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Stress, Dietary Habit And Physical Activity Express Progression Of Metabolic Syndrome In Adult

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ABSTRACT: ***Background*:** Metabolic syndrome is an array of disorders characterized by dyslipidemia (Increased TG, and decreased HDL level in circulation), high blood pressure, abdominal obesity and Insulin Resistance. As multiple factors are involved in the onset and progression of this syndrome, it is vital to consider and evaluate those multi-array risk factors independently and in association with chronic diseases.

Objective: To evaluate the risk factors which are associated for progression of metabolic syndrome in young adults.

Methodology: This case-control study was conducted among adults of University of Karachi, Karachi, Pakistan during January 2015 to December 2015. The participants of this study were aged between 16 to 25 years. They were divided into two groups, Control and metabolic syndrome (MetS) subjects. International Diabetes Federation Criteria was used to diagnose Metabolic Syndrome in participants. Fasting Blood sample was taken for Fasting plasma glucose, Fasting plasma insulin, High density Lipoprotein, Triglyceride and Cholesterol estimation. Homeostatic Model Assessment Calculator version 2.2 was used for better understanding of Beta cell Function and Insulin sensitivity. Stress score was determined by Holmes Rahe Life Stress Inventory Scale, while data on Physical Activity Level and Food Intake were recorded through well-defined questionnaire. For statistical analysis, Pearson Chi square Test of independence, Independent t-test and Binary logistic Regression were used. P-Value <0.05 were used as significant.

Result: Anthropometric indices including body mass index and waist circumference were found to be significantly different among groups (p-value <0.05). FPG, HDL, TG, VLDL and stress score were significantly high, while Percent Beta, Percent Sensitivity were significantly low in MetS subjects. SBP, DBP, Pulse pressure, Pulse Rate, FPI, HOMA-IR, CHO and LDL were found to be insignificant. Large number of patients were consuming moderate to High level of fat subsisting a sedentary lifestyle. Stress, sedentary life style and fat consumption were shown as significant risk. While FPI and SBP were insignificant predictor of TG and FPG in MetS patients.

Conclusion: The results of this study revealed that, young adults of Pakistani population are at high risk of MetS due to involvement of Stress, Sedentary style of living and high amount of fat consumption. According to IDF criteria fluctuation of WC, FPG, TG and HDL level were found in patients. Along with significantly high BMI, VLDL and low Percent Beta, Percent Sensitivity were found as dominant characters which were altered in youngadults with MetS. No significant changes were observed in SBP and DBP in our result.

Key Words: Metabolic Syndrome, Stress, Physical Activity, Dietary Fat Consumption.

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Introduction:

Metabolic syndrome (MetS) is characterized by dyslipidemia, high blood pressure, and abdominal obesity and Insulin resistance [1-10]**.** Metabolic syndrome is one of the risk factor for the induction of heart disease [11]**.**

Epidemiologic studies of longitudinal and cross-sectional design have shown the prevalence and incidence of MetS [12, 13]. Also, the prevalence of obesity has been dramatically raised and is being associated with increase in diabetes [14].

This analysis put forward a prospective determination of the presence of metabolic syndrome in young adults, it could offer the understanding of its pathogenesis along with recognition in the potential interference of elements.

This syndrome is multifactorial ***(Bruce & Byrne, 2009)*** Evaluation of susceptible factors for chronic diseases with their independent relationship is being considered as vital for prevention of the disease. In children, decreased

physical activity [15-18] low weight during birth [19] infant weight gain [20], alongwith diet, nutrition, breast feeding and genotype are reported as risk factor for metabolic syndrome [21]. However, data of metabolic syndrome risk is largely unknown in young adults.

Dietary habits carry a vital role in its progression. Dietary pattern significantly determines diet associated disease [22-24]. Along with this , physical activity is reported as a key feature to reduce the chances of cardiovascular disease [25], MetS [26] and the prevalence of mortality in adolescence [27] In twenty first century, the physically inactive and obese adolescents are susceptible to develop metabolic syndrome [28]. Therefore, it is critically important to manage the lifestyle during adolescence. The routine physical activities in adolescence can contribute active life style until adulthood. [29]

The increasing rate of insulin resistance (IR) and heart diseases in young adults compels us to examine the factors associated with the development of metabolic syndrome. Early diagnosis may possibly prevent the onset or progression of heart disease.

Methodology:

Data for the current study was collected from young adults of the University of Karachi, during January 2015 to December 2015. All the participants were between 16 to 25 years of age. The individuals having severe food allergies, Anorexia Nervosa, Bulimia Nervosa or any other chronic medical disease as well as those with dietary restrictions, gestation period or nursing women were excluded from the study.

For the determination of resting systolic and diastolic blood pressure sphygmomanometer was used on the right arm. The subjects were advised not to take any medicine which interfere the result as well as avoid strenuous exercise or hard physical activity before the test.

Blood samples were taken from antecubital vein after 8 hours of overnight fasting. Fasting plasma glucose were estimated by enzymatic method, Lipid profile including Triglyceride, Cholesterol and high density lipoprotein (HDL) was estimated through CHOD-PAP, GPO-PAP method. Serum insulin levels were detected by sandwich ELIZA. HOMA Calculator version 2.2 was used for better understanding of beta cell function, Insulin sensitivity and Insulin resistance.

All volunteers filled a questionnaire assessing demographic profile, and medical history of chronic disease. While stress scores were determined by Holmes Rahe life stress Inventory Scale. Fat intake questionnaire was used for analysis of dietary habits. The questionnaire had 17 questions regarding Fats, Protein Carbohydrate. The answers were taken according to usage in times per week (Never, Less than once, 1-2, 3-5, 6 or more). The score of dietary habits was categorized into low fat, low to moderate fat, moderate fat, moderate to high fat and high fat intake.

Physical Activity level scale was used and classified into five categories including Inactive, Sedentary, Moderate Active, Very Active, Extremely Active.

For the determination of BMI (kg/m^2), Height was measured by the height measuring apparatus, and weight was measured in kg with the help of weighing machine. Weighing machine was placed on flat surface. In measurement of Waist Circumference, all participants were asked to stand straight, with relaxed stomach and without any additional clothing. Measurements were made at the narrowest point of the waist in inches.

To identify the statistical difference among groups, Pearson chi square test of independence and independent t-test was used for qualitative and quantitative data respectively. Qualitative and quantitative data is expressed as n(%) and mean-SD respectively. P-Value<0.05) was considered as significant. Multivariate linear Regression and Univariate Binary Logistic regression was performed to estimate the increasing risk for metabolic syndrome.

Result:

In this study, 12.5 % male and 375% female had MetS as compared to 9.2% control male and 40.8% control male. The average mean among group was found as 21.7 ± 2.2 for patients and 21.4 ± 2.0 control. For anthropometric indices, BMI and WC were significantly high in patients with a p-value of 0.015 and 0.000 respectively. The mean values for BMI and WC for both patients and controls were recorded as 26.3 ± 2.9 kg/m^2 vs. 25.0 ± 2.5 kg/m^2 and 82.0 ± 1.6 kg/m^2 vs. 73.7 ± 3.8 kg/m^2. The participants of MetS had significantly higher levels of FPG (112.1 ± 13.2 mg/dL vs. 87.6 ± 9.5 mg/dL), TG (179.6 ± 38.7 mg/dL vs. 92.4 ± 40.2 mg/dL), VLDL (35.9 ± 7.7 mg/dL vs. 18.4 ± 8.0 mg/dL) and Stress (133.6 ± 80.3 vs. 78.0 ± 41.8) with a p-value <0.05. While significantly low levels of Percent Beta (67.9 ± 24.4vs. 106.3 ± 8.6), Percent Sensitivity (5.0 ± 30.4 vs. 118.7 ± 63.0) and HDL (48.1 ± 10.8 mg/dl vs. 48.1 ± 10.8mg/dl) were observed.

SBP, DBP, Pulse rate, Pulse Pressure, FPI, HOMA-IR, CHO, and LDL, were found to have no difference in control and MetS subjects (Table#1).

The analyses of dietary habits showed that 2.5% volunteers consumed Low fat diet, 5% Low to Moderate fat diet, 10% Moderate fat diet, 25% Moderate to high fat diet and 7.5% [30] consumed High fat diet. While in normal control participants the outcome was 6.7%, 20.8%, 4.2%, 7.5% and 10.8% respectively. The data of dietary habits were found as significant among groups.

According to Physical Activity Level criteria, the MetS populations were 6.7% Inactive, 20.8% Sedentary, 4.2% Moderate Active, 7.5% Very Active and 10.8% Extremely Active. As compared to control groups, which were 4.2%, 5.8%. 5.0%, 20.8%, and 14.2% active among aforementioned respective categories.

WC and VLDL for TG and FPG were found as significant predictor. FPI and SBP were found as insignificant risk factor for TG and FPG of MetS. (Table#2). Stress (OR=0.984, CI=0.976-0.9922, p=0.000), Dietary Intake (OR=0.636, CI =0.740-0.860, P-Value=0.003) and Physical activity (OR=0.642, CI=0.485-0.84, P=0.002) were expressed as the factors for progression of MetS (Table#3)

Table 1: Characteristics Of Metabolic Syndrome In Control And Mets Participants

Continuous Variables (Mean ±SD)	**Metabolic Syndrome Subjects (n=60)**	**Control Subjects (n=60)**	**P-Value**
Age	21.7±2.2	21.4±2.0	0.37
Anthropometrics Indices			
BMI (kg/m^2)	26.3±2.9	25.0±2.5	0.015*
WC (cm)	82.0±1.6	73.7±3.8	0.000*
Body Vitals			
SBP (mm/Hg)	119.8±9.7	117.5±7.0	0.142
DBP (mm/Hg)	80.0±7.6	77.4±6.9	0.055
Pulse pressure	39.3±2.6	39.58±3.9	0.685
Pulse Rate	81.5±8.9	81.7±11.7	0.889
Blood Sample Analysis			
FPG (mg/dL)	112.1±13.2	87.6±9.5	0.000*
FPI (µU/ml)	8.2±3.0	8.2±3.5	0.934
Percent Beta	67.9±24.4	106.3±8.6	0.000*
Percent Sensitivity	50.7±30.4	118.7±63.0	0.000*
HOMA-IR	1.13±0.3	1.05±0.45	0.295
HDL (mg/dL)	48.1±10.8	55.9±7.8	0.000*
TG (mg/dL)	179.6± 38.7	92.4±40.2	0.000*
CHO (mg/dL)	153.8±47.9	157.6±52.9	0.679
LDL (mg/dL)	69.0±51.3	83.2±52.1	0.138
VLDL (mg/dL)	35.9±7.7	18.4±8.0	0.000*
Stress Scale	133.6±80.3	78.0±41.8	0.000*
Categorical Variables [n(%)]			
Gender Male Female	 15(12.5) 45(37.5)	 11(9.2) 49(40.8)	 0.375
Dietary Intake			
Low fat Low to Moderate Fat Moderate Fat Moderate to High Fat High Fat	3(2.5) 6(5) 12(10) 30(25) 9(7.5)	8(6.7) 25(20.8) 5(4.2) 9(7.5) 13(10.8)	0.000*
Physical Activity Level			

Inactive	8(6.7)	5(4.2)	0.001*
Sedentary	25(20.8)	7(5.8)	
Moderate Active	5(4.2)	6(5.0)	
Very Active	9(7.5)	25(20.8)	
Extremely Active	13(10.8)	17(14.2)	

*p-Value <0.05 considered as significant using Independent Sample T-Test and Pearson Chi square test of Independence.
Independent Sample T-test is used for quantitative variables.
Pearson Chi-square Test of independence is used for Qualitative variables.
BMI: Body Mass Index, WC: Waist Circumference, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, FPG: Fasting Plasma Glucose, FPI: Fasting Plasma Insulin, HDL: High Density Lipoprotein, TG: Triglyceride, CHO: Cholesterol, LDL: Low density Lipoprotein, VLDL: Very Low-Density Lipoprotein

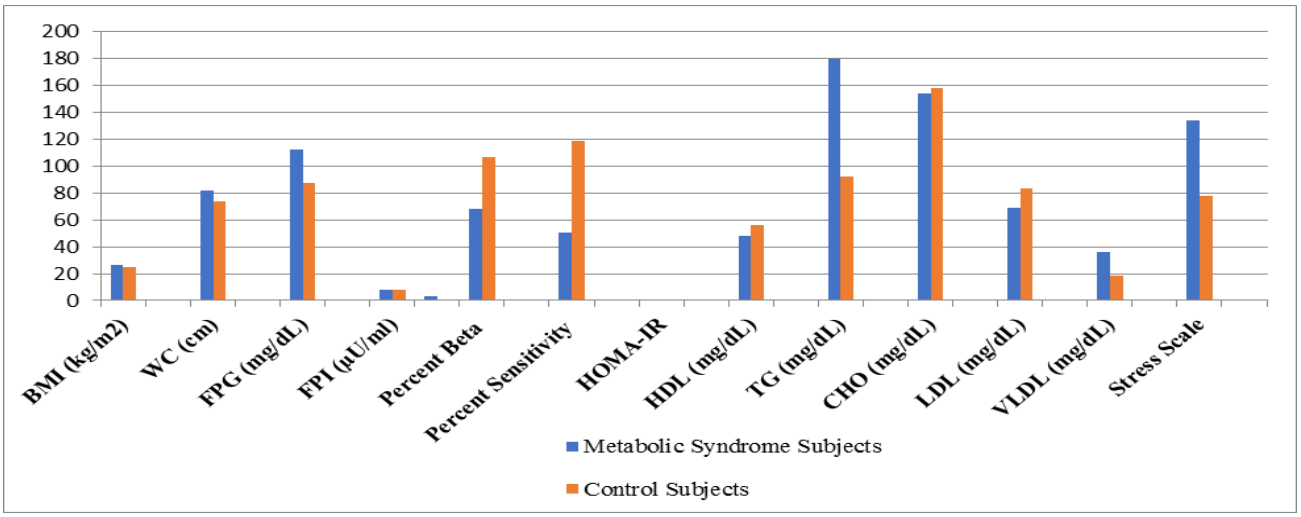

Figure 1:
Baseline Characteristics Between Control And Metabolic Syndrome

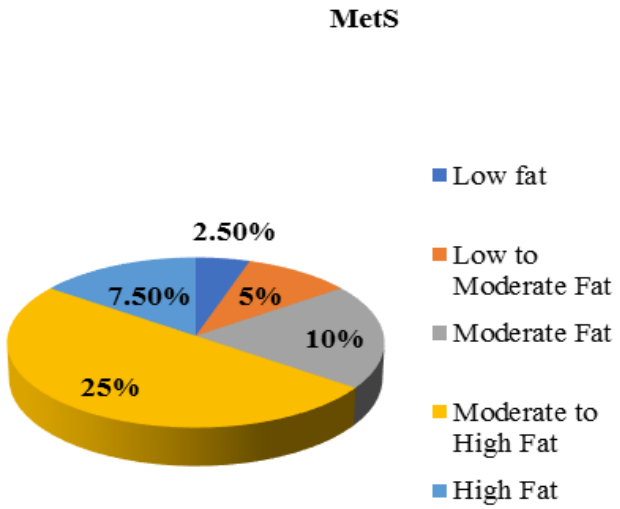

Figure 2:
Fat Consumption in Metabolic syndrome Subjects

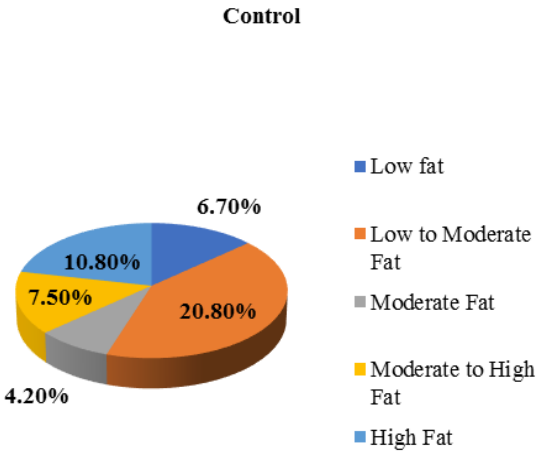

Figure 3:
Fat consumption in control participants

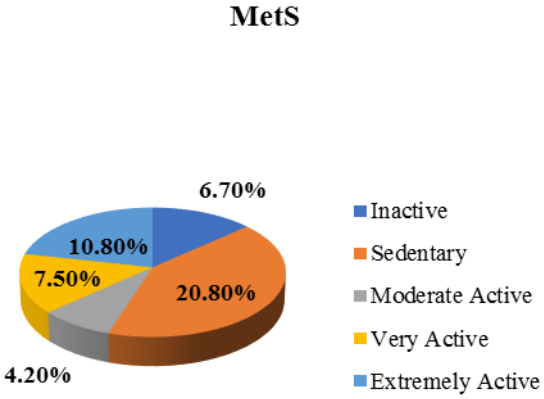

Figure 4:
Activity level of control participants

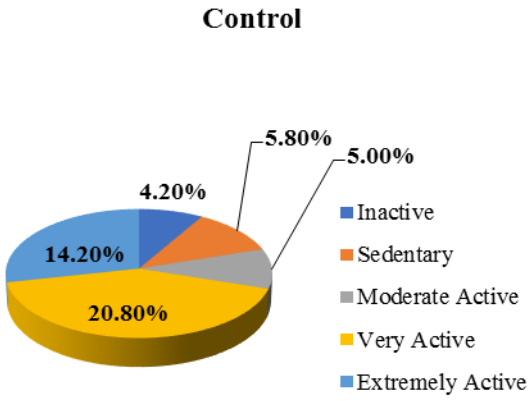

Figure 5:
Activity level of metabolic syndrome participants

Table 2: Multivariate Linear Regression Models for Prediction of High TG and FPG in Metabolic Syndrome

	TG			**FPG**		
	OR	**95% CI**	**P-Value**	**OR**	**95%CI**	**P-Value**
MODEL I	6.940	5.253-8.628	0.000	1.961	1.475-2.447	0.000
MODEL II	5.000	4.99-5.000	0.000	0.283	0.025-0.541	0.032
MODEL III	0.000	-0.005-0.003	0.740	0.208	-0.534-0.950	0.555
MODEL IV	0.000	-0.002-0.001	0.393	-0.73	-0.361-0.215	0.618
Model I: Unadjusted for WC, Model II: Adjusted for WC and VLDL, Model III: Adjusted for WC, VLDL and FPI, Model IV: Adjusted for WC, VLDL, FPI and SBP						

Table 3: Univariate Binary Logistic Regression Models for Prediction of Metabolic Syndrome

	OR	**95%CI**	**p-Value**
Stress	0.984	0.976-0.9922	0.000
Dietary Intake	0.636	0.740-0.860	0.003
Physical Activity	0.642	0.485-0.849	0.002
OR: Odd Ratio, CI: Confidence Interval			

DISCUSSION:

The current studyevaluated the risk factors associated with metabolic syndrome. Previous studies emphasizes on susceptibility factors in children and adolescence. Less number of studies are found that shows the predisposition in young age group. 50% males and 50% females have participated in this study. This makes the results more reliable as the interfering factors associated to gender have been removed.

High Fat Consumption and sedentary lifestyle observed in patients. [15] [16] [17, 18] has an impact in progression of MetS , They have showed the significant association with activity level. While ***Ekelund et al., 2009*** have reported the diet and nutritional interference within MetS among chidren. The present result is in accordance with their evaluations but in adolescents. . Systolic Blood pressure, Diastolic Blood pressure, Pulse pressure, Pulse Rate and LDL were found to be insignificant in our study.

Several factors contribute to develop and progress stress in individuals. In our findings, stress levels found in MetS subjects were significantly higher than normal adults. These results clearly represent the involvement of stress in development of MetS (95% CI; 0.976-0.992) . [31] Have reported this association in their study. In,

Limitation factors in this study is the relatively small sample size. The participants werefrom multiple ethnicities. Use of medicines might be a confounding factor in this study. Hormonal changes between 16 to 20 years of age and above 21 might be conflicting factor which induces obesity especially in female participants.

CONCLUSION

The result of this study ~~was~~ revealed that, young adults of Pakistani population are at a higher risk of MetS due to involvement of stress, sedentary style of living and high amount of fat consumption. According to IDF criteria fluctuation of WC, FPG, TG and HDL level were found in Patients. Along with that significantly higher BMI, VLDL and low Percent Beta, Percent Sensitivity were found as dominant characteristics which were altered in adults with MetS. No significant changes were observed in SBP and DBP.

References

1. Kaur, J., A comprehensive review on metabolic syndrome. Cardiology research and practice, 2014. 2014.
2. Bergmann, N., F. Gyntelberg, and J. Faber, The appraisal of chronic stress and the development of the metabolic syndrome: a systematic review of prospective cohort studies. Endocrine connections, 2014. 3(2): p. R55-R80 %@ 2049-3614.
3. Tyagi, A., et al., An explorative study of metabolic responses to mental stress and yoga practices in yoga practitioners, non-yoga practitioners and individuals with metabolic syndrome. BMC complementary and alternative medicine, 2014. 14(1): p. 445 %@ 1472-6882.

4. Schlaich, M., et al., Metabolic syndrome: a sympathetic disease? The lancet Diabetes & endocrinology, 2015. 3(2): p. 148-157 %@ 2213-8587.
5. Lopuszanska, U.J., et al., Mental illness and metabolic syndrome-a literature review. Annals of Agricultural and Environmental Medicine, 2014. 21(4 %@ 1232-1966).
6. Baumeister, D., S.L. Lightman, and C.M. Pariante, The interface of stress and the HPA axis in behavioural phenotypes of mental illness, in Behavioral Neurobiology of Stress-related Disorders. 2014, Springer. p. 13-24.
7. Kahl, K.G., et al., Depression, anxiety disorders, and metabolic syndrome in a population at risk for type 2 diabetes mellitus. Brain and behavior, 2015. 5(3): p. e00306 %@ 2162-3279.
8. Hajian-Tilaki, K., et al., Prevalence of metabolic syndrome and the association with socio-demographic characteristics and physical activity in urban population of Iranian adults: a population-based study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 2014. 8(3): p. 170-176 %@ 1871-4021.
9. Clarke, J. and I. Janssen, Sporadic and bouted physical activity and the metabolic syndrome in adults. Medicine & Science in Sports & Exercise, 2014. 46(1): p. 76-83 %@ 0195-9131.
10. Cooper, A.J.M., et al., Association between objectively assessed sedentary time and physical activity with metabolic risk factors among people with recently diagnosed type 2 diabetes. Diabetologia, 2014. 57(1): p. 73-82 %@ 0012-186X.
11. Roberts, C.K., A.L. Hevener, and R.J. Barnard, Metabolic syndrome and insulin resistance: underlying causes and modification by exercise training. Comprehensive Physiology, 2013.
12. Lorenzo, C., et al., Trend in the prevalence of the metabolic syndrome and its impact on cardiovascular disease incidence. Diabetes Care, 2006. 29(3): p. 625-630.
13. Cameron, A.J., J.E. Shaw, and P.Z. Zimmet, The metabolic syndrome: prevalence in worldwide populations. Endocrinology and metabolism clinics of North America, 2004. 33(2): p. 351-375.
14. Morrison, J.A., et al., Development of the metabolic syndrome in black and white adolescent girls: a longitudinal assessment. Pediatrics, 2005. 116(5): p. 1178-1182.
15. Ekelund, U., et al., Independent associations of physical activity and cardiorespiratory fitness with metabolic risk factors in children: the European youth heart study. Diabetologia, 2007. 50(9): p. 1832-1840.
16. Sardinha, L.B., et al., Objectively measured time spent sedentary is associated with insulin resistance independent of overall and central body fat in 9-to 10-year-old Portuguese children. Diabetes care, 2008. 31(3): p. 569-575.
17. Eisenmann, J.C., Aerobic fitness, fatness and the metabolic syndrome in children and adolescents. Acta Paediatrica, 2007. 96(12): p. 1723-1729.
18. Anderssen, S.A., et al., Low cardiorespiratory fitness is a strong predictor for clustering of cardiovascular disease risk factors in children independent of country, age and sex. European Journal of Cardiovascular Prevention & Rehabilitation, 2007. 14(4): p. 526-531.
19. Ramadhani, M.K., et al., Lower birth weight predicts metabolic syndrome in young adults: the Atherosclerosis Risk in Young Adults (ARYA)-study. Atherosclerosis, 2006. 184(1): p. 21-27.
20. Ekelund, U., et al., Association of weight gain in infancy and early childhood with metabolic risk in young adults. The Journal of Clinical Endocrinology & Metabolism, 2007. 92(1): p. 98-103.
21. Ekelund, U., et al., Prevalence and correlates of the metabolic syndrome in a population-based sample of European youth. The American journal of clinical nutrition, 2009. 89(1): p. 90-96.
22. Hu, F.B., Dietary pattern analysis: a new direction in nutritional epidemiology. Current opinion in lipidology, 2002. 13(1): p. 3-9.
23. Kant, A.K., Dietary patterns and health outcomes. Journal of the American Dietetic Association, 2004. 104(4): p. 615-635.
24. Newby, P. and K.L. Tucker, Empirically derived eating patterns using factor or cluster analysis: a review. Nutrition reviews, 2004. 62(5): p. 177-203.
25. Carnethon, M.R., M. Gulati, and P. Greenland, Prevalence and cardiovascular disease correlates of low cardiorespiratory fitness in adolescents and adults. Jama, 2005. 294(23): p. 2981-2988.
26. LaMonte, M.J., et al., Cardiorespiratory fitness is inversely associated with the incidence of metabolic syndrome. Circulation, 2005. 112(4): p. 505-512.
27. Laukkanen, J.A., et al., Cardiovascular fitness as a predictor of mortality in men. Archives of internal medicine, 2001. 161(6): p. 825-831.
28. Moreira, C., et al., Metabolic risk factors, physical activity and physical fitness in Azorean adolescents: a cross-sectional study. BMC Public Health, 2011. 11(1): p. 214.
29. Kjønniksen, L., T. Torsheim, and B. Wold, Tracking of leisure-time physical activity during adolescence and young adulthood: a 10-year longitudinal study. International Journal of Behavioral Nutrition and Physical Activity, 2008. 5(1): p. 69.

30. Garbarino, S. and N. Magnavita, Work stress and metabolic syndrome in police officers. A prospective study. PLoS One, 2015. 10(12): p. e0144318 %@ 1932-6203.
31. Holmes, M.E. and K.E. Spring, A Brief Review of the Physical activity, Stress, and Metabolic Syndrome Relationship in Youth: Consideration of Socioeconomic Position as a Chronic Stressor. Medical Research Archives, 2018. 6(4 %@ 2375-1924).