HEART RATE VARIABILITY OF OBESE AND NON-OBESE FILIPINO ADOLESCENTS

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Original scientific paper

Abstract
The purpose of this research was to compare the differences in heart rate variability (HRV) parameters between obese and non-obese individuals from spontaneous breathing (SB) and paced breathing (PB). Totally 20 subjects, healthy male adolescents participated in the study: 10 obese (age: 17.1 ± 0.74 yrs; height: 173.5 ± 4.94 cm; weight: 103.9 ± 16.4 kg; %BF =29.0 ± 5.68; waist circumference (WC): 102.8 ± 7.8 cm; systolic blood pressure (SBP): 119.2 ± 5.9 mmHg; diastolic blood pressure (DBP): 74.6 ± 6.7; physical activity level: 36.9 ± 9.48) and 10 non-obese (age:16.5 ± 0.71 yrs; height: 166.7 ± 5.33 cm; weight: 55.1 ± 106 kg; %BF:10.5 ± 5.22; SBP: 100.0 ± 11.5 mmHg; WC: 68.3 ± 6.4; DBP: 62.6 ± 6.6; physical activity level: 41.1 ± 14.8) They underwent two 5-minute heart rate recordings for SB and metronome guided PB respectively. PB was adjusted from the respiratory rate during SB. Results from two-way repeated measures ANOVA revealed non-significant differences in the standard deviation of N-N intervals (SDNN), low frequency (LF), peak LF (LFpeak), relative contribution of LF (%LF), LF normalized unit (LFnu), high frequency (HF), peak HF (HFpeak), relative contribution of HF (%HF), HF normalized unit (HFnu), total power (TP), LF to HF ratio (LF/HF), instantaneous beat to beat variability (SD1), continuous beat to beat variability (SD2), and SD1 to SD2 ratio (SD1/SD2). In conclusion, metronome guided PB adjusted from SB rate did not produce any significant difference in time, frequency and non-linear domains of HRV between asymptomatic obese and non-obese adolescents.

Key words: *heart rate variability, obesity, adolescence*

Introduction

In the recent decade, there has been an increasing trend in the use of heart rate variability (HRV) as tool for measuring autonomic functioning in clinical and sport settings. HRV refers to the R-R interval between consecutive heart rates which can be measured from cardiac electrical activity (Gamelin et al., 2006; Task Force, 1996). Indices of HRV include time, frequency and non-linear values. For time domain, the standard deviation of normal to normal (NN) intervals (SDNN), triangular index, standard deviation of sequential 5-minute period mean values of NN intervals (SDANN), the square root of the mean squared differences between successive RR intervals (RMSSD) are recommended for HRV assessment (Task force, 1996). SDNN and triangular index are estimates of overall HRV. SDANN and RMSSD estimate long-term and short-term components of HRV respectively. In the frequency domain, low frequency (LF), high frequency (HF), and LF/HF ratio are values that detect vagal activity. Low frequency is also known as the 10-second rhythm or the Mayer wave which range from 0.04 to 0.15 Hz. Researchers suggest that LF is a measure of sympathetic activity (Malliani et al., 1991). High frequency (HF) range from 0.15 to 0.4 Hz and is believed to reflect parasympathetic activity (Task force, 1996). LF/HF ratio is suggested to mirror sympathovagal balance or sympathetic activity. Recently, there has been an increasing interest in the use of non-linear methods in HRV analysis (Sunkaria, 2011). These non-linear parameters are Poincaré plot values which are represented by SD1, SD2, and SD1 / SD2 (Brunetto et al., 2005; Silva et al., 2005; Vanderlei et al., 2010). SD1 represents an index of instantaneous recording of the variability of beat-to-beat and reflects parasympathetic activity. On the other hand, SD2 is the HRV in the long term-records and represents overall HRV. SD1/SD2 is the ratio between short and long variations of RR intervals. Adjustment of respiratory rate plays a crucial role in HRV (Guzik et al., 2007; Millis et al., 2011; Millis et al., 2010; Schipke et al., 1999; Song & Lehrer, 2003). For example, Millis et al. (2011) found out that TP, SDNN, VLF and LF/HF were lower in spontaneous breathing (SB) compared to paced breathing (PB) at 12 breaths/min (0.2 Hz) in healthy males. Millis et al. (2010) also discovered lower normalized LF in SB (0.2 Hz) compared to PB among healthy young men. Guzik et al. (2007) demonstrated that 0.2 Hz breathing temporarily increases HF and reduces long term HRV. Song and Lehrer (2003) suggested that slow breathing rates produced higher HRV amplitudes than faster breathing rate. Lastly, Schipke et al. (1999) found no significant differences in HRV time domains at various respiratory rates. In adolescent obesity, conflicting results comparing HRV parameters of obese and non-obese adolescents exist. Guízar et al. (2005) identified that male obese adolescents posted higher LF/HF index but lower SDNN and total power (TP) compared to their non-obese counterparts. Khrisanapant et al., (2008) discovered no significant differences in sympathetic and parasympathetic functioning between obese (OB) and non-obese (NO) male and female adolescents.

Adolescent obesity is critical in determining severe adult obesity and adult mortality (Adami and Vasconcelos Fde, 2008; The, Suchindran, North, Popkin, & Gordon-Larsen, 2010). However, there seems to be a paucity of literature regarding the extent of adolescent obesity in HRV utilizing paced breathing schemes adjusted from spontaneous breathing. Such undertaking may provide valuable information in HRV response to a given breathing stimulus. Thus, the purpose of this study was to compare time, frequency and non-linear HRV domains between obese and non-obese Filipino adolescents in spontaneous breathing (SB) and paced breathing (PB).

Methods

Participants

The participants of the study were 10 obese (age: 17.1 ± 0.74 yrs; height: 173.5 ± 4.94 cm; weight: 103.9 ± 16.4 kg) and 10 non-obese (age: 16.5 ± 0.71 yrs; height: 166.7 ± 5.33 cm; weight: 55.1 ± 106 kg) physical education students from a university in the Philippines. Inclusion criteria involved: 1. resting systolic/diastolic blood pressure < 140/90 mm Hg; 2. absence of any oral medication or supplementation; 3. non-smoking; 4. absence of diabetes mellitus and/or abnormal cardiac activity; and, 5. absence of any sleeping disorder (e.g. snoring). Self-report of unsupervised overnight fasting of 12 hours with only water intake allowed after the last meal was also utilized to limit the effects of diet related differences in autonomic activity (Millis et al., 2009). The participants were categorized as obese or non-obese based on the waist circumference criteria of the International Diabetes Federation for male Asians which is > 90 cm. A written informed consent was requested from the parent or guardian of the participant < 18 years old. Godin Leisure Time Exercise Questionnaire was used to identify the physical activity level of the participants (Godin and Shephard, 1997). The participants were also requested to: 1. avoid any strenuous physical activity and alcohol consumption 48 hours prior to experimentation; and 2. attain at least six hours of sleep before the testing session. Ethical clearance for this study was acquired from the Ethical Review Board of Staffordshire University. The experimental protocol complied with the declaration of Helsinki for human testing.

Procedures

Experimentation was conducted inside the exercise science laboratory for one single session that occurred from 0700 hrs - 1100 hrs. Room temperature was 26.1 to 28.5 degrees centigrade with a relative humidity of 60% - 76%. Upon arrival at the laboratory, the participants were asked to sit for 7 minutes. During the first 2 minutes of the seated rest, self reports of 12 hour fasting, 6 hour sleep, 48 hour avoidance of alcohol consumption and non-participation from any strenuous activity were gathered by the tester. The remaining 5 minutes was devoted to an uninterrupted rest.

After 7 minutes, the participants remained seated for 3 recordings of systolic blood pressure (SBP) and diastolic blood pressure (DBP) taken in between 1 minute interval (Omron HEM-7221, Omron Healthcare Inc., USA). This was followed by determination of height, weight, percentage body fat (%BF) and waist circumference (WC) respectively. Height was measured to the nearest 0.1 cm (SECA 206, SECA, GmBH & Co Kg, Hamburg, Germany). Weight and percentage %BF were computed to the nearest 0.1 value (Tanita BC-1000, Tanita Inc., USA).

WC was acquired to the nearest 0.1 cm (SECA 201, SECA, GmBH & Co Kg, Hamburg, Germany) for 2 trials with measurement procedures following WHO STEPS guidelines (WHO, 2008). After anthropometrics, an elastic belt (Polar WearLink®, Polar Electro, Finland) with transmitter (Transmitter, Polar Electro, Finland) was placed at the sternal angle of the participants. The participants were requested to lie down in a supine position for 5 minutes. Avoidance from any movement and noise were requested to the participants once this position was achieved. SB recording commenced after the 5-minute supine rest. There was a 5-minute rest interval after SB recording. In the last 3 minutes of the 5-minute rest, the participants underwent a metronome guided PB familiarization that corresponded to their SB rate.

PB recording succeeded thereafter. Respiration rates from SB and PB were identified from commercial software (Firstbeat Technologies, Oy, Finland). Heart rate data were transmitted through bluetooth technology (Polar Windlink, Polar Electro Inc., Finland) via commercial software (Polar Pro Trainer 5™, Polar Electro Inc., Finland) displayed on a laptop computer (ACER P1VE6, ACER Inc., USA). The heart rate data were saved as .hrm files and were used to derive HRV variables through an open source HRV software (Kubios, Finland). HRV parameters that were subjected for analyses included SDNN, LF, peak LF (LFpeak), LF contribution to total power (LF%), LF normalized unit (LFnu), HF, peak HF (HFpeak), HF contribution to total power (HF%), HF normalized unit (HFnu), LF to HF ratio (LF/HF), total power (TP), SD1, SD2, and SD1/SD2.

Statistical Analyses

Data are displayed as means and standard deviations. Two-way repeated measures ANOVA were utilized to determine the main effects of bodytype (OB and NO) and breathing pattern (SB and PB) in HRV values. This test also sought to determine the interaction of bodytype and breathing pattern in HRV values. Estimation of effect size in two-way repeated measures ANOVA was determined using eta squared. Pearson's bivariate correlation was used to determine the pairwise relationship between WC/%BF and indices of HRV in SB and PB. Statistical analyses were carried out using a commercial statistical package (SPSS 19, SPSS Inc., USA) with significance level set at 0.05 level.

Results

Table 1. Heart Rate Variability Parameters of Obese and Non-Obese Individuals

	SB-OB	PB-OB	SB-NO	PB-NO
SDNN (ms)	53.1 ± 14.4	62.8 ± 16.9	61.0 ± 14.7	69.5 ± 30.5
LF (ms^2)	498.3 ± 285.2	641.4 ± 493.7	862.0 ± 629.6	681.7 ± 694.6
LFpeak (Hz)	.0641 ± .0259	.0680 ± .0301	.0750 ± .0354	.0707 ± .0272
LF%	23.1 ± 10.7	17.7 ± 6.90	24.6 ± 9.85	14.7 ± 6.87
LFnu	45.0 ± 24.7	33.0 ± 17.5	47.5 ± 20.1	36.4 ± 26.5
HF(ms^2)	1085.9 ± 1331.0	1638.4 ± 1515.2	1361.9 ± 1466.5	2160.0 ± 2723.1
HFpeak	.2535 ± .0585	.2700 ± .0576	.2781 ± .0718	.2465 ± .0494
HF%	32.3 ± 19.0	43.2 ± 22.3	29.5 ± 15.3	37.3 ± 21.8
HFnu	55.0 ± 24.7	67.0 ± 17.5	52.5 ± 20.1	63.6 ± 26.5
LF/HF	1.39 ± 1.57	.632 ± .642	1.77 ± 2.97	1.36 ± 2.53
Total Power	2720.2 ± 2132.6	3525.5 ± 1777.7	3848.0 ± 2919.0	5149.2 ± 4590.8
SD1 (ms)	37.1 ± 19.2	43.9 ± 21.8	37.2 ± 12.0	39.9 ± 22.5
SD2 (ms)	66.7 ± 14.7	76.2 ± 16.6	77.0 ± 20.0	89.5 ± 37.8
SD1/SD2	.547 ± .232	.563 ± .204	.491 ± .173	.438 ± .102
Breathing Rate/	15.9 ± 2.6	15.4 ± 2.5	15.9 ± 2.7	15.0 ± 2.4

SDNN - standard deviation of normal to normal intervals; LF - low frequency; LFpeak – peak LF; LF% relative contribution of LF; LFnu – LF normalized unit; HF – high frequency; HFpeak – peak high frequency; HF% - relative contribution of HF; HFnu – HF normalized unit; LF/HF – LF/HF ratio; SD1 – instantaneous heart rate variability(HRV); SD2 – long term HRV; SD1/SD2 – SD1/SD2 ratio

Table 2. Relationship of WC and %BF HRV Values in SB and PB

	SB		PB	
	WC	%BF	WC	%BF
SDNN (ms)	-.281	-.299	-.110	-.093
LF (ms^2)	-.370	-.441	-.021	-.022
LFpeak (Hz)	-.172	-.186	.047	.162
LF%	-.142	-.074	.162	.620
LFnu	-.137	-.066	-.113	-.104
HF(ms^2)	-.022	-.077	-.104	-.101
HFpeak	-.078	-.056	.312	.350
HF%	.161	.089	.162	.115
HFnu	.138	.066	.113	.104
LF/HF	-.072	-.039	-.248	-.260
Total Power	-.168	-.240	-.188	-.150
SD1 (ms)	.076	.145	.125	.092
SD2 (ms)	-.357	-.369	-.205	-.171
SD1/SD2	.246	.341	.427	.331
** significant at 0.01 level				
* significant at 0.05 level				

Table 2 presents the HRV variables and respiratory rates of OB and NO in SB and PB. Two-way repeated measures ANOVA revealed non-significant main effects of body type and breathing pattern in SDDN. No significant interaction between body type and breathing pattern was also discovered in SDNN. In the frequency related HRV domain, no significant main effects were seen in LF and LFpeak. Similarly, there were no significant interactions between bodytype and breathing pattern in LF and LFpeak. No significant main effect of body type was observed in LF%. There was a significant main effect of breathing in LF% at $F(1, 9) = 10.1$, $\eta 2 = 0.63$, $p = .011$. The interaction between body type and breathing pattern detected in LF% failed to reach statistical significance. No significant main effect of bodytype in LFnu was observed. Breathing pattern has a main effect on LFnu at $F(1, 9) = 7.50$, $\eta 2 = 0.40$, $p = .023$.

There was no significant interaction between body type and breathing in LFnu. For HF and HFpeak values, no significant main effects were identified. There were also no significant interactions between bodytype and breathing pattern in HF and HFpeak. Non-significant main effect of bodytype was observed in HF%. A significant main effect of breathing in HF% was discovered, $F(1, 9) = 14.2$, $\eta 2 = 0.39$, $p = .004$. No significant interaction between bodytype and breathing was found in HF%. There was no significant main effect of bodytype in HFnu. Breathing has a main effect on HFnu at $F(1, 9) = 7.50$, $\eta 2 = 0.40$, $p = .023$. The interaction between bodytype and breathing was non-significant in HFnu. No significant main effects were discovered in LF/HF ratio, total power, SD1, SD2, and SD1/SD2. Identically, no significant interactions between body type and breathing pattern were determined in the previous variables.

Table 2 depicts the HRV parameters of OB and NO individuals in SB and PB. There were no significant relationships observed between indices of obesity (WC and %BF) and HRV-SB values. There were also no significant relationships that existed with WC and %BF and indices of HRV-PB. Table 3 shows the relationships of WC and %BF to HRV measures in SB and PB.

Discussion

The purpose of this study was to examine indices of HRV in SB and PB of OB and NO. Findings showed no significant difference in HRV between OB and NO in SB and PB. In this study, the respiratory rates of the participants in SB and PB fall within the HF band. These suggest that autonomic functioning in SB and PB within the HF band may exhibit similar results in OB and NO. Another possible confounding factor that may have affected the results of this study is the same physical activity level of the OB and NO. The engagement of the participants in regular physical activity may have led to the reversibility of obesity related autonomic dysfunction (Felber Dietrich et al., 2008; Nagai & Moritani, 2004). Non-significant differences in the parasympathetic markers of HRV may also be related to similar respiratory patterns between OB and NO participants which was in congruence with the findings of Boran et al. (2007) but contrasted the study of Paralikar et al. (2012). Boran et al. (2007) suggested that the existence of predominant subcutaneous fat in the population of the previous study may have led to non-significant respiratory differences between OB and NO. In a similar light, the existence of physical activity in OB and NO participants in the study may have led to reversible effects in obesity related respiratory complications (Parameswaran et al., 2006). Lastly, the study limited the age range of the participants which might have decreased the incidence of autonomic differences related to age (Lenard et al., 2004; Monahan et al., 2001). An interesting finding in the study is the significant reduction of LF% and LFnu from SB to PB. Consequently, HF% and HFnu increased in PB compared to SB. Both findings did not alter HF and LF power which agreed with the findings of Pinna et al. (2006). In the study of Pinna et al. (2006), participants breathing within the HF band posted different inspiratory duty cycle set at 0.4 during 0.25 Hz paced breathing compared to SB. PB also produced greater respiratory target ratio, increased total oxygen saturation and decreased expired total carbon dioxide. The changes in respiratory components in PB in this study reduced the incidence of spectral leakage by maintaining the HF power within the narrow peak of the respiratory frequency. These findings suggest the possibility of achieving non-significant changes in spectral power with equi-respiratory rate whilst alteration in contribution to the total power and normalized units of spectral values. Indices of body fat (WC and %BF) were not associated to any HRV parameter in SB and PB. This contradicted the findings posted by Fu et al. (2006) which related body fat to HF, LF/HF and LF% in SB. Possible explanations from contrasting findings include the use of the marker of obesity and population size. Fu et al. (2006) utilized body mass index (BMI) while this study used waist circumference. Researchers proposed WC as a better predictor in health risks over BMI (Brenner et al., 2010; Janssen et al., 2004). Also, the study of Fu et al. (2006) involved male and female participants while only male participants were included in this study. The findings in %BF relationships to HRV in SB and PB by Millis et al. (2010) were also inconsistent with the findings in the study. Millis et al. (2010) manifested negative relationships of %BF to TPnu, LFnu, and LF/HF ratio during SB. There was also a positive relationship that existed between %BF and HFnu in the same breathing condition. In the same study, only a negative relationship between %BF and TPnu existed in PB. One possible mechanism that may have caused the inconsistent results may be attributed to the position of the participants during HRV recording which may have altered vagal modulation (Sharma et al., 2009). Also, the study of Millis et al. (2010) failed to adjust the same respiratory rate of PB from SB which might have exhibited disparity in frequency breathing. Although this study presented the profile of OB and NO adolescents in SB and PB, some limitations which might have influenced the results should be noted. These include assessment of respiratory parameters, severity of obesity, SBP and DBP measurement during SB and PB. Future directions with the inclusion of the previous variables are warranted. In conclusion, there was no significant difference in HRV variables of asymptomatic OB and NO in SB and PB adjusted from SB breathing rate.

References

Adami, F., & Vasconcelos Fde, A. (2008). Childhood and adolescent obesity and adult mortality: a systematic review of cohort studies. *Cadernos de Saúde Pública, 24*(4), 558-568.

Boran, P., Tokuc, G., Pisgin, B., Oktem, S., Yegin, Z., & Bostan, O. (2007). Impact of obesity on ventilatory function. *Jornal de Pediatria, 83*(2), 171-176.

Brenner, D.R., Tepylo, K., Eny, K.M., Cahill, L.E., & El-Sohemy, A. (2010). Comparison of body mass index and waist circumference as predictors of cardiometabolic health in a population of young Canadian adults. *Diabetology and Metabolic Syndrome, 2*, 28-35.

Brunetto, A.F., Silva, B.M., Roseguini, B.T., Hirai, D.M., & Guedes, D.P. (2005). Heart rate variability threshold in obese and non-obese adolescents. *Revista Brasileira de Medisina do Esporte, 11*(1), 22-27.

Felber-Dietrich, D., Ackermann-Liebrich, U., Schindler, C., Barthélémy, J.C, Brändli, O., Gold, D.R., Knöpfli, B., Probst-Hensch, N.M., Roche, F., Tschopp, J.M., Von Eckardstein, A., Gaspoz, J.M., & Sapaldia team.

(2008). Effect of physical activity on heart rate variability in normal weight, overweight and obese subjects: Results from the SAPALDIA study. *European Journal of Applied Physiology, 104*(3), 557-565.

Fu, C., Li, Y., Pei, D., Chen, C., Lo, H., Wu, D., & Kuo, T. (2006). Heart rate variability in Taiwanese obese children. *Tzu Chi Medical Journal, 18*, 199-204.

Gamelin, F.X., Berthoin, S., & Bosquet, L. (2006). Validity of the polar S810 to measure R-R intervals at rest. *Medicine and Science in Sports and Exercise, 38*(5), 887-893.

Guízar, J.M, Ahuatzin, R., Amador, N., Sánchez, G., & Romer, G. (2005). Heart autonomic function in overweight adolescents. *Indian Pediatrics, 42*(5), 464-469.

Godin, G., & Shephard, R. J. (1997). Godin Leisure-Time Exercise Questionnaire. *Medicine and Science in Sports and Exercise, 29*, S36-S38.

Guzik, P., Piskorski, J., Krauze, T., Schneider, R., Wesseling W.H., Wykretowicz A., & Wysocki, H. (2007). Correlations between Poincaré heart rate variability parameters assessed during paced breathing. *Journal of Physiological Sciences, 57*(1), 63-71.

Janssen, I., Katzmaryzk, P.T., & Ross, R. (2004). Waist circumference and not body mass index explains obesity-related health risk. *American Journal of Clinical Nutrition, 79*, 379-384.

Khrisanapant, W., Sengmeuang, P., Pasurivong, O., & Kukongviriyapan, U. (2008). Does cardiac autonomy modulation exist in obese adolescents. *Srinagarind Medical Journal, 23*(3), 234-239.

Lenard, Z., Studinger, P., Mersich, B., Kocsis, L., & Kollai, M. (2004). Maturation of cardiovagal autonomic function from childhood to young adult age. *Circulation, 110*(16), 2307-2312.

Malliani, A., Pagani, M., Lombardi, F., & Cerutti, S. (1991). Cardiovascular neural regulation explored in the frequency domain. *Circulation, 84*(2), 482-492.

Millis, R.M., Austin, R.E., Bond, V., Faruque, M., Goring, K.L., Hickey, B.M., Blakely, R., & De Meersman, R.E. (2009). Effects of high-carbohydrate and high-fat dietary treatments on measures of heart rate variability and sympathovagal balance. *Life Sciences, 85*, 141-145.

Millis, R.M., Austin, R.E., Hatcher, M.D., Bond, V., & Goring, K.M. (2011). Metabolic energy correlates of heart rate variability spectral power associated with a 900-calorie challenge. *Journal of Nutrition and Metabolism, 11*, 1-6.

Millis, R.M., Austin, R.E., Hatcher, M.D., Bond, V., Faruque, M.U., Goring, K.M., …. & DeMeersman, R.E. (2010). Association of body fat percentage and heart rate variability measures of sympathovagal balance. *Life Sciences, 86*, 153-157.

Monahan, K.D., Dinenno, F.A., Seals, D.R., Clevenger, C.M., Desouza, C.A., & Tanaka, H. (2001). Age-associated changes in cardiovagal baroreflex sensitivity are related to central arterial compliance. *American Journal of Physiology – Heart and Circulatory Physiology*, *281*(1). H284-H289.

Nagai, N., & Moritani, T. (2004). Effect of physical activity on autonomic nervous function in lean and obese children. *International Journal of Obesity and Related Metabolic Disorders, 28*(1), 27-33.

Parameswaran, K., Todd, D.C., & Soth, M. (2006). Altered respiratory physiology in obesity. *Canadian Respiratory Journal, 13*(4), 203-210.

Paralikar, S.J., Kathrotia, R.G., Pathak, N.R., & Jani, M.B. (2012). Assessment of pulmonary functions in obese adolescent boys. *Lung India, 29*(3), 236-240.

Pinna, G.D., Maestri, R., La Rovere, M.T., Gobbi, E., & Fanfulla, F. (2006). Effect of paced breathing on ventilatory and cardiovascular variability parameters during short-term investigations of autonomic function. *American Journal of Physiology Heart and Circulatory Physiology, 290*, H424-H433.

Schipke, J.D., Pelzer, M., & Arnold, G. (1999). Effect of respiration rate on short-term heart rate variability. *Journal of Clinical and Basic Cardiology, 2*(1), 92-95.

Song, H., & Lehrer, P. (2003). The effects of specific respiratory rates on heart rate and heart rate variability. *Applied Psychophysiology and Biofeedback, 28*(1), 13-23.

The, N.S., Suchindran, C., North, K.E., Popkin, B.M., & Gordon-Larsen, P. (2010). Association of adolescent obesity with severe obesity in adulthood. *Journal of American Medical Association, 304(*18), 2042-2047.

Vanderlei, L.C, Pastre, C.M., Frietas $_{Jr}$, I.F., & Godoy, M.F. (2010). Geometric indexes of heart rate variability in obese and eutrophic children. *Arquivos Brasileiros de Cardiologia, 95*(1), 35-40.

* * * (2008). /World Health Organization (WHO)/. *WHO STEPwise approach to surveillance (STEPS)*. Geneve: WHO.

* * * (2013). Task force of the European society of cardiology and the North American society of pacing and electrphysiolgy. Heart rate variability – standards of measurement, physiological interpretation, and clinical use. *Circulation, 93*(5), 1043-1065.

* * * (2013). /International Diabetes Federation/. *The IDF consensus worldwide definition of the metabolic syndrome*. Retrieved from www.idf.org/webdata/docs/MetSyndrome_FINAL.pdf.

VARIJABILNOST SRČANOG RITMA KOD GOJAZNIH I NEGOJAZNIH FILIPINSKIH ADOLESCENATA

Sažetak

Svrha ovog istraživanja bila je usporedba razlika u parametrima varijabiliteta srčanog ritma (HRV) između gojaznih i negojaznih pojedinaca od spontanog disanja (SB) do pojačanog disanja (PB). Ukupno 20 zdravih mladih ispitanika adolscenata je sudjelovalo u studiji: 10 gojaznih (uzrast: 17.1 ± 0.74 god.; visina: 173.5 ± 4.94 cm; težina: 103.9 ± 16.4 kg; %BF =29.0 ± 5.68; opseg grudnog koša (WC): 102.8 ± 7.8 cm; sistolički krvni tlak (SBP): 119.2 ± 5.9 mmHg; dijastolički krvni tlak (DBP): 74.6 ± 6.7; razina tjelesne aktivnosti: 36.9 ± 9.48) i 10 negojaznih (uzrast:16.5 ± 0.71 god.; visina: 166.7 ± 5.33 cm; težina: 55.1 ± 106 kg; %BF:10.5 ± 5.22; SBP: 100.0 ± 11.5 mmHg; WC: 68.3 ± 6.4; DBP: 62.6 ± 6.6; razina tjelesne aktivnosti: 41.1 ± 14.8). Bili su dvaput podvrgnuti 5-to minutnom mjerenju srčanog ritma za SB i uz vođenje metronomom PB respektivno. PB je bio korigiran uz ritam disanja za vrijeme SB. Rezultati dobiveni uz dvostruko ponovljeno mjerenje obrađeno ANOVA analizom pokazali su neznačajne razlike u standardnim devijacijama N-N interval (SDNN), niske frekvencije (LF), vrška LF (LFpeak), relativnog doprinosa LF (%LF), LF normalizirane jedinice (LFnu), visoke frekvencije (HF), vrška HF (HFpeak), relativnog doprinosa HF (%HF), HF normalizirane jedinice (HFnu), ukupne snage (TP), odnosa LF i HF (LF/HF), instnantne varijabilnosti otkucaja (SD1), kontinualnoe varijabilnosti otkucaja (SD2) i odnosa Sd1 i SD2 (SD1/Sd2). U zaključku, metronomski vođen PB i korigiran od SB ritma nije proizveo nikakve značajne razlike u vremenu, frekvenciji i nelinearnoj domeni HRV-a između asimptomatskih gojaznih i negojaznih adolescenata.

***Ključne riječi**: varijabilnost srčanog ritma, gojaznost, adolescencija*

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