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ORIGINAL ARTICLE

Effects of a controlled exercise programme on anthropometric parameters, dietary habit and sleep quality of obese university students

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ABSTRACT

According to the World Health Organization, obesity has reached epidemic proportions globally. In spite of growing public awareness of the importance of weight loss, obesity prevalence continues to rise with at least 2.8 million people dying each year as a result of being overweight or obese. The main objective of this study was to investigate the effects of jogging exercise programme (JEP) on anthropometric parameters, dietary habit and sleep quality of obese Ghanaian university students. This randomised controlled study employed 33 obese (BMI > 30 kg/m^2) students from a tertiary university in Ghana. The experimental group participated in a six-week, 3-5 times/week JEP for 45 and 40 minutes per session while the control group had intervention free session. Anthropometric parameters were assessed using the Omron body composition analyser and a standard tape measure. Sleep quality and Dietary habit were determined using a pre-validated Sleep Quality Scale and Performance of a Brief Dietary Assessment and Intervention tool for Health Professionals questionnaire respectively. The participants had a mean age of 21.70 ± 3.74 years. There were 14 (42.4%) males and 19 (57.6%) females of which 26 (80.8%) were indigenous and 7 (19.2%) were international students. There was significant decrease in body mass index, waist to hip ratio, and visceral fat; and increase in sleep quality (p < .05) at the end of the intervention period. However, the dietary habit of the experimental group did not change significantly (p > .05). In conclusion, JEP has positive impacts on anthropometric parameters and sleep quality of obese persons.
Keywords: Sport medicine, Physical exercise, Visceral fat, Waist to hip ratio, Jogging exercise programme, Obesity.

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INTRODUCTION

Individuals with body mass index (BMI) of more than 30.0 kg/m^2 are classified as obese according to the World Health Organisation. (Peven et al., 2020). Obesity is a major public health problem that has attracted considerable attention worldwide. The global prevalence of obesity has more than doubled since 1980, affecting 107.7 million children and 603.7 million adults in 2015, with more than two-thirds of the United States population being overweight or obese (O'Donoghue et al., 2020). Across South Asia and Sub-Saharan Africa, 1-in-5 adults have a BMI greater than 25kg/m^2 (Muramoto et al., 2014). The prevalence of obesity has tripled over the past 35 years and it is estimated that it will affect over one billion people worldwide by 2030 (O'Donoghue et al., 2020).

Obesity is a known risk factor associated with the development of chronic conditions including hypertension, hyperlipidaemia, hyperglycaemia, chronic hypoxemia, some types of cancer, sleep apnoea and degenerative joint diseases (Park et al., 2003). Obesity also adversely impacts on the quality of sleep which consequently affect cardiovascular and metabolic markers (Basnet et al., 2016).

The rapid surge in obesity is driven mainly by lifestyle factors such as physical inactivity and unhealthy dietary choices (Afshin et al., 2017; McHill and Wright, 2017). The fundamental cause of excess weight gain is the failure to ensure a balance between energy intake and energy expenditure (Bhutani et al., 2021). It has been reported that factors including increased consumption of energy dense poor nutrient foods contributes towards the development of obesity and metabolic syndrome (Ashizawa et al., 2014). A sedentary lifestyle negatively affects physical fitness in persons with obesity. Studies of the fitness levels of those with obesity, although not quite enough, indicate that aerobic and anaerobic exercise levels are much lower in persons living with obesity (Zouhal et al., 2020). Although the factors influencing a compromised performance in the population with obesity remain unclear, there is a consensus that excess body fat and sedentary lifestyles remain important factors to consider in developing intervention programme (Zouhal et al., 2020).

Exercise and physical activity do not only help to reduce the risk of chronic diseases, but also improve sleep quality (Monteiro et al., 2014). According to a behavioural construct, good sleep health is characterized by subjective satisfaction, appropriate timing, adequate duration, high efficiency, and sustained alertness during waking hours (Buysse, 2014). It is typically, but not necessarily, accompanied by postural recumbence, behavioural quiescence, closed eyes, and all the other indicators one commonly associates with sleeping.

In a cross-sectional study in Japanese females (Katagiri et al., 2014), poor sleep quality was found to be significantly associated with consumption of energy drinks and sugar-sweetened beverages, skipping breakfast, and eating irregularly. The study further suggested that unhealthy food habits may be associated with insomnia symptoms, and prospective weight gain in individuals with sleep disorders. Thus, the crosstalk between sleep quality and metabolism plays a key role in the regulation of food intake and energy balance, affects obesity development and should be taken into account in both obesity treatment and prevention (Basolo et al., 2021; Katagiri et al., 2014).

Sleep is therefore an indicator of health status in both diseased and general population (Miró et al., 2008). The effects of sleep are not limited to the body when in need of neurological restoration, but on normal development, functioning of cognitive and intellectual capabilities and good quality of life (Miró et al., 2008). Epidemiological studies have reported an inverse relationship between sleep duration and body mass index (Hursel et al., 2013; Patel, 2009). Potential mechanisms linking poor sleep to obesity and cardio-metabolic risk include up regulation of appetite and reduced motivation to be physically active (Knutson and Cauter,

2008; Quist et al., 2016). Evidence suggests that short sleep duration, poor sleep quality, and irregular sleep patterns are associated with increased risk of obesity and the metabolic syndrome (Schmid et al., 2015).

The treatment for obesity consists primarily of an improvement in eating habits and increased physical activity (Jacob and Isaac, 2012; Klem, et al., 1997; Nordmo et al., 2020). While treating obesity, major emphasis should be directed towards increasing regular physical activity and supported with dietary interventions. By this approach the risk of other chronic diseases often associated with obesity could be minimized thereby improving the quality of life (Jacob and Isaac, 2012).

A recent study among 4393 reproductive female students of higher institution in Ghana showed that 31.1% and 22.4% were overweight and obese respectively (Killian et al., 2021). The authors revealed that the prevalence of obesity in Ghana may be associated with multiple factors such as socio-economic, lifestyle and biological factors, environmental factors such as physical proximity to fast food outlets.

Jogging is an outdoor physical activity mostly used to stay active, fit and healthy particularly in Ghana. Early morning jogging is a very popular physical activity in Ghana especially on weekends. Although there has been research on overweight and obesity related interventions, no attention has been placed on jogging exercise programme. Scientific report of the effectiveness of jogging exercise programme will significantly complement existing practices.

The present study seeks to broaden the knowledge depth on interventions to manage obesity among university students in Ghana. Also, the study will make available information on weight management as well as helping to reduce obesity related problems among students. This study therefore seeks to investigate jogging exercise programme; its effect on dietary habits, anthropometric parameters and the sleep quality of obese persons in a university in Ghana.

MATERIAL AND METHODS

Research design

The study employed a randomized control design to assess the effect of jogging exercise programme (JEP) on the anthropometric parameters, dietary habits, and sleep quality of obese university students.

Participants

The study involved thirty-three obese university students who were recruited regardless of their college, programme and level of study. Purposive and randomized control sampling techniques were used to recruit and assign the participants. The participants were initially invited for voluntary health screening and advice programme at the main university campus. During the health advice session, about ten percent (33) of those with BMI of 30 kg/m^2 and above initially indicated interest to join any beneficiary exercise programme session. They were thereafter contacted for jogging exercise programme. Out of the 33 obese students, 26 consented to participate in a six-week jogging exercise programme while 7 declined due to study workload but agreed to serve as control for the study. All participants were taken through all the test and training protocols before the start of the study and completed an informed consent form prior to the commencement of the study. Participants were informed that participation is voluntary and that they exercise the prerogative right to withdraw from the study without having to provide any reasons.

Measurements

Demographic characteristics of the participants such as age, gender, year of study, ethnicity were obtained.

Anthropometric parameters

Omron Body Composition Monitor and Scale with Seven Fitness Indicators Model: HBF-514C (Omron Healthcare Co. Ltd., Kyoto, Japan) was used to measure the anthropometric parameters such as body fat percentage, body mass index (BMI), skeletal muscle, resting metabolism, visceral fat, and body weight. Waist and hip circumference were measured using a standard tape measure. The measured waist circumference and hip circumference of the participants was used to calculate their Waist to hip ratio (WHR), using the formula: WHR = waist circumference/hip circumference.

Sleep quality assessment

Sleep quality scale designed by Yi et al. (2006) was used to assess the participants' subjective sleep quality. A total score is between the range of 0 – 84 (28 items and a 4-point Likert scale was used, that is 0, 1, 2, 3 and interpretation of rarely, sometimes, often and almost always respectively). Higher scores represented more difficult sleeping problems. Lower scores denote high sleep quality or little or absence of sleeping difficulties. The scale has a consistency level of 0.92 and test-retest reliability of 0.81 from previous research (Digdon and Landry,2013). However, the current study proved to have a Cronbach alpha of 0.78 indicating the scale is highly reliable. Examples of some questions the scale assess are; I have difficulty falling asleep, I fall into deep sleep, poor sleep gives me headache.

Dietary habit

Dietary habit was measured with the Performance of a Brief Dietary Assessment and Intervention Tool for Health Professionals (Paxton et al., 2011). The scale contains 10 questions with 4 responses (1, 2, 3, and 4), total scores ranges from 10 to 40. The author's interpretation to the score is that 10-19 represent poor dietary habits, 20-29 represent fair, 30-39 represent good dietary habits and 40-50 corresponds to excellent dietary habits. The scale with the current study had a Cronbach alpha of 0.69, indicating high reliability. Examples of the questions in this scale are; How many servings (1 serving = 1/2 cup) of fresh, canned, frozen or dried fruit did you eat each day? How many times a day did you eat fast/fried food/or packaged snacks high in fat/salt/or sugar? How would you rate your overall habits of eating healthy foods?

Intervention

Anthropometric parameters, dietary habit and sleep quality of the participants were determined before and after the six weeks jogging exercise programme (JEP) to help establish any changes in research variables.

JEP sessions for the participants included a warmup and cool down of 10 minutes each, followed by 45 minutes of a combination of different types of jogging (Base, Long, Recovery, Sprint, Fartlek, Progression, Hill repeats, Tempo and Intervals) 3 times a week (Monday, Thursday and Saturday) for the first two weeks. From week 3 to 6, the JEP duration was reduced to 40 minutes and frequency increased to 5 times a week (Monday, Tuesday, Thursday, Friday and Saturday) with the same types of jogging. Each of the JEP sessions took place every morning (5:00am-7:00am). Studies have established the efficacy of the various types of jogging (Kurz et al., 2000). Details of the JEP is presented in Table 1.

The seven participants in the control group did not participate in any exercise session and were instructed not to embark on any form of exercise. They were however monitored and restricted only to activities of daily living during the period of the study.

The study was approved by the authors' institutional Research Ethics Committee (Number: CHRPE/AP/582/21).

Table 1. Jogging exercise programme.

Week	Warm-up/cool down	Type	Frequency	Duration
Week 1	10 Minutes	Jogging: Base, Long, Recovery, Sprint, Fartlek, Progression, Hill repeats, Tempo, Intervals	3	45 Minutes
Week 2			3	45 Minutes
Week 3			5	40 Minutes
Week 4			5	40 Minutes
Week 5			5	40 Minutes
Week 6			5	40 Minutes

Data analysis

IBM Statistical Package for Social Sciences (SPSS) version 21.0 was used for data entry and analysis. Descriptive statistics on participants' demographics was done. T-test was used to determine the effect of the exercise programme on research variables. Statistical significance, *p* was set at .05.

RESULTS

Demographic characteristics

Table 2. Demographic characteristics of participants.

Variables	Frequency (n = 33)	Percentage (100%)
Age group (years)		
16-20	11	33.3
21-25	17	51.52
Above 25	5	15.15
Total	33	100
Year of Study		
First year	5	15.15
Second year	7	21.21
Third year	9	27.77
Final year	12	36.36
Total	33	100
Sex		
Male	14	42.40
Female	16	57.60
Total	33	100
Student status		
Indigenous student	26	78.80
International student	7	21.20
Total	33	100
Any family history of obesity?		
Yes	15	45.50
No	18	54.50
Total	33	100

Participants' minimum and maximum ages were 17years and 25years respectively with a mean age of 21.70 ± 3.74 years. First years, second years, third years and final years accounted for 5 (15.15%), 7 (21.21%), 9 (27.27%) and 12 (36.36%) respectively. There were 14 (42.40%) males and 19 (57.60%) females. Twenty-

six (80.8%) were indigenous students and 7 (19.2%) were international students, 45.50% had a family history of obesity whiles 54.55% had no family history of obesity. Participants' demographic characteristics are represented in Table 2.

Effect of JEP on anthropometrics, dietary habits and sleep quality

Pre and post data analysis of experimental and control groups variables are presented in Table 3 and 4 respectively. T-test analysis showed a significant decrease in all anthropometric and sleep quality parameters ($p < .05$) except for dietary habits ($p > .05$) in the intervention group. However, the controlled group showed no significant difference in the anthropometrics and the dietary habits ($p > .05$) but not so with the sleep quality which showed significant improvement ($p < .05$) although the percentage of improvement is not compared to the experimental group.

Table 3. Pre-post analysis of experimental group.

Variable	Pre-Test	Post-Test	Mean Diff.	%Diff	SEM	T-value	*p*-value
	Mean ± SD		± SD		(95% CI)		
BMI	33.04±2.71	31.46±2.45	1.57±1.27	4.75	0.25(2.09-1.06)	6.321	.00
Sleep quality	1.31±0.29	0.81±0.12	0.50±0.30	38.44	1.63(17.50-10.80)	8.700	.00
Dietary habits	27.88±3.17	28.23±3.33	-0.35±3.78	1.25	0.74(1.18-1.87)	-0.472	.645
Visceral fat	10.31±3.16	8.54±2.30	1.77±1.73	17.16	0.34(2.47-1.07)	5.225	.00
Waist to hip ratio	0.86±0.03	0.83±0.04	0.02±0.03	2.33	0.01(0.03-0.01)	4.283	.00

Table 4. Pre-post analysis of control group.

Variable	Pre-Test	Post-Test	Mean Diff.	%Diff	SEM	T-value	*p*-value
	Mean ± SD		± SD		(95% CI)		
BMI	33.14±3.44	33.14±2.61	-0.57±1.72	1.72	0.65(1.02-2.16)	0.880	.413
Sleep quality	1.46±0.16	1.29±0.22	0.17±0.12	12	1.27(8.11-1.89)	3.930	.008
Dietary habits	26.29±3.20	27±2.31	-0.71±4.92	2.70	1.86(3.83-5.26)	-0.384	.714
Visceral fat	9.86±2.73	10.43±2.23	0.00±1.41	0.00	0.53(1.31-1.31)	0.000	1.000
Waist to hip ratio	0.85±0.04	0.85±0.04	0.01±0.02	1.18	-0.01(0.02-0.01)	0.63	.555

DISCUSSION

The main objective of this study was to investigate the effects of jogging exercise programme on anthropometric parameters, dietary habits and sleep quality of obese students in a Ghanaian university.

The findings from this study reveal that, the anthropometric parameters such as visceral fat, Body Mass Index and Waist to Hip ratio decreased significantly in obese students after undergoing 6 weeks structured jogging exercises programme ($p = .00$). A control group of the same population found no significant difference in their anthropometry: BMI ($p = .413$), WHR ($p = .555$) and visceral fat ($p = 1.000$).

In conformity with the present study, a similar study by Fett et al. (2008) reported that total body mass, BMI, body fat percentage from anthropometry, body fat percentage by BIA, as well as WHR were significantly reduced in the intervention group after a 6-week jogging programme.

Zouhal et al. (2020) also reported that both aerobic (e.g., endurance training) and anaerobic training (e.g., high-intensity training, resistance training) improved body composition and physical fitness indicators in

adults, adolescents and children with obesity. They suggested that both low- and high-intensity training significantly reduced body weight and fat mass while increasing fat-free mass in individuals with obesity.

Again, findings from the current study is similar to the study conducted by Wouters et al. (2010). The authors found that, total fat mass and waist circumference decreased by 1.4 kg (p = .03) and 3.1 cm (p = .005), respectively. The authors concluded that jogging was associated with reduced body fat, waist circumference and improved aerobic fitness and quality of life.

From the study, sleep quality proved to be significantly affected positively by JEP as seen in the exercise group with an average sleep quality score of 1.31 (pre-test) to 0.81 (post-test) which denote sleep pattern with rare to few sleep problems. The control group likewise showed significant improvement in their sleep quality which could be attributed to the physical activity level of the participants as a result of their daily lifestyle choices that were not controlled for in this study. The exercise group however was affected by the JEP as results showed higher significance level of change. JEP therefore can effectively help to reduce the sleep problems that is associated with obese students.

Among other studies which have shown significant effects of physical activity on the sleep quality of obese persons, Brand et al. (2010) investigated whether chronic vigorous exercising is related to improved sleep and psychological functioning. Results showed that, compared with controls, athletes in the experimental group reported better sleep patterns including higher sleep quality, shortened sleep onset latency, and fewer awakenings after sleep onset, as well as less tiredness and increased concentration during the day. In another study, Kredlow et al. (2015), who examined the effects of acute and regular exercise on sleep quality reported that regular exercise has moderate beneficial effects on sleep quality, which is in conformity with the present study.

The study revealed no significant difference in the dietary habits of both the exercise group and the control group though there was an improvement in the scores of both groups. This means that the 6 weeks JEP did not significantly improve the dietary habit of the participants. A study by Vizuete et al. (2012) about the relationship between the physical activity levels and diet quality of a group of young adults from Madrid revealed that active individuals follow healthier diets habit and keep a more adequate body weight. The authors clearly concluded that, when an individual exercises or live an active lifestyle, it increases the metabolic rate and hence force them to select foods that are energy yielding. In other words, the lower the physical activity level the poorer the dietary habit. Contrary to this finding, the current study found no significance difference in the dietary habits of the participants and may be because most of the participants were living sedentary lives prior to the intervention of this study. In addition, the six weeks intervention of this study might not be long enough to effect changes in the dietary habits of the participants.

Another study conducted by Joo et al. (2019) examined the effect of a 15-week exercise training programme on overall dietary patterns among young obese adults. Results showed that, within each of the seven dietary patterns identified, most dietary pattern scores decreased following exercise training, consistent with increased voluntary regulation of food intake. A longer duration of exercise was associated with decreased preferences for the western and snacking patterns, while a higher intensity of exercise was linked to an increased preference for the western and snacking patterns. The current study on the contrary showed no significant effect on the dietary habits of the participants and this could possibly be as a result of the differences in the exercise duration and the study population as well as the geographical location of the participants.

CONCLUSION

In conclusion, the major findings of the present study were that there was a clear dose-response effect observed between amount of 6-week JEP and amount change of anthropometric parameters such as visceral fat, waist to hip ratio and body mass index. The finding also establishes significant change in the sleep quality of the participants. JEP, however, did not improve the dietary habits of the participants significantly. Findings from this study suggest that a modest amount of JEP can control the anthropometrics and improve sleep quality of obese persons with no changes in dietary habits and may lead to important weight loss in obese individuals. Future research should look into comparing JEP and other exercise programmes to establish how different they could affect the anthropometric parameters, dietary habits and sleep quality of obese persons. Similar research should be conducted with larger sample size and longer exercise duration to be able to generalize widely. The current study did not take into consideration the genetic and other biological factors that influence obesity status. Future researches can however look at how individuals who are genetically predisposed to obesity could be controlled biologically.

AUTHOR CONTRIBUTIONS

Conception and design (Adams, C. ,Oppong, P. and Moses, M.O.). Implementation of exercise protocol and data collection (Oppong, P., Worlanyo, J.K., Agblo, S.P., Owusu, S., Addo, E.). Formal analysis and interpretation of data (Oppong, P., Worlanyo, J.K., Agblo, S.P., Owusu, S., Addo, E.). Supervision (Adams, C. and Moses, M.O). Writing of original draft (Adams, C. and Oppong, P.). Writing, review and final editing (Adams, C. , Oppong, P. and Moses, M.O).

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors. The experiment complies with the current laws of Ghana and was given ethical approval by the researchers institution.

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