic and cardiovascular outcomes, including type 2 diabetes, atherosclerotic heart disease (Pischon *et al*., 2008) and severe impairment of lung function (Leone *et al*., 2009). Cytokines released by adipocytes may cause inflammation which can lead to certain cancers in tissues such as in colon, endometrium and breast (American Cancer Society, 2016). Risk of diabetes is increased when the waist circumference is more than 31.5 inches (80 cm) in women and more than 35.5 inches (90 cm) in men (The International Diabetes Federation, 2010).

Stress is a state of threatened homeostasis caused by intrinsic or extrinsic adverse forces (stressors) (Tsigos *et al*., 2000). Intrinsic

stressors were defined as stressful components that are triggered by the cognitive challenges (Sandi and Pinelo-Nava, 2007) such as dealing with uncertainty, novel and urgent tasks (Pottier *et al.*, 2015). Extrinsic stressors were defined as stressful components that are induced by conditions that are completely unrelated to the cognitive tasks (Sandi and Pinelo-Nava, 2007) such as noise, pain, sleep deprivation and crowding (Pottier *et al.*, 2015). Stress is counteracted by complex physiological responses including increased heart rate, increased sweating, dilation of the pupil and behavioral responses including changing eating and sleeping patterns, feeling angry or depressed (Henry, 1997).

Central and peripheral stress systems contribute to maintain and re-establish the body equilibrium (Tsigos *et al*., 2000). Within the CNS, they produce lasting changes relevant to depression and anxiety-like behavior by activating the hypothalamic-pituitary-adrenal axis. Peripheral systems release immature, pro-inflammatory monocytes and neutrophils into the peripheral circulation that precipitate a series of immune events (Pfau and Russo, 2015). Each one's stress is determined by a multiplicity of genetic, environmental and developmental factors (Tsigos et al., 2000).

Methods to assess the stressors include self-report and biofeedback methods. In a self-report questionnaire an individual's answer questions about the mental or physical state (Morgan, Umberson and Hertzog, 2014). Perceived Stress Scale (PSS) is a validated self-report tool thatused globally (Chiu *et al.*, 2016). For the understanding of daily stress, diary methods, ecological momentary assessment, short questionnaire and telephone interviews are used (Almeida, McGonagle and King, 2009). In the biofeedback technique, record the activity of the physiological systems of the body's stress response. Measurement of blood pressure, heart rate, respiratory rate and stress hormones (mostly cortisol) in saliva can be used (Lupien, 2013).

Stress has a multitudes impact on health. Short-term stressors boost the immune system but chronic stress suppresses the immune system and increased risk for viral illnesses (Segerstrom and Miller, 2004). Stress increased the risk of bronchoconstriction (Edith, *et al*., 2007), diabetes mellitus (Richard, 2002), gastroesophageal reflux causing peptic ulcers, stress ulcers or ulcerative colitis (Bradley *et al.*, 1993). Stress is linked to psychiatric illnesses such as schizophrenia and depression (Cheryl *et al*., 2002). As well as Stress has been associated with poor eating behaviors, diet quality, high body mass index (Richardson *et al.*, 2015) and impairs the inclination to be physically active (Stults *et al*., 2014).

Undergraduate students are subjected to high levels of stress due to academic, health-related and psychosocial stressors (Waghachavare *et al.*, 2013). Stress plays a role in the determination of body fat distribution among the female population. This is consistent with the known effects of cortisol in the redistribution of fat from the periphery to the abdominal region (Dallman, Pecoraro and la Fleur, 2005). Enzymes that control tissue cortisol concentrations is located in adipose (fat) tissues (Morris and Zemel, 2005). Thus, a higher percentage of deep fat cells surrounding the abdomen may lead to obesity due to the production of greater amounts of cortisol at the tissue level (Epel *et al.*, 2000). Therefore, evaluation of the association of the stressors and obesity may be important for the prevention of stress-related obesity among female undergraduate University students.

This study aimed to determine the prevalence of obesity among undergraduate female and to evaluate the association between perceived stress with body mass index and waist

circumference among undergraduate female students in the university of Peradeniya.

Methodology:

The study is a descriptive and exploratory study that was carried over a period of six months from December 2017 to June 2018. Third-year undergraduate female students from all nine faculties in the University of Peradeniya were included and undergraduate female students who are with disabilities were excluded from the sample. A random sampling method was used to select the sample. According to the large sample theory, the sample size was taken as 450. The names of the female third-year students were taken randomly from the registers under the permission of deans and senior registrars from each faculty.

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Height was measured using a calibrated stadiometer. Weight and visceral fat were measured using bioelectrical impedance machine (BIA). Waist at minimal waist circumferences was taken using a calibrated measuring tape. The degree of Perceived Stress level was measured using validated English, Sinhala and Tamil version of the self-report tool PSS; 10 item questionnaire. Sinhala PSS Translation courtesy of Dr. A.V.S. Rekha Aththidiye, Licensed Clinical Psychologist, University of Colombo; Sri Lanka. Tamil Translation courtesy to Mr. Santhalingam Sathees, University of Jaffna.

Ethical clearance was taken from the faculty of Allied Health Science, University of Peradeniya. Permission to conduct the study was obtained from the Deans of all nine faculties and contact the senior registrars of each faculty. Registers of names were obtained to select the random sample and get a convenient time and the venue for data collection was decided after discussing with the participant of each faculty. Research assistants and primary investigator were trained under the supervision of a clinical nutritionist, for measurement of anthropometric measurements and to operate the BIA machine. Clinical nutritionist evaluates the trainees for precise and accurate measurements. Calibrated of equipment were done along with the training. Participants were recruited by the poster. Spend one to three days per faculty to get the total number expected from one faculty. On the day of the study, it was arranged in a suitable place.

The information sheet that includes a description of the research, ethical consideration and medical boundaries of the research and the written consent forms were distributed and time was given to participants to read, understand, ask for queries and sign the document before the data collection process.

Questionnaire used to collect demographic data including age and district. Perceived stress scale questionnaire (Cohen, *et al*, 1983) that is consisted of ten items about the feelings and thoughts during the last month was used to assess perceived stressors. It was taken 10 to 15 minutes to complete the questionnaire for a single participant.

A. PSS Score

Reverse the scores for questions 4, 5, 7, and 8. On these 4 questions, change the scores like, 0 =4, 1 = 3, 2 = 2, 3 = 1, 4 = 0. Add up the scores for each item to get a total. Individual scores on the PSS can range from 0 to 40 with higher scores indicating higher perceived stress. Scores ranging from 0-13, 14-26 and 27-40 would be considered as low, moderate and high perceived stress.

B. Anthropometric measurements.

Each anthropometric measurement was taken by a single investigator. Anthropometric measurements were taken according to accepted guidelines ('WHO | Physical status: the use and interpretation of anthropometry', 2013). Measurement of height was taken by a stadiometer to the nearest 0.5 cm. Participants

were asked to remove their shoes, hair ornaments and stand with his back of the head, back, buttocks, calves and heels should be touching upright, feet together and to look straight. The headpiece of the stadiometer of the sliding part of the measuring rod was lowered so that the hair was pressed flat and height was recorded to the resolution of the height. Measurements for waist circumferences were taken using a calibrated measuring tape. Waist circumference was taken at the minimal part of the midsection. Abdominal obesity was defined based on WC ≥80 cm measured by at the minimal waist.

Measurements for weight to the nearest 0.1 kg, predicted visceral fat was derived from bioelectrical impedance by OMRON BF 511 body composition analyzer. Instructed to the participant being measure, should not contact with any other non-conducting surface with legs apart and arms away from the body (Omron Healthcare Co Ltd: Body Composition Monitor BF500 Instruction Manual, 2017).

BMI was estimated with the body weight (kg) / height2 (m2) formula. In accordance with the classification by the World Health Organization for Asian Population, they were regarded as underweight (BMI 18.5 kg/m2 below), normal weight (BMI 18.45-22.9 Kg/m2), overweight (BMI 23- 27.4 Kg/m2) and obese (BMI ≥27.5 Kg/m2) (WHO Expert Consultation, 2004).

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Statistical Package for Social Sciences (SPSS) version 20.0 for Windows was used for data entry and analysis. The results of descriptive statistical analysis were summarized as mean, standard deviations (±), frequencies (***N***) and percentages (***%***) and illustrated as tables and figures. Association between perceived stress with BMI and WC, groups were determined by employing Chi-Square test where P value less than 0.05 was considered to be statistically significant.

Results:

The mean age of the respondents was 23.30 ± 0.892. Study subjects were presented from every district from Sri Lanka. The mean ± SD values for BMI, WC and VF of the total study population were 20.83±3.86, 69.87±6.79 and 3.46±1.35 respectively. In Table 3.1, based on BMI, majority of students (49.1%) had normal weight and prevalence of overweight and obesity were 19.9% and 4.1% respectively. Prevalence of abdominal obesity (≥80 cm) was 10.6% measured by waist circumference that is
higher than general obesity. Percentage of students for high visceral fat level (VF level >10), indicated that is none of the study subjects had visceral obesity.

Table 1 - Prevalence of obesity among undergraduate female students in the University of Peradeniya

	Frequency(*N*)	**Mean ±SD***	**Percentage (%)**
BMI category			
Underweight	119	17.01 ± 1.15	26.9
Normal weight	217	20.59 ± 1.23	49.1
Overweight	88	24.97 ± 1.39	19.9
Obesity	18	28.61 ± 1.50	4.1
WC category			
<80 cm	397	68.26 ± 5.10	89.4
≥80 cm	47	83.44 ± 3.14	10.6
VF level			
<6	401	3.24 ± 1.13	92.4
6-9	33	6.18 ± 0.63	7.6
>10	0	0	0

BMI: Body mass index, WC: Waist circumference, VF: Visceral Fat. Using the WHO classification for Asian population (2004) and weekly epidemiological report released by Ministry of Health, Sri Lanka (2013); Normal BMI: 18.0-22.9 kg/m^2, Overweight: 23.0-27.4 kg/m^2, Obesity: ≥27.5 kg/m^2. Abdominal obesity: WC≥80 cm for women. Using body Composition Monitor BF500 Instruction Manual, (2017) Normal VF: 0-9, high VF: ≥10.*SD- Standard Deviation.

Table 2 - Level of stress among female undergraduate students according to stress score on 10 item perceived stress scale.

Perceived stress level (score)			
	Low Perceived Stress	Moderate Perceived Stress	High Perceived Stress
Frequency(*N*)	63	337	39
Percentages (*%*)	14.4	76.8	8.9
mean ± SD	11.02 ± 1.77	19.24 ± 3.29	29.00 ± 2.10

Using Cohen *et al* (1983); Low perceived stress: 0-13 score, moderate perceived stress: 14-26 score, high perceived stress: 27-40 score.

The mean ± SD perceived stress scale (PSS) score of the total study population was 18.92±5.22. There was a significant difference between means of perceived stress levels ($p<0.01$) according to the One-way ANOVA test. The descriptive characteristics for each PSS are as shown in Table 3.2 and majority of students (76.8%) perceived moderate stress.

Table 3 - Comparison of WC, BMI and stress score with the chi-square test, among undergraduate female Students University of Peradeniya.

	PSS score			P value, df
	low	*moderate*	*high*	
	N (%)	*N (%)*	*N (%)*	
WC categories				
<80 cm	47 (12.1)	306 (79.1)	34(8.8)	*p*=0.002*, 2
≥80 cm	14(30.4)	27(58.7)	5(10.9)	
BMI categories				
Underweight	18 (15.5)	96 (82.8)	2 (1.7)	*p*=0.067,6
Normal weight	25 (11.8)	161 (75.9)	26 (12.3)	
overweight	14 (16.5)	62 (72.9)	9 (10.6)	
obesity	3 (16.7)	13 (72.2)	29 (11.1)	

*Significant association between degree of stress based on WC categories assessed, WC: waist circumference, BMI: Body Mass Index, PSS: Perceived Stress Scale, N = frequency counts, figures in parentheses represent percentages.

There was a statistically significant association between perceived stress level and the waist circumference categories ($p<0.05$) and a similar trend with BMI even though it is not significant ($p>0.05$) (Table 3.3).

Discussion

Excess body fat is well documented as a risk factor for numerous chronic conditions, such as diabetes, hypertension, hyperlipidemia and cardiovascular diseases (Must and McKeown, 2000). In this study, BMI; a measure of general obesity and WC; a measure of abdominal obesity that are predictors of cardiovascular risks, non-insulin-dependent diabetes, and hypertension (Morris and Zemel, 2005).

Total 450 subjects represent students from every district in Sri Lanka. The mean age of the study
the population was 23.30±0.892 years. The prevalence of underweight, normal, overweight and obesity determined by BMI were 26.9%, 48.1%, 19.9%, and 4.1% respectively. This study indicates lower prevalence of obesity than the previous report of 7.3 % prevalence of obesity in the female population,Sri Lanka (World Data Atlas, 2017).

The prevalence of overweight, obesity and central obesity among university students reported from India were 26.8% and 10.7%, and 16.4% (Pengpid and Peltzer, 2014) In another study involving university students in 22 countries prevalence of underweight, normal weight, over weight and obesity were 17.6%, 62.1%, 14.1% and 5.2% respectively (Peltzer *et al.*, 2014). Both studies indicate a lower prevalence of obesity (4.1%) and a higher prevalence of underweight (26.9%) in our sample, probably indicating the socioeconomic background of our university entrants. It is important to note that none of the study subjects had visceral obesity when compared with 39% of prevalence among female students in A'shaqiyah University, Oman (Louay Labban, 2015). Obesity prevalence by BMI was 4.1% when compared to 10.6% of obesity prevalence that is

measured by WC. 6.5% of obese girls were not detected by BMI. The discrepancy of obesity prevalence measured by BMI and WC needs further evaluation.

The average perceived stress score was 18.92, which is higher than the standard score (M = 14.2; SD = 6.2), and 51.9 % of students had scored above standard, indicating a higher prevalence of stress among these participants. However, the mean perceived stress scale score (18.92) reported by Swaminathan *et al* in a Tamil Nadu university was 21.09 (Swaminathan *et al.*, 2015) and findings of Al-Dubai *et al* among medical residents in Malaysia was 20.4 (Al-Dubai *et al.*, 2014) and in a study in Pakistan among first and second-year students was 30.84 (Shah *et al.*, 2010) indicating better stress levels in our university students that is probably indicating the psychosocial relief provided by this garden university with vast facilities for leisure and recreation. Comparisons with other universities in the country would be a valuable exercise.

The focus of this study was on the association of PSS on BMI and WC, two measures used to classify obesity and the risk of fat accumulation. PSS investigation would make a unique contribution to understanding the association in a university female population. There was a statistically significant association between perceived stress level and the waist circumference categories (p<0.05) and a similar trend with BMI even though it is not significant (p>0.05).

This study provides preliminary evidence that perceived stress interacts to play a role in the determination of body fat distribution among female. This is consistent with the known effects of cortisol to redistribute fat from the periphery to the abdominal region (Dallman, Pecoraro and la Fleur, 2005)

Stress is a phenomenon occurring between an individual and the environment, and it creates a biochemical, psychosomatic condition including releasing cortisol. Particular enzymes that control tissue cortisol concentrations is located in adipose (fat) tissues (Morris and Zemel, 2005). Thus, higher levels of these enzymes in these deep fat cells surrounding the abdomen may lead to obesity due to greater amounts of cortisol being produced at the tissue level (Epel *et al.*, 2000).

It is suggested that women with visceral fat accumulation have elevated cortisol secretion due to an increased sensitivity along the hypothalamic-pituitary-adrenal axis, and that this may be causing their abnormal fat depot distribution (Marin P. *et al.*, 1992)

Conclusion

Low prevalence of obesity among study subjects was noticed when compared with reported prevalence of 7.3% among females in the general population, Sri Lanka.. Better stress levels in female students in Peradeniya University, probably indicate that the psychosocial relief provided by this garden university with vast facilities for leisure and recreation. Also, it may associate with body image perceptions of attractiveness as female students to maintain a healthy BMI to remain attractive. WC becomes a useful measure in a university setting due to its simplicity. Discrepancy of obesity prevalence measured by BMI and WC needs further evaluation.

The results of this study show statistically significant association with perceived stress with WC So, perceived stress is a risk factor of obesity for female university students, which is manageable and need attention and further clarification. The impact of high perceived stress; a manageable risk factor of obesity was recognized.

Acknowledgement

This research is a granted project by University research grants in December 2017 (Grant No. URG/2017/42/M)

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