A PSYCHO-PHYSICAL INTERVENTION FOR WAIST CIRCUMFERENCE AND WAIST HIP RATIO AMONG PAKISTANI WOMEN: A RANDOMIZED CONTROL TRIAL STUDY

Muhammad Waseem Tufail[1]
Rahmattullah Khan[2]
Md. Azman Shahadan[3]
Muhammad Saleem[4]

[1-3] *Department of Psychology & Counseling, Sultan Idris Education University, Malaysia*
[4] *Department of Applied Psychology, The Islamia University of Bahawalpur, Pakistan*

[1]Corresponding author: waseemtufail.pk@gmail.com

ABSTRACT

*Central obesity reduction through effective treatment is desirable everywhere in the world including Pakistan. The current study intends to provide effective intervention programs to reduce central obesity among Pakistani women. Through randomized control trial study fourteen females (N= 14, WHR= .897 ± .030) were recruited by employing penal data technique with simple randomization. The sample distributed into two equal groups from online randomization. The experimental group received 10-week sessions of modified cognitive behavior therapy (CBT) along with supervised and unsupervised exercise execution, plus supervised diet management plan. As a contrast, the control group received 10-week sessions without offering standard treatment. The results found that the intervention group or experimental group significantly reduced waist circumference (-2.33 inches) while control group reduced (-0.36 inches) within 10 weeks, F=42.82, p<.001***, η^2_p =0.781. Likewise, the experimental group reduced hip circumference (-0.75 inches), and control group reduced only (-0.07 inches), F=69.75, p<.001***, η^2_p =0.853 respectively. Finally, the experimental group reduced waist to hip ratio (-0.042) but control group reduced only (-0.007) within 10 weeks, F=27.0, p<.001***, η^2_p =0.692. Conclusively, the combination of CBT with an exercise regimen and diet plan is effective to reduce waist circumference, hip circumference, and waist to hip ratio among obese women. The limitations and future directions are also discussed that can be a good contribution in the body of knowledge concerning obesity research.*

Keywords: *CBT, exercise, diet management, women, central obesity, pakistan, effective interventions*

INTRODUCTION

Waist circumference (WC) is the best predictor to quantify the absolute amount of visceral adipose tissue in a human being (Despres, 2001), and can be a good representation for central obesity (Ashwell & Hsieh, 2005). Waist circumference directly correlated with abdominal fat mass in terms of correlation with intra-abdominal and subcutaneous and regularly used as a substitute of abdominal fat mass (Klein, 2007). A medical study on computed tomography revealed that waist-to-hip ratio is linked with a high proportion of intra-abdominal fat (Beevers, & Prince, 1991).

Waist circumference (WC) and waist-to-hip ratio (WHR) are well predictor of obesity comparable to BMI among Pakistani population (Ghafoor, Mahmood-ur-Rehman, & Irshad, 2016), while female have significantly larger waist circumference and higher prevalence of central obesity as compared to male (Mogre, Aleyira, & Nyaba, 2015). Furthermore, South Asian females are more obese in perspective of the larger waist and hip circumference as well as waist-to-hip ratio comparable to male (Amin, Fatima,

Islam, & Gilani, 2015). In perspective of the waist and waist-to-hip ratio, South Asian people are significantly bigger than European and Black Caribbean people (Williams et al., 2015).

Pakistani women raised waist and waist-to-hip ratio (approximately 55%) more than twice as compared to other women (approximately 20%) in general (Fox, 2004), and high waist hip ratio is more frequently observed in Pakistani females (Zahid, Meyer, Kumar, Claussen, & Hussain, 2011). The study explored that Pakistani women were the highest proportion of central obesity, more obesity prevalence, greater waist circumference (≥0.88cm) and waist-to-hip (≥0.85) comparatively with Turkey, Vietnam, and Iranian women (Kumar, Meyer, Wandel, Dalen, & Holmboe-Ottesen, 2006). Meanwhile, within Pakistani community women belongs to Aga Khani community are more abdominal obese as compared to Dawoodi Bohra and Memon (Parveen, Ali, Ali, & Hasnain, 2016).

Waist circumference considered as a vital part of a metabolic syndrome that leads toward comorbidity of other medical diseases and even mortality. A large number of waist circumference have approximately 20% higher mortality risk among women (Koster et al., 2008). A longitudinal study (12-years) explored that waist hip ratio is a better predictor of in myocardial infarction, stroke, angina pectoris, and even death than any other anthropometric measurement (Larsson, Svärdsudd, Welin, Wilhelmsen, Björntorp, & Tibblin, 1984).

Pakistan national diabetes survey explored that waist-to-hip ratio is more significantly correlated with diabetes as compared to BMI and study findings shows that for the women WHR is strongly associated with glucose intolerance (Khan, & King, 1999). Therefore, waist circumference is better indicator to BMI for explaining obesity associated health risks in women (Janssen, Katzmarzyk, & Ross, 2004), future risk of diabetes mellitus and Hyperglycaemia (Lopatynski, Mardarowicz, & Szczesniak, 2003; McKeigue, Shah, & Marmot, 1991; Neeland et al., 2012; Qiao, & Nyamdorj, 2010; Zafar et al., 2011; Zafar et al., 2016), type 2 diabetes (Chan, Rimm, Colditz, Stampfer, & Willett, 1994; Fawwad et al., 2016), tuberculosis (Aftab et al., 2017), hyperinsulinemia and cardiovascular risk (Akatsu, & Aslam, 1996; Sowers, 2003), hypertension (Hayashi et al., 2003; Safdar, Bertone-Johnson, Cordeiro, Jafar, & Cohen, 2015), systolic and diastolic blood pressure (Khan et al., 2008).

Waist circumference is useful for health promotion programs and greater than 80cm waist for women should ask for weight management as well as women having equal or greater than 88cm waist should reduce their weight (Lean, Han, & Morrison, 1995). Defensibly, waist circumference considered as a good and reliable indicator to measure changes in intra-abdominal fat particularly during weight loss attempts (Van der Kooy, Leenen, Seidell, Deurenberg, & Hautvast, 1993), and could be used for managing body weight (Ashwell, Lejeune, & McPherson, 1996). That is the reason to launch intervention program for Pakistani women and used psycho-physical interventions including modified CBT, exercise regimen, and diet plan because these combinations of intervention are very effective for obese women to reduce waist, hip circumference and waist-to-hip ratio (Eriksson, Westborg, & Eliasson, 2006; Mefferd, Nichols, Pakiz, & Rock, 2007).

Objective of the study

To gauge the efficacy of psycho-physical ways (modified cognitive behavior therapy, exercise management, and diet plan) to reduce waist, hip circumference and waist-to-hip ratio among Pakistani females.

Hypotheses of the study:

H1: CBT, Exercise and Diet group (Experimental group) lose more waist circumference and hip circumference as compared to control group among Pakistani females.

H2: CBT, Exercise and Diet group (Experimental group) reduced more waist-to-hip ratio as compared to control group among Pakistani females.

METHOD

Participants and Procedure

The current randomized control trial study recruited 14 adult females through penal sampling on the basis of a waist-to-hip ratio (WHR ≥ .80) from South-Punjab, Pakistan, because global health survey found that high prevalence of maternal waste and poor malnutrition indicators in Southern Punjab districts (Di Cesare et al., 2015).

Body composition analyzer (In-Body 370) was used to measure waist circumference, hip circumference, and waist-to-hip ratio. Insertion tape also used for reconfirmation of measurement to measure participant's waist, hip circumference and calculated waist-to-hip ratio manually. All participants equally distributed into two groups through online randomization after taking informed consent. The experimental group received multiple treatments as a form of modified cognitive behavior therapy-CBT (Motivational Interviewing, Self-monitoring & Problem-solving) plus supervised physical activity or exercise (treadmill, aerobic exercise, & unsupervised walking using a pedometer) plus supervised diet management for 10-weeks (weekly session). While control group actually waitlist group that received no proper treatment until 10-week sessions, but engaged them in a group discussion during the session and evaluate their knowledge by asking questions in every week session until 10th-week sessions. After that waist, hip circumference and waist-to-hip ratio measured again at 10th week. After completing data collection, data were analyzed through SPSS (23.0) and results show into tabulated form.

Measurements

The waist circumference, hip circumference and waist-to-hip ratio were measured from body composition analyzer (in-Body 370). Insertion tape also used for reconfirmation of the measurements manually according to world health organization guidelines (WHO, 2011) about waist circumference and hip circumference such as waist circumference measurement taken from the midpoint between the lower margin of the last palpable rib and top of the iliac crest near the 0.1 cm. Furthermore, hip circumference measurement is taken from the maximal circumference over the buttocks. Finally, the waist-to-hip ratio calculated by dividing waist circumference by the hip circumference.

Data Analyses

Data were analyzed through SPSS (23.0) by using descriptive statistics including mean and standard deviation for computing differences between experimental group and control group in terms of age, waist, hip circumference and the waist-to-hip ratio at baseline. Repeated measure ANOVA was employed for computing differences and changes in the waist, hip circumference and the waist-to-hip ratio between experimental group and control group from baseline to week 10th.

Ethical Considerations

The current study considered and fulfilled almost all basic ethical concerns related to experimental in nature studies. Initially, study proposal approval taken from the ethical review committee. The current study fulfilled this step, by the recommendation of proposal evaluation panel from Institute of postgraduate study during proposal defense presentation. Penal sent study proposal to an ethical review committee that consists of five relevant national and international field experts. Study proposal amended according to filed experts' valuable suggestions. The next informed consent (written) taken from all participants. Privacy, autonomy, and confidentiality were maintained of all participants. Further, contamination was avoided among groups to arrange separate sessions in different timing and different days and to identify friends, and relatives who were included in the different groups. Participants guided to hide information about session activities until completing all sessions to verify the effectiveness of the treatment and to control extraneous variables. Withdraw privilege provided to every participant as everyone has a right to withhold any answer to any specific question(s) during the sessions. A participant may also terminate participation at any time, without penalty. Furthermore, risk and benefits considered as the completion of this study may provide benefits in the form of increased self-awareness regarding diet plan and exercise management. For some individuals, this self-awareness may produce momentary discomfort, or during an exercise session

suffer fatigue. However, no appreciable adverse effects on participant's health or well-being expected. Of course, there may be unforeseen effects for particular individuals such as physical fatigue, shortness of breath, rapid heartbeat, muscles contractions etc. That's why medical officer presented during the sessions. The main potential benefit to accrue from this study was decreased waist, hip circumference, and waist-to-hip ratio as well as improved physical activity, and balanced diet.

RESULTS

Table 1: Descriptive Statistics at base line

Measures	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Age	31.0	6.27	26.43	5.19
Waist (inch)	38.0	3.10	39.14	3.76
Hip (inch)	42.0	4.24	44.28	5.82
Waist hip ratio	.907	.025	.888	.033

The table 1 shows descriptive statistics of age, waist, hip, and waist to hip ratio at baseline between experimental groups and control group. The result shows that mean age of the experimental group is 31.0 with standard deviation 6.27 while control group means age is 26.43 with standard deviation is 5.19 at baseline. The mean waist circumference of the experimental group is 38.0 with standard deviation is 3.10 while the mean waist of the control group is 39.14 with standard deviation is 3.76 that is larger waist from the experimental group. The mean hip circumference of the experimental group is 42.0 with standard deviation is 4.24 but the control group hip circumference mean is 44.28 with standard deviation is 5.82 that is wider hip circumference from the experimental group at baseline. Finally, the mean waist hip ratio of the experimental group is .907 with standard deviation is .025 while control group waist hip ratio mean is .888 with standard deviation is .033 that is lower mean from the experimental group at baseline.

Table 2: Outcomes measures form baseline to Post intervention

Measures	Baseline Mean (SD)	Ten Weeks Mean (SD)	Change	*F*	η^2_p	*p*-value
Waist (inch)						
Experimental	38.0 (3.10)	35.67 (2.97)	-2.33	42.82	.781	<.001
Control	39.14 (3.76)	38.78 (3.70)	-0.36			
Hip (inch)						
Experimental	42.0 (4.24)	41.25 (4.28)	-0.75	69.75	.853	<.001
Control	44.28 (5.82)	44.21 (5.76)	-0.07			
Waist hip ratio						
Experimental	.907 (.025)	.865 (.026)	-0.042	27.00	.692	<.001
Control	.888 (.033)	.881 (.041)	-0.007			

Note: Computed using alpha = .05

Table 2 shows loss of waist, hip circumference and the waist-to-hip ratio between experimental group and control group from baseline to week 10th. A 2 × 2 repeated measure (group by time) ANOVA result reveal that experimental group reduced waist circumference (-2.33 inches) within 10 weeks while control group reduced only (-0.36 inches) within the same time frame (see figure 1). There was a significant interaction between treatment condition and time (F= 42.82, η^2_p =

.781, p = <.001***) between experimental group and control group to lose waist circumference. Similarly, the experimental group reduced hip circumference (-0.75 inches) within 10 weeks while control group reduced only (-0.07) within the same time duration (see figure 2). There was a significant interaction between treatment condition and time (F= 69.75, η^2_p = .853, p = <.001***) to reduce hip circumference. Finally, experimental group loses waist to hip ratio (-0.042) within 10 weeks but control group loses only (-0.007) within the same time frame (see figure 3). There was a significant interaction between treatment condition and time (F= 27.00, η^2_p = .692, p = <.001***) for waist hip ratio reduction.

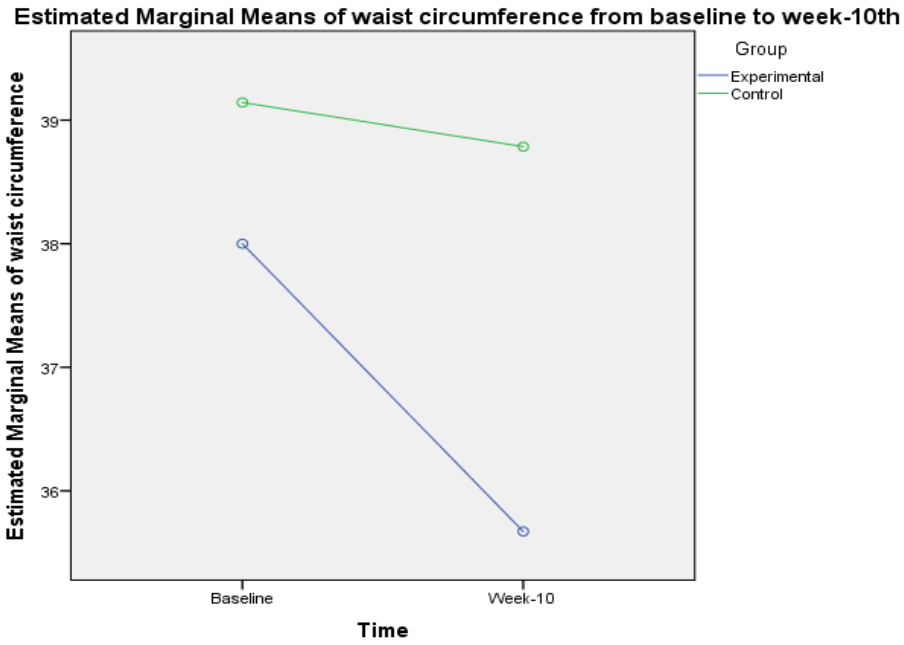

Figure 1

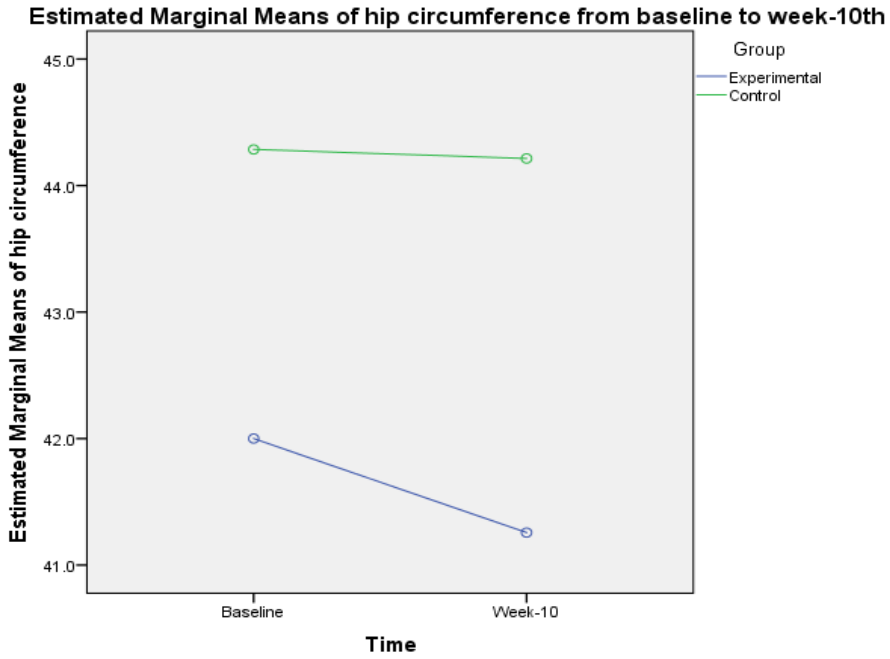

Figure 2

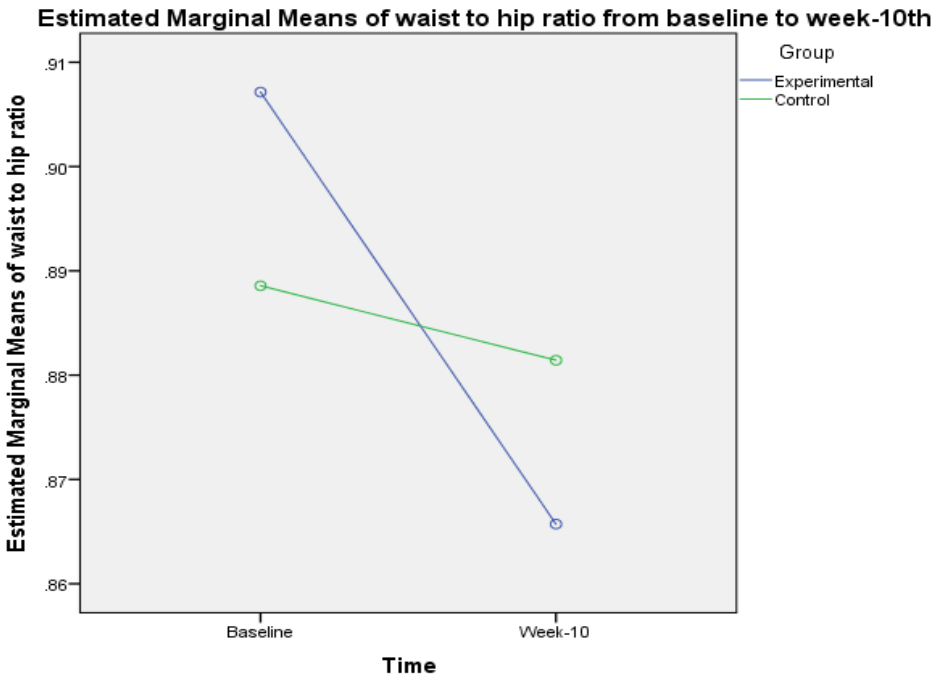

Figure 3

DISCUSSION

The current study used psycho-physical interventions including CBT-modified (motivational interviewing, self-monitoring, problem solving), exercise and diet management for reduction of waist, hip circumference, and waist-to-hip ratio among Pakistani obese women. Supportive studies found that CBT including self-monitoring technique is effective to regulate exercise and diet plan (through continuous monitoring) that further reduced waist circumference, waist to hip ratio, weight, and obesity treatment during intervention period (Burke et al., 2011, 2012), such as motivational interviewing effective technique to motivate participants toward regular exercise, control diet, and behavior change to reduce waist, and hip circumference, as well as other obesity diagnostic factors (Resnicow et al., 2001; Rollnick, Miller, Butler, & Aloia, 2008). Further problem-solving technique identify and solved problems that hinder regular exercise and diet management to reduce waist, hip circumference and obesity treatment (Aronne, 2003; Grundy, 2003). A review study found that 50% intervention studies used CBT including motivational interviewing, self-monitoring and problem-solving techniques to regulate exercise and diet management for reduction waist, hip circumference and obesity treatment (Kelly & Kirschenbaum, 2011).

The current study results indicated that experimental group (modified CBT + Exercise + Diet plan) reduced waist circumference (-2.33 inches) within 10th weeks and control group lose waist circumference only (-0.36 inches) within the same time duration. A similar study reported that through standardized behavior modification women can reduce their waist circumference (-2.92 cm) within 4 months (Rogers, 2012). Another study supported that nutritional intervention reduced waist circumference (-0.6 cm) of women within 6 weeks while (-1.3 cm) loose waist circumference within 12 weeks (Goulet, Nadeau, & Lemieux, 2003). Church and colleagues (2009) reported that exercise reduced waist circumference (-2.0 to -4.0 cm) of women within 6 months while control group only reduced (-1.0 cm) within 6 months. Similarly, Ross and colleagues (2004) investigated that through diet plan women can reduce their waist circumference (-3.8 cm) within 14 weeks while through exercise reduced waist (-6.5 cm) within 14 weeks but control group increased waist circumference (1.1 cm) instead of decreasing within 14 weeks. Another study reveals that through exercise women can reduce their waist circumference from (0 to 2.9 cm) within 6

months while control group loses waist only (-1.4 cm) within 6 months (Church, Earnest, Skinner, & Blair, 2007). Another study supported that through diet plan annual changes in waist circumference is -0.84 cm (Newby et al., 2003).

Furthermore, current study result shows that experimental group reduced hip circumference (-0.75 inches) while control group loses only (-0.07 inches) within 10th weeks. A similar study supported that through behavior modification, exercise management and diet plan people can reduce their hip circumference (-1.1 cm) with 3 months interventions and with 1 year follow up, while control group reduced hip circumference only (-0.5 cm) within same time frame (Eriksson, Westborg, & Eliasson, 2006). Another study supported that through combinations of CBT, exercise and diet plan women can reduce their hip coreference (-4.8 cm) within 16 weeks intervention while control group reduced only (-1.9 cm) within the same time frame (Mefferd, Nichols, Pakiz, & Rock, 2007).

Finally, current study result shows that experimental group reduced waist to hip ratio (-0.042) of obese women while control group loses only (-0.007) within 10th weeks. A similar study supported that through combinations of CBT, exercise and diet plan women can reduce their waist to hip ratio (-2.3 cm) within 16 weeks intervention while control group reduced only (-1.1 cm) within the same time frame (Mefferd, Nichols, Pakiz, & Rock, 2007). Another study supported that through behavior modification, exercise management and diet plan intervention people can reduce their waist to hip ratio (-0.01) with 3 months supervision and with 1 year follow up, while control group not reduced waist to hip ratio (-0.00) within same time frame (Eriksson, Westborg, & Eliasson, 2006).

LIMITATIONS AND FUTURE DIRECTIONS

There are some limitations of the study. The current study was limited to conduct 10th-week sessions without follow up sessions. The future studies should be an extended interventions time frame to get better results and should provide follow up sessions to avoid relapse chances. The current study was focused to reduce only one obesity diagnostic factor (waist to hip ratio) without considering other obesity diagnostic factors and contributing factors of obesity or covariate variables. The future studies should examine contributing factors of obesity and interventions should focus other obesity diagnostic factors as well.

CONCLUSION

The psycho-physical intervention (combination of modified CBT, Exercise management, & Diet plan) is effective for reducing obesity diagnostic factor and to get a significant result within a short period of time between experimental group and control group. The current intervention is also effective particularly for reduction of waist, hip circumference and waist-to-hip ratio among Pakistani obese women.

REFERENCES

Aftab, H., Ambreen, A., Jamil, M., Garred, P., Petersen, J. H., Nielsen, S. D., ... & Christensen, D. L. (2017). High prevalence of diabetes and anthropometric heterogeneity among tuberculosis patients in Pakistan. *Tropical Medicine & International Health*, *22*(4), 465-473.

Akatsu, H., & Aslam, A. (1996). Prevalence of hypertension and obesity among women over age 25 in a low income area in Karachi, Pakistan. *Journal-Pakistan medical association*, *46*, 191-193.

Amin, F., Fatima, S. S., Islam, N., & Gilani, A. H. (2015). Prevalence of obesity and overweight, its clinical markers and associated factors in a high-risk South-Asian population. *BMC obesity*, *2*(1), 16.

Aronne, L. J. (2003). Obesity and the Primary Care Physician. *Handbook of Obesity: Clinical Applications*, 33.

Ashwell, M., & Hsieh, S. D. (2005). Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *International*

journal of food sciences and nutrition, *56*(5), 303-307.

Ashwell, M., Lejeune, S., & McPherson, K. (1996). Ratio of waist circumference to height may be better indicator of need for weight management. *BMJ: British Medical Journal*, *312*(7027), 377.

Beevers, D. G., & Prince, J. S. (1991). Some recent advances in non-communicable diseases in the tropics: 1. Hypertension: an emerging problem in tropical countries. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *85*(3), 324-326.

Burke, L. E., Conroy, M. B., Sereika, S. M., Elci, O. U., Styn, M. A., Acharya, S. D.,... Glanz, K. (2011). The Effect of Electronic Self-Monitoring on Weight Loss and Dietary Intake: A Randomized Behavioral Weight Loss Trial. *Obesity*, *19*(2), 338-344.

Burke, L. E., Styn, M. A., Sereika, S. M., Conroy, M. B., Ye, L., Glanz, K., . . . Ewing, L. J. (2012). Using mHealth technology to enhance self-monitoring for weight loss: a randomized trial. *American journal of preventive medicine*, *43*(1), 20-26.

Chan, J. M., Rimm, E. B., Colditz, G. A., Stampfer, M. J., & Willett, W. C. (1994). Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. *Diabetes care*, *17*(9), 961-969.

Church, T. S., Earnest, C. P., Skinner, J. S., & Blair, S. N. (2007). Effects of different doses of physical activity on cardiorespiratory fitness among sedentary, overweight or obese postmenopausal women with elevated blood pressure: a randomized controlled trial. *Jama*, *297*(19), 2081-2091.

Church, T. S., Martin, C. K., Thompson, A. M., Earnest, C. P., Mikus, C. R., & Blair, S. N. (2009). Changes in weight, waist circumference and compensatory responses with different doses of exercise among sedentary, overweight postmenopausal women. *PloS one*, *4*(2), e4515.

Despres, J. P. (2001). Health consequences of visceral obesity. *Annals of medicine*, *33*(8), 534-541.

Di Cesare, M., Bhatti, Z., Soofi, S. B., Fortunato, L., Ezzati, M., & Bhutta, Z. A. (2015). Geographical and socioeconomic inequalities in women and children's nutritional status in Pakistan in 2011: an analysis of data from a nationally representative survey. *The Lancet Global Health*, *3*(4), e229-e239.

Eriksson, K. M., Westborg, C. J., & Eliasson, M. C. (2006). A randomized trial of lifestyle intervention in primary healthcare for the modification of cardiovascular risk factors The Björknäs study. *Scandinavian Journal of Social Medicine*, *34*(5), 453-461.

Fawwad, A., Siddiqui, I. A., Basit, A., Zeeshan, N. F., Shahid, S. M., Nawab, S. N., & Siddiqui, S. (2016). Common variant within the FTO gene, rs9939609, obesity and type 2 diabetes in population of Karachi, Pakistan. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *10*(1), 43-47.

Fox, C. (2004). British Heart Foundation and NHS publication. Heart disease and South Asians (delivering the National Service Framework for Coronary Heart Disease). Retrieved from Department of Health website: http://www.dh.gov.uk/assetRoot/04/09/89/19/04098919.pdf

Ghafoor, M. U., Mahmood-ur-Rehman, & Irshad, F. (2016). Screening tools for obesity; evaluation of waist hip ratio, waist circumference and BMI among hypertensive patients in a tertiary care hospital. *Professional Medical Journal*, *23*(7), 844-857.

Goulet, J., Nadeau, G., & Lemieux, S. (2003). Effect of a nutritional intervention promoting the Mediterranean food pattern on plasma lipids, lipoproteins and body weight in healthy French-Canadian women. *Atherosclerosis*, *170*(1), 115-124.

Grundy, S. M. (2003). Prevention and Management of Dyslipidemia and the Metabolic Syndrome in Obese Patients. *Handbook of Obesity: Clinical Applications*, 115.

Hayashi, T., Boyko, E. J., Leonetti, D. L., McNeely, M. J., Newell-Morris, L., Kahn, S. E., & Fujimoto, W. Y. (2003). Visceral adiposity and the prevalence of hypertension in Japanese Americans. *Circulation*, *108*(14), 1718-1723.

Janssen, I., Katzmarzyk, P. T., & Ross, R. (2004). Waist circumference and not body mass index explains obesity-related health risk. *The American journal of clinical nutrition*, *79*(3), 379-384.

Kelly, K., & Kirschenbaum, D. (2011). Immersion treatment of childhood and adolescent obesity: the first review of a promising intervention. *Obesity reviews*, *12*(1), 37-49.

Khan, A., Haq, F. U., Pervez, M. B., Saleheen, D., Frossard, P. M., Ishaq, M., ... & Ahmad, U. (2008). Anthropometric correlates of blood pressure in normotensive Pakistani subjects. *International journal of cardiology*, *124*(2), 259-262.

Khan, I. A., & King, H. (1999). Pakistan National Diabetes Survey Prevalence of Glucose Intolerance and Associated Factors in North West Frontier Province (NVVFP) of Pakistan. *JPMA-Journal of the Pakistan Medical Association, OPMA*, *49*, 206.

Klein, S., Allison, D. B., Heymsfield, S. B., Kelley, D. E., Leibel, R. L., Nonas, C., & Kahn, R. (2007). Association for Weight Management and Obesity Prevention; NAASO, The Obesity Society; American Society for Nutrition; American Diabetes Association. Waist circumference and cardiometabolic risk: a consensus statement from Shaping America\'s Health: Association for Weight Management and Obesity Prevention; NAASO, The Obesity Society; the American Society for Nutrition; and the American Diabetes Association. *Am J Clin Nutr*, *85*, 1197-1202.

Koster, A., Leitzmann, M. F., Schatzkin, A., Mouw, T., Adams, K. F., van Eijk, J. T. M., ... & Harris, T. B. (2008). Waist circumference and mortality. *American journal of epidemiology*, *167*(12), 1465-1475.

Kumar, B. N., Meyer, H. E., Wandel, M., Dalen, I., & Holmboe-Ottesen, G. (2006). Ethnic differences in obesity among immigrants from developing countries, in Oslo, Norway. *International journal of obesity*, *30*(4), 684.

Larsson, B., Svärdsudd, K., Welin, L., Wilhelmsen, L., Björntorp, P., & Tibblin, G. (1984). Abdominal adipose tissue distribution, obesity, and risk of cardiovascular disease and death: 13 year follow up of participants in the study of men born in 1913. *Br Med J (Clin Res Ed)*, *288*(6428), 1401-1404.

Lean, M. E. J., Han, T. S., & Morrison, C. E. (1995). Waist circumference as a measure for indicating need for weight management. *Bmj*, *311*(6998), 158-161.

Lopatynski, J., Mardarowicz, G., & Szczesniak, G. (2003). A comparative evaluation of waist circumference, waist-to-hip ratio, waist-to-height ratio and body mass index as indicators of impaired glucose tolerance and as risk factors for type-2 diabetes mellitus. In *Annales Universitatis Mariae Curie-Sklodowska. Sectio D: Medicina*, 58(1), 413-419.

McKeigue, P. M., Shah, B., & Marmot, M. G. (1991). Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. *The Lancet*, *337*(8738), 382-386.

Mefferd, K., Nichols, J. F., Pakiz, B., & Rock, C. L. (2007). A cognitive behavioral therapy intervention to promote weight loss improves body composition and blood lipid profiles among overweight breast cancer survivors. *Breast cancer research and treatment*, *104*(2), 145.

Mogre, V., Aleyira, S., & Nyaba, R. (2015). Misperception of weight status and associated factors among undergraduate students. *Obesity research & clinical practice*, *9*(5), 466-474.

Neeland, I. J., Turer, A. T., Ayers, C. R., Powell-Wiley, T. M., Vega, G. L., Farzaneh-Far, R., ... & de Lemos, J. A. (2012). Dysfunctional adiposity and the risk of prediabetes and type 2 diabetes in obese adults. *Jama*, *308*(11), 1150-1159.

Newby, P. K., Muller, D., Hallfrisch, J., Qiao, N., Andres, R., & Tucker, K. L. (2003). Dietary patterns and changes in body mass index and waist circumference in adults. *The American journal of clinical nutrition*, *77*(6), 1417-1425.

Parveen, Z., Ali, A., Ali, T. M., & Hasnain, A. (2016). Association of dietary patterns with anthropometric, lifestyle and socio-

economic factors among women of selected communities from Karachi, Pakistan. *JPMA. The Journal of the Pakistan Medical Association*, *66*(10), 1249-1257.

Qiao, Q., & Nyamdorj, R. (2010). Is the association of type II diabetes with waist circumference or waist-to-hip ratio stronger than that with body mass index?. *European journal of clinical nutrition*, *64*(1), 30.

Resnicow, K., Jackson, A., Wang, T., De, A. K., McCarty, F., Dudley, W. N., & Baranowski, T. (2001). A motivational interviewing intervention to increase fruit and vegetable intake through Black churches: results of the Eat for Life trial. *American Journal of Public Health*, *91*(10), 1686-1693.

Rogers, R. J. (2012). *The comparison of a technology-based system and in-person behavioral weight loss intervention in the severely obese* (Doctoral dissertation, University of Pittsburgh).

Rollnick, S., Miller, W. R., Butler, C. C., & Aloia, M. S. (2008). Motivational Interviewing in Health Care: Helping Patients Change Behavior. COPD: *Journal of Chronic Obstructive Pulmonary Disease*, *5*(3), 203-203. doi: 10.1080/15412550802093108

Ross, R., Janssen, I., Dawson, J., Kungl, A. M., Kuk, J. L., Wong, S. L., ... & Hudson, R. (2004). Exercise-induced reduction in obesity and insulin resistance in women: a randomized controlled trial. *Obesity*, *12*(5), 789-798.

Safdar, N. F., Bertone-Johnson, E. R., Cordeiro, L., Jafar, T. H., & Cohen, N. L. (2015). Dietary patterns and their association with hypertension among Pakistani urban adults. *Asia Pacific journal of clinical nutrition*, *24*(4), 710-719.

Sowers, J. R. (2003). Obesity as a cardiovascular risk factor. *The American journal of medicine*, *115*(8), 37-41.

van der Kooy, K., Leenen, R., Seidell, J. C., Deurenberg, P., & Hautvast, J. G. (1993). Effect of a weight cycle on visceral fat accumulation. *The American journal of clinical nutrition*, *58*(6), 853-857.

Williams, E. D., Tillin, T., Richards, M., Tuson, C., Chaturvedi, N., Hughes, A. D., & Stewart, R. (2015). Depressive symptoms are doubled in older British South Asian and Black Caribbean people compared with Europeans: associations with excess co-morbidity and socioeconomic disadvantage. *Psychological medicine*, *45*(9), 1861-1871.

World Health Organization. (2011). Waist circumference and waist-hip ratio: Report of a WHO expert consultation, Geneva, 8-11 December 2008.

Zafar, J., Bhatti, F., Akhtar, N., Rasheed, U., Bashir, R., Humayun, S., ... & Nazar, M. (2011). Prevalence and risk factors for diabetes mellitus in a selected urban population of a city in Punjab. *JPMA-Journal of the Pakistan Medical Association*, *61*(1), 40.

Zafar, J., Nadeem, D., Khan, S. A., Jawad Abbasi, M. M., Aziz, F., & Saeed, S. (2016). Prevalence of diabetes and its correlates in urban population of Pakistan: A Cross-sectional survey. *J Pak Med Assoc*, *66*, 922-927.

Zahid, N., Meyer, H. E., Kumar, B. N., Claussen, B., & Hussain, A. (2011). High levels of cardiovascular risk factors among Pakistanis in Norway compared to Pakistanis in Pakistan. *Journal of obesity*, *2011*.