

Association between caloric intake and work-related stress among nurses in two district hospitals in Ghana

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Abstract

Background: The nursing profession is generally perceived as tedious and stressful and has been shown to be associated with inappropriate caloric intake with its attending consequences of obesity and increased risk of cardiovascular diseases.

Objective: This study examined caloric intake and stress levels among nurses.

Methods: A cross sectional study design was used, and a total of 85 nurses were sampled from two district level hospitals. Physiological and psychological levels of stress were measured using Salivary Cortisol Enzyme Immunoassay and the Cooper's life stress inventory questionnaire, respectively. Body mass index (BMI) using height and weight measurements and caloric intake (using food frequency questionnaire and the 24 h recall of participants) were also determined. Stress levels were compared to caloric intakes using the Pearson's correlation test. Data was analyzed using Statistical Package for Social Scientists, Version 21. Statistical significance was set at $p < 0.05$.

Results: Participants were mostly females (90.60%) with a mean age $\pm$ [standard deviation (SD)] of 34.86 ± 6.27 yr. and majority of them (68.20%) were married. More than half (52.94%) of the nurses were in the World Health Organization classification of overweight, with a mean BMI ($\pm$ SD) of 26.11 ± 2.96 kg/m². Their mean caloric intake ($\pm$ SD) off duty (2368.74 ± 259.67 kcal) was significantly higher ($p < 0.001$) compared to that on duty (1784.80 ± 402.84 kcal). When off duty compared to on duty, the nurses also recorded significantly higher ($p < 0.001$) mean physiological stress scores ($\pm$ SD) (61.18 ± 7.42 vs 17.12 ± 7.15) and salivary cortisol levels ($\pm$ SD) (11.79 ± 1.06 μ g/ μ L vs 5.10 ± 1.02 μ g/ μ L). Significant positive correlations were observed for total caloric intakes and salivary cortisol levels for the nurses, both on duty [$r = 0.585$; 95% confidence interval (CI), 0.425-0.780; $p < 0.001$] and off duty ($r = 0.316$; 95% CI, 0.113-0.498; $p < 0.003$).

Conclusion: The nurses had high stress levels while on duty and this was associated with low caloric intakes. Excessive caloric intakes were observed during off duty periods and associated with relatively lower stress levels.

Keywords: Body mass index, calories, work-related stress

INTRODUCTION

Stress encompasses non-specific sympathetic activation, leading to increased heart rate and blood pressure, it also involves the release of catecholamines and corticosteroids, along with psychological changes such as heightened alertness or increased attention [1], often in response to certain triggering factors [2]. Several studies [3,4,5] have investigated the relationship between stress, quantities and types of food consumed and many health conditions such as cardiovascular diseases and cholesterol levels. However, not much attention has been paid to occupation/job specific stressors and related effects of dietary habits of individuals. The demands of different

occupational engagements place different stressors on individuals [6]. The response to these stressors may be different between populations in different classes of occupation and even among individuals of the same population [7]. The nursing profession is generally perceived as a strenuous, stressful, and demanding [8,9]. A review of employee stress in healthcare settings across 17 countries found that nurses in most countries experience high levels of occupational stress [10]. Workplace stress had a negative effect not just on the health of nurses but also on their job satisfaction and the overall quality of care. Workplace stress also increased the number of sick leave taken, employee turnover and number of accidents [11]. Sarafis et al. (2016) concluded that, occupational stress affects nurses' health-related quality of life negatively and consequently on patient outcomes [8]. In fact, work-related stress (WRS) has been cited as a significant health problem [12]. Even though, stress among nurses is gradually gaining some attention in recent times

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[9,13,14], yet still, the number of relevant studies that links WRS among nurses to their caloric intake is limited. Moreover, most of the research in this area have been carried out within western culture settings [15,16], with a few conducted in Ghana [13]. It remains unclear if the findings in those settings are applicable to Ghanaian nurses.

MATERIALS AND METHODS

Study area

The study was conducted at the Tetteh Quarshie Memorial Hospital and the Bryan Lowe Orthopedic Hospital in Mampong-Akuapem of the Akuapem North Municipal Assembly in the Eastern Region of Ghana. These are hospitals which run the shift system. The Tetteh Quarshie Memorial Hospital with a total staff strength of 167 of which 85 are nurses, is the highest referral centre in the district with departments of general medicine, obstetrics and gynaecology, paediatrics, ear nose and throat, optometry, dentistry, physiotherapy, surgery and mortuary. It runs a 24 h, seven days a week system and attends to over 200 patients a day. The Bryan Lowe Orthopedic Hospital employs 49 staff of which 24 are nurses. All though, specialised in orthopaedics, it provides services in obstetrics and gynaecology, paediatrics, general medicine, surgery, physiotherapy, and mortuary. The hospital is also a primary care referral centre and runs a 24 h, seven days a week service with a daily client count of over 150.

Study design

The study design was cross sectional, involving participants from the two hospitals. Data from participants were obtained at one specific point in time. The data collected involved responses to predetermined structured questions which were asked to discover specific characteristics, food choices and behaviors with focus on occupational stress levels and coping strategies. Anthropometric and biochemical data were also obtained.

Study Population and eligibility criteria

Participants were nurses from two separate hospitals. The total number of nurses in the two hospitals was 109. However, only nurses who were on full time engagement and locum but run a full shift (40 h a week normal working time) were recruited for the study. Student nurses on internship and nurses on steroid medications which could affect the level of salivary cortisol were excluded.

Sample size and sampling technique

Purposive sampling technique was employed to select a total of 85 nurses from the 109 registered nurses in the two hospitals. List of nurses were obtained from the Nurses' Administration of the hospitals and combined into one list with the most senior staff at the top. The nurses were ranked into junior, mid-level and senior categories.

Data collection instruments

Data were obtained from socio-demographic, dietary, anthropometric, psychological, and biochemical assessments of participants. A self-administered validated questionnaire was adopted and modified for the data collection. The questionnaire was made up of three main sections: socio-demographic

characteristics; dietary history- their food habits and food intakes [17]; and psychological data (a structured Stress Self-Test) to determine the stress level of participants [18].

Dietary data. The quantitative food frequency questionnaire and 24 h recalls were administered to participants to determine their diet histories. The food frequency questionnaire contained a list of selected foods. These selected foods were classified into groups that provide similar nutrients (example cereals and grains, fruits, fruit juices, soft drinks, animal protein, plant protein among others). Participants ticked how frequently they ate those foods. Options included were daily, weekly, occasionally, or never. The 24 h recall was used to determine the foods and fluids consumed by participants in the last 24-hrs. Questions regarding time, quantity, form (fried, boiled, roasted) and type of meal (breakfast, lunch, supper, snack) of foods eaten were asked. Questions were asked about the kind of meal taken (breakfast, lunch, or supper), the time the meal was eaten (e.g., 8:00 am, 12:00 pm, 4:00 pm), and the food eaten. Household handy measures common to the Ghanaian were then used to estimate portion sizes consumed during mealtimes [17].

Cooper's life stress inventory. Cooper's life stress inventory was given to participants to tick their perceived severity of stressors listed [18]. The Cooper's life stress inventory contains a list of stressors known to be experienced in the life of people. It was pretested in the study setting to take out some stressors that did not apply to the study population. A few stressors that applied to the population but were not included in the original list were also added. Each stressor was assigned a Likert scale score against which study participants tick. Their total scores were calculated and grouped according to their levels of stress. A total score of 0-25 was classified as no stress, 26-52 was classified as moderate stress, and 53-78 was classified as very high stress.

Anthropometric measurements

With the consent of participants, various body measurements including total body fat, visceral fat, and body mass index (BMI) were taken. Height was measured using a portable stadiometer (Seca, Hamburg, Germany) which was placed on a firm flat ground to ensure accuracy. Height was recorded to the nearest 0.10 cm. Participants' weights were measured to the nearest 0.10 kg using a Seca 770 floor digital scale (Seca, Germany). Respondents were in minimal clothing, and were asked to remove shoes, jackets and other heavy objects before standing on the scale. They stood on the scale with feet fully placed on the scale to ensure that weight was evenly distributed on both feet. The BMI was determined from the height (H) and weight (W) measurements and calculated as W/H^2 . Outcome measures were defined as underweight $<18.50 \text{ kg/m}^2$, normal weight $18.50\text{--}24.49 \text{ kg/m}^2$, overweight $25.70\text{--}29.99 \text{ kg/m}^2$, obese $\geq 30.00 \text{ kg/m}^2$ based on the World Health Organization (WHO) criteria for adults [19].

Measurement of cortisol

Saliva Collection. About 5 mL of saliva samples were taken into a clean test tube. Participants were asked to rinse their mouths and then wait for 10 min. Pooled saliva was then taken into the test tube and corked with a cotton bud. All samples were taken at least 45 min after food had been consumed [20] to ensure

that food eaten did not affect salivary cortisol levels. The test tube with saliva was then transported to the laboratory. From these samples, 25 μ L was measured and used according to the manufacturer's instruction (Salimetrics cortisol assay kit, 2014) for the cortisol analysis [21].

Salivary Cortisol Enzyme Immunoassay steps. A clean, disposable tip was used for dispensing each standard and each patient sample. Twenty-five microliters (25 μ L) each of the standards and samples were pipetted into their respective wells. These were followed by the addition of 200 μ L diluted Cortisol-HRP conjugate to each well; well A1 was left for substrate blank. The wells were covered with aluminum foil supplied in the kit and incubated at 37°C for 1 h. When the incubation was completed, the foil was removed, and contents of the wells were aspirated. The wells were next washed thrice with 300 μ L of diluted wash solution. Overflows from the reaction wells were avoided. During each washing step, the plate was gently shaken for 5 sec and excess solution was removed by tapping the inverted plate on an absorbent paper towel. One hundred microliters (100 μ L) Tetramethylbenzidine (TMB) solution was dispensed into wells and incubated for exactly 15 min at room temperature (22-28°C) in the dark. Then 100 μ L of the stop solution was dispensed into all wells in the same order as the TMB substrate solution and the microplate was gently shaken. The absorbance of the specimen at 450 nm against a reference wavelength of 620-630 nm was measured [21].

Statistical analysis

Descriptive analysis was used to analyze the variables, cortisol levels, dietary patterns, and stress levels with the help of Statistical Package for Social Scientists Version 21 (SPSS 21.0). Data gathered with 24 h recalls and food frequency were analyzed to determine if types and quantity of food eaten during the on duty hours differed from those of the off duty using Micro-Diet version 5. The levels of cortisol during duty hours and off duty hours were then correlated to caloric intake based on the premise that cortisol affects appetite positively in chronic stress and that normal level of cortisol follows a circadian clock in normal hours only. Psychological levels of stress were compared to both physiological measures and caloric content of foods consumed with Spearman's correlation test. Continuous variables were expressed in mean $\pm$ standard deviation. A $p < 0.05$ was considered significant. Variations in stress levels among ranks of nurses were analyzed with frequency tables.

RESULTS

Socio-demographic characteristics of the nurses

Table 1 shows the socio-demographic characteristics of the nurses. A total of 85 nurses were recruited. Majority (90.60%) of the nurses were females. More than half (68.20%, 58/85) of them were married. The nurses were predominantly Christians (92.9%, 79/85). In terms of educational status, more than half (56.5%, 48/85) had a diploma/certificate in their profession. The mean age of the nurses was 34.86 ± 6.27 yr. and most (61.2%, 52/85) of them were in the 25–34 yr. age group.

Anthropometric measurements of the nurses

The anthropometric measurements of the nurses showed that mean height was 1.59 ± 0.07 m and their mean weight was 65.80

Table 1: Socio-demographic characteristics of the nurses

Variable	Category	Number	Percentage
Gender	Male	8	9.41
	Female	77	90.59
Age (yr.)	25 - 34	52	61.18
	35 - 44	28	32.94
	45 - 55	5	5.88
Marital status	Married	58	68.24
	Single	27	31.80
Religion	Christianity	79	92.90
	Islam	6	7.10
Education	Diploma/Certificate	48	56.50
	Degree	37	43.50

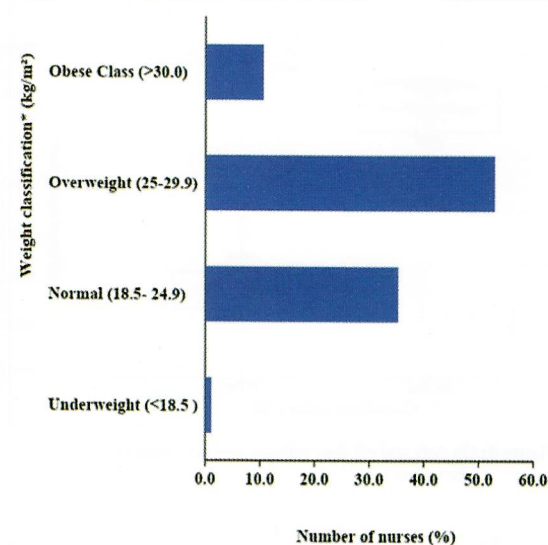


Figure 1: Weight classification of the nurses based on BMI
 *WHO 2010.

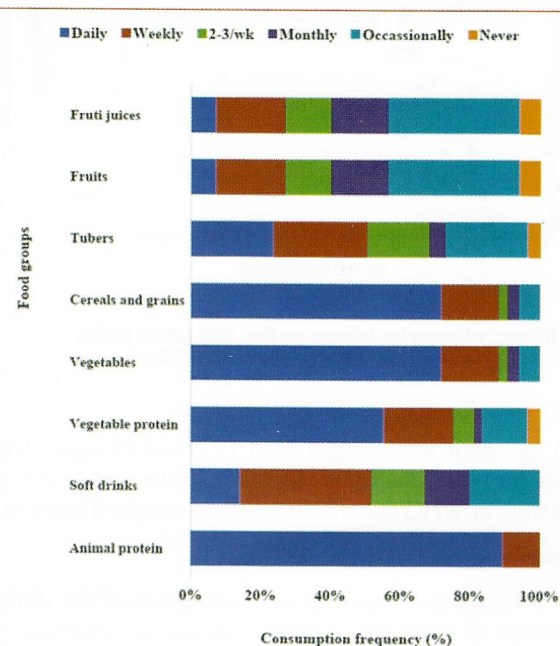


Figure 2: Frequency of consumption of foods

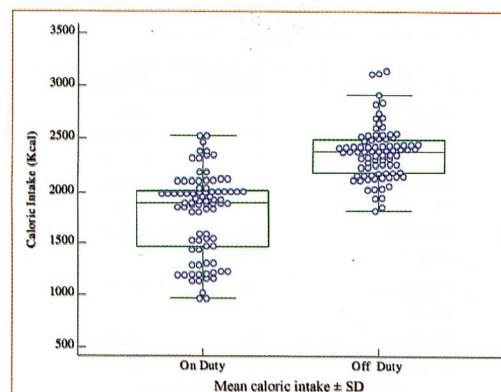


Figure 3: On duty and off duty daily caloric intake of the nurses.

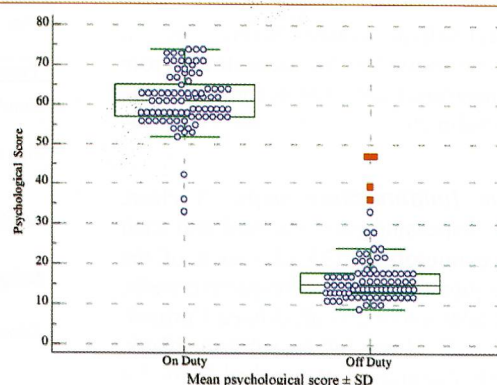


Figure 4: On duty and off duty psychological scores of the nurses

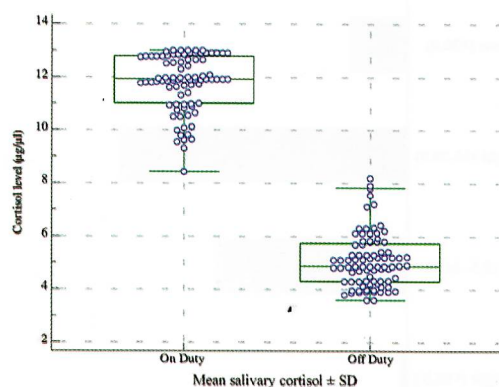


Figure 5: On duty and off duty salivary cortisol levels of the nurses

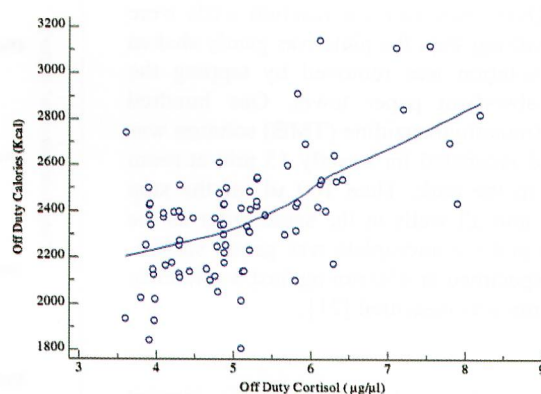


Figure 6: Correlation between off duty total caloric intakes and off duty salivary cortisol levels of the nurses

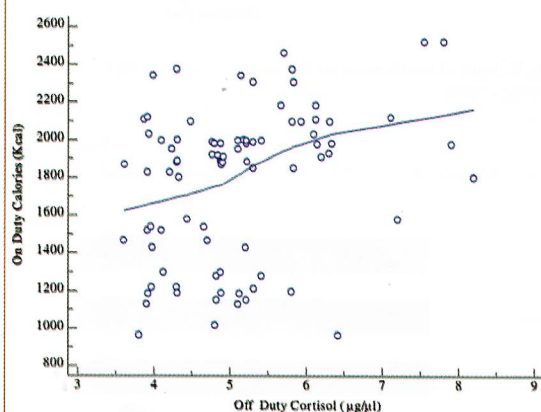


Figure 7: Correlation between on duty total caloric intakes and off duty salivary cortisol levels of the nurses

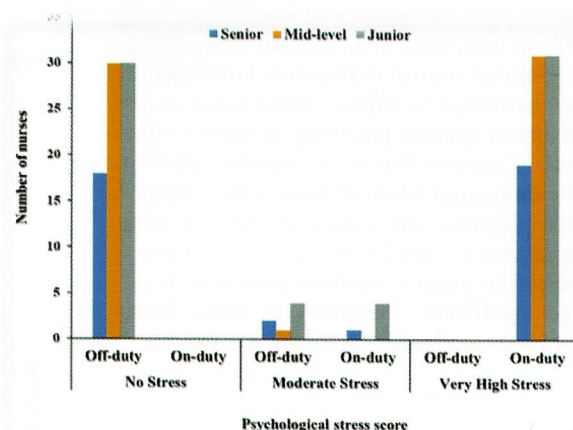


Figure 8: Ranks of nurses and their psychological levels of stress. Legend: blue color-Senior nurse; orange color-Mid-level nurses; ash color-Junior nurses

± 6.80 kg. Their BMI ranged from 17.96–34.82 kg/m² with a mean of 26.11 ± 2.96 kg/m². Majority of the nurses (52.94%, 48/85) were in WHO classification of overweight (Figure 1).

Frequency of consumption of foods

Figure 2 shows the frequency of consumption of the different food groups by the nurses. Animal protein was consumed more frequently than all other food groups with 89.41% (76/85) of the nurses consuming it daily. This was followed by a daily

consumption of cereals and grains (71.86%, 61/85). The least frequent daily consumed of the food groups by the nurses was fruit juice (7.05%, 6/85). In terms of weekly consumption, soft drinks were the most consumed (37.65%, 32/85).

On duty and off duty daily caloric intake of nurses

The mean daily caloric intake of the nurses, both on duty and off duty, is shown in Figure 3. The nurses had higher intakes of calories when off duty compared to when on duty. There was a

statistically significant difference ($p < 0.001$) in caloric intake between on duty and the off duty hours of the nurses.

Psychological Stress Scores. The psychological scores of the nurses, both on duty and off duty, is shown in Figure 4. The nurses had lower psychological stress scores when off duty compared to when on duty. There was a statistically significant difference ($p < 0.001$) in psychological stress scores between on duty and the off-duty hours of the nurses.

Salivary cortisol levels. The salivary cortisol levels of the nurses, both on duty and off duty, are shown in Figure 5. The nurses had higher salivary cortisol levels when on duty compared to when off duty. There was a statistically significant difference ($p < 0.001$) in salivary cortisol levels between on duty and the off duty hours of the nurses.

Effects of stress on total daily caloric intake of nurses

Psychological levels of stress. Low mean psychological stress level scores (17.12 ± 7.15) corresponded to high mean total daily caloric intake (2368.74 ± 259.67 kcal) while the nurses were off duty. On the other hand, high mean psychological stress level scores (61.18 ± 7.42) corresponded to low mean total daily caloric intake (1784.80 ± 402.84 kcal) while the nurses were on duty. However, no significant correlations were observed (all $p > 0.05$).

Salivary cortisol levels. Low mean salivary cortisol levels (5.10 ± 1.02 $\mu\text{g}/\mu\text{L}$) corresponded to high mean total daily caloric intake (2368.74 ± 259.67 kcal) while the nurses were off duty. On the other hand, high mean salivary cortisol levels (61.18 ± 7.42 $\mu\text{g}/\mu\text{L}$) corresponded to low mean total daily caloric intake (1784.80 ± 402.84 kcal) while the nurses were on duty. However, significantly positive correlations (Figures 6 and 7) were observed with total caloric intakes and salivary cortisol levels whether the nurses were on duty ($r = 0.585$; 95% confidence interval (CI), 0.425-0.780; $p < 0.001$) or off duty ($r = 0.319$; 95% CI, 0.113-0.498; $p < 0.003$).

Ranks of nurses and their psychological levels of stress

Almost all the nurses (91.76%, 78/85), irrespective of rank indicated that they had no stress while off duty. Almost all the nurses (95.29%, 81/85), irrespective of rank, also indicated they had very high stress on duty (Figure 8). Mid-level and junior nurses recorded the highest frequency (30 each rank) of very high stress scores while on duty as well as highest numbers of no stress when off duty. Fewer senior nurses (18) recorded high psychological stress levels while on duty.

DISCUSSION

This study assessed the association between caloric intake and work related stress among nurses in two district level hospitals. Results indicated that, the nurses developed unhealthy eating behaviors characterized by poor caloric intakes at different duty times in attempt to adjust and adopt to the work place stress, evidenced by the high body mass indices and the stress levels recorded. Majority of the nurses were overweight which predisposes them to increased risk of many serious diseases such as Non-Communicable Diseases (NCDs) including obesity and cardiovascular disorders [22] and its related health problems and complications. This overweight status of the nurses could be

attributed to their excessive caloric intakes during off duty hours, coupled with their high consumption of simple carbohydrates such as soft drinks as shown in their dietary pattern assessment. This agrees with findings that individuals may seek out and consume energy dense foods during stressful situations [23]. Another contributory factor to the high BMI of the nurses could be their relative inactivity for long hours when they had few patients to attend to or when they dispensed medications and during ward duties [24]. Most nurses, after closed of work, may tend to take some rest till their next shift begun and are likely to engage in little exercises. In the present study, although the energy intakes was low, they probably did not utilize all the energy and their bodies still managed to store some energy as fat due to the low activity level, thereby increasing their BMI [25].

Food intake assessment revealed that animal source proteins were more frequently consumed, (>80%) daily than any other food group. Cereals and grains were the next (71%) frequently consumed food group. This was due to their choices of foods like banku, rice, kenkey and waakye which are cereal and grain based and constitute the staples in that area. These foods are mostly whole grain and can contribute a good source of dietary fibre. However, they are also starch based foods and serve as a good source of energy which adds up to energy gotten from the consumption of simple carbohydrate foods such as soft drinks. The 24 h recalls revealed that nurses skipped meals usually while on duty. This was reflected in the lower mean caloric consumption (1,754.85 kcal), observed on duty which was less than the recommended daily intake of energy [reference daily intake (RDI), 1800-2200 kcal] for adults. This was reflected in the BMI of some respondents being as low as 17.96 kg/m^2 (underweight). The nurses explained that working morning shifts from 7:00 am to 2:00 pm compelled them to leave home very early for work, resulting in taking breakfast outside home. This often caused them to take their first meals as late as 11:00 am and consequently, the second meal conveniently shifting to late afternoon (4:30 pm to 5:00 pm) when at home. This poor eaten pattern had gradually become routine and habitual for many of them. The 24 h recall dietary assessment further, revealed that while on duty, some nurses consumed as low as 966 kcal/day. This low energy intake could make them lethargic and ineffective and could also have significant impact on immune response, considering their relatively higher risks for infections compared to other professionals. This agrees with findings that these interactions could prove hazardous on health of workers [26]. Such low intake of calories at work, also agrees with the findings that acute stress, such as experienced by nurses when emergency patients are rushed into the hospital results in a physiological response that suppresses appetite [27]. This also led to the conclusion that, the raised levels of stress and depression among nurses in carrying out their duties could affect body systems, hence their nutritional status [28].

The high scores in the psychological and physiological stress indices in this study are in accordance with the earlier study which concluded after a review of healthcare settings across 17 countries, that nurses experience a high level of occupational stress, related to low caloric intake [10]. These findings confirm Helford's conclusions that hormones released in response to stress could either suppress appetite or induce appetite [29]. In the present study, increased salivary cortisol levels related to decreased energy intake ($p = 0.001$) observed, demonstrates a

decrease in appetite. Mehlum [30] also reported a suppression of appetite by corticotropin-releasing hormone during stress. This could be attributed to Bjorntorp's [31] submission that, cortisol as a marker of hypothalamic-pituitary-adrenal (HPA) axis activity, may affect the regulation of appetite via neuropeptide Y and leptin. Mean salivary cortisol level measured both on duty and off duty showed that salivary cortisol as an indicator of physiological stress will rise with rising stress levels. Cortisol levels rise due to perturbations in the organism's environment (i.e., stressors) [32].

Hyper-activation of the HPA axis, with release of corticosteroids has been associated with individuals who are chronically stressed [31]. These elevated levels of the hormones are necessary to mobilize energy from body stores in order to deal with the stress encountered. Responses to acute or chronic stress can lead to physiological changes which include elevation of blood pressure, increase in heart rate, mobilization of energy stores, and decrease in blood flow to non-essential organs, like the digestive system, kidneys and skin [33]. This implies that blood and energy may be shunted to the areas of the body such as muscles, cardiovascular system and the liver that will utilize it to contain or overcome the stress placed upon the body. A correlation of on duty psychological stress scores and on duty caloric intake was weak (0.07) and statistically insignificant ($p = 0.535$). This implies that even though high scores of psychological stress were registered, there was very little effect on caloric intake. This could be attributed to the reduced access to food in the hospital premises observed during work hours. In addition, nurses may be so busy attending to patients that they forget to eat or may not be able to make time to acquire food. The same correlation off duty showed an inverse relationship ($r = -0.082$, $p = 0.457$). This observation suggests that, as psychological stress is reduced at the homes, caloric intakes of the nurses rather increases. This also agrees with Takeda et al. [34] who stated that cortisol is known to stimulate appetite during recovery from stress. Relatively elevated cortisol levels while nurses were off duty correlated with increased caloric intake ($p < 0.001$). A correlation ($p = 0.003$) of off duty cortisol level and on duty caloric intake further confirmed that when cortisol levels increased, food intake by nurses also increased. This further confirms the findings that increased cortisol levels will increase appetite and hence food intake [34]. When nurses have returned home from work, they are able to better consume foods as this is the time they are relaxing and far removed from stress.

The lack of time to prepare and consume foods while under stress as observed in the nurses has also been associated with intake of higher caloric foods in stressed individuals [35]. They observed that energy intake is higher during periods of life stress due to insufficient time to purchase and prepare foods and the increased use of convenience foods, which are typically energy dense. Perceived stress of the various nursing ranks was also assessed both off and on duty. Fewer nurses reported high stress while off duty with the only indication being moderate stress among some of the senior rank nurses. While at work however, all ranks recorded very high stress with the mid-level and junior ranked nurses having the highest scores. This suggests higher exposure to stressors among junior ranks in accordance with Onasoga & Osamudiamen [24] who observed significant relationship between the rank of nurses and the emotional stress experienced. This however, contradicts the findings that, the

rank of a nurse does not affect his or her emotional state [36]. The findings support the urgent need for the design and implementation of stress management counseling programs to tackle WRS of the nurses, as, such high chronic stress could be hazardous to health of the nurses. Moreover, since overweight, obesity and stress are known risk factors for cardiovascular diseases and other NCDs, periodic cardiovascular risk screening/assessment is recommended for early detection and management of such conditions. The study also demonstrates the importance of healthy eating in maintaining optimum health of nurses. There is the need for nurses to patronize dietetic services-have regular dietary consultations with registered dietitians, to provide them with appropriate diet plans and regimen, regular BMI monitoring, offer dietary interventions that will be suitable for their peculiar work schedules.

Conclusion

Significant differences in the stress levels of the nurse, when on duty and when off duty, were observed. High psychological stress scores and salivary cortisol levels (physiological stress) when on duty correlated with their low intake of calories and conversely. Duty hours limited food intake considerably resulting in low caloric intake while the opposite was true when nurses were off duty. This poor eating behavior contributed to their overweight status. Junior staff nurses recorded the highest number of reported high stress. Toxicological studies should be conducted to assess the safety of the bioactive extracts. Further work involving the determination of the targets of intracellular signaling pathways must be done.

DECLARATIONS

Ethical considerations

Approval was given by the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences (ISBAHS-ET/10443664/AA/4A/2012-2013). Written permission was sought from the hospitals' administrations before recruitment of participants.

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Competing Interests

No potential conflict of interest was reported by the authors

Author contributions

CAB and JKA originated the concept and design of the study. NN participated in the design, collected the data and conducted laboratory work under supervision of CAB and JKA. Data was analyzed by NN under supervision of CAB; NN drafted the manuscript with JKA. CAB and JKA critically reviewed the draft. All authors read and approved the final manuscript.

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Availability of data and materials

Data is available upon request to the corresponding author

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