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Effects of Tele-Exercise on Body Weight, Body Mass Index, and Fat Mass of Obese Employees

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Abstract

BACKGROUND: Obesity is a growing health problem in Indonesia, with one of the main causes being physical inactivity. Meanwhile, employees are a group that is susceptible to obesity as they often have limited time while working sedentarily in front of a desk or computer, especially during the COVID-19 pandemic. This causes risks of many cardiovascular diseases and obesity and can indirectly cause death. Tele-exercise, a live online video exercise, may be the solution to this problem.

AIM: Therefore, the purpose of this study is to analyze the effects of tele-exercise on body weight, BMI, and fat mass percentage as indicators of obesity.

METHODS: The research was conducted from July 2020 to January 2021 according to the policy regarding the pandemic. Furthermore, it used a pre- and post-quasi-experimental design. A total of 39 subjects were given tele-exercise involving two strength training and one cardio training per week for 3 months.

RESULTS: Subsequently, the results showed that exercise had a significant effect ($p < 0.05$) on BMI and body weight, while fat mass percentage only decreased significantly ($p < 0.05$) from the second to third assessment. To the best of our knowledge, this is the first study analyzing the effects of tele-exercise on obese employee's body weight, body mass index, and fat mass.

CONCLUSION: This proves that tele-exercise is an effective therapy for obesity that does not require a large space and has beneficial online aspects, especially during the pandemic. The timing of measurement and hydration status should be considered to assess the body composition.

Introduction

Obesity is a growing health problem with many negative effects, mainly non-communicable diseases, and even death. It may cause coronary heart disease, hypertension, stroke, and other cardiovascular illness [1]. The basic national health research in Indonesia (Riskesdas) showed a growing trend in adult obesity, with 10.5% in 2007, 14.8% in 2013, and 21.8% in 2018 [2]. Meanwhile, employees are a group that is susceptible to obesity and the research by Shrestha *et al*. [3], showed that overweight and obesity are related to the absence of an employee, early retirement due to poor health conditions, and a decrease in total performance. Most employees work in front of a desk, especially during the pandemic, causing a decrease in physical activity and an increase in sitting time, leading to increased risks of many cardiovascular diseases, obesity, and even causing death indirectly [3].

During the pandemic, tele-exercise or live exercise through live and online video may be an effective substitute for exercise outside of the home, especially for employees who always work in front of a computer. The study conducted by Tomlinson *et al*., 2020 [4] showed the subjects' satisfaction with tele-exercise, a live online exercise guided by an instructor, as an alternative to normal forms of exercise deliverance. Mascarenhas *et al.* [5] also showed that young mothers with limited time, similar to an employee with less free time, experienced an increase in physical activity time up to 50 min/week, with significantly reduced depression score after doing tele-exercise. The positive effects of tele-exercise include improvement of the body composition and fitness in the elderly [6].

Furthermore, exercise aims to prevent and resolve obesity by improving body composition and energy expenditure, thereby improving body weight as well [7]. Although a routine moderate-intensity exercise can cause weight loss, it requires a relatively large time commitment, which serves as a barrier to physical activity [8]. In general, low-to-moderate-intensity exercises which are designed to decrease body weight, are not effective, hence, the need for a new, more effective, and efficient exercise strategy, to improve body composition and blood lipid profile [9]. The research by Kuswari *et al*., 2019 [10] showed that a combination of HIIT (High-Intensity Interval Training) and aerobic

exercise as strength and cardio training, respectively, is effective in improving cardiorespiratory fitness, while the research of [11] showed that HIIT improves lipid profile of overweight and obese students. Furthermore, recent research showed that interval training improves body composition and waist circumference on productive-age women [12]. Therefore, the purpose of this study is to analyze the effects of tele-exercise on body weight, BMI, and fat mass percentage as indicators of obesity.

Methods

Participants

The population consisted of 60 overweight or obese employees working at one of the Fast-Moving Consumer Goods (FMCG) company offices in Jakarta, Indonesia. The inclusion criteria include BMI > 25 kg/m^2, employees working at the head office, the age range of 25–45 years, registering as program participants, attending virtual training programs of more than 70%, and taking all nutrition assessments and fitness tests. The BMI cutoff was chosen for a person to be categorized as overweight using global WHO criteria [13], since some of the employee who participated in this study are expatriate coming from other countries outside from Asia. Meanwhile, the exclusion criteria include a woman who is pregnant, injured, and is unable to take the overall nutrition assessment and fitness test. The inclusion criteria analyzed 39 people, while seven people entered into the exclusion criteria for not following all nutritional assessment and fitness tests.

Procedure

The research was conducted for every subject from July 2020 to January 2021 according to the policy regarding the pandemic in Indonesia. Furthermore, the research was quantitative and descriptive observational study, with pre- and post-quasi-experimental design while the data collection and intervention were taken and given, respectively, for 3 months. The intervention was given through live online video, using the ZOOM application as a medium, consisting of 3 days of exercise per week. The subjects had a 2 days strength training (Circuit training, HIIT, Tabata Training, and 7-min workout) and only one cardio exercise per week (moderate-impact aerobic exercise and zumba). This was in contrast to most guidelines or other research which used one strength and two cardio training. The subjects' diet was not intervened by any means, including the consumption of supplements; subjects are free to choose what they eat during intervention.

The independent variables were exercise (two strength training per week and one cardio training per week), while the dependent variables were body weight, nutritional status, and fat mass percentage. Furthermore, the total sampling method was used because the population was under 100 people [14].

Data collection and analysis

The data collected by form consisted of name, gender, age, and phone number, while anthropometric data and body composition were measured using microtoise for body height and BIA/Body impedance analyzer (Omron KaradaScan HBF-375) for body weight, body composition, and BMI. This was done before the intervention, after the first half of intervention time (1 1/2 months after the intervention started), and after the intervention was completed. Ethical approval of this study is obtained from Komite Etik Penelitian Kesehatan Fakultas Kedokteran Universitas Indonesia (Health Research Ethics Committee, Faculty of Medicine, University of Indonesia) with protocol number 20-10-1309. The normality of the data was tested using Kolmogorov–Smirnov test, while paired t-test with CI (Confidence Interval) being 95% was used to obtain the mean differences and value of significancy. All data were analyzed using SPSS 26.0 and Microsoft Excel 2019.

Results

Two-thirds (67%, n = 26) of subjects were female, while one-third (33%, n = 13) were male. The youngest subject was 23 years old, while the oldest subject was 53 years old. The average age of subjects is 34.97 ± 8.37 years. Subsequently, the subjects' mean body weight decreased significantly after each assessment. The mean body weight for assessment 1 (pre-intervention) was 77.35 ± 11.68 kg, which decreased significantly ($p < 0.05$; 95% CI = 1.10–3.43) to 75.48 ± 11.43 kg in assessment 2 (1 1/2 months after the intervention started), and then ($p < 0.05$; 95% CI = 1.33–6.00) to 73.6 ± 11.74 kg in assessment 3 (after all intervention was done).

Furthermore, the same was observed with the subjects' BMI, which decreased with each assessment. The mean body weight for assessment 1 (pre-intervention) was 29.05 ± 4.39 kg/m^2, which decreased significantly ($p < 0.05$, 95% CI = 0.35 – 1.29) to 28.33 ± 4.43 kg/m^2 in assessment 2 (1 1/2 months after the intervention started), and then ($p < 0.05$, 95% CI = 0.39–2.16) to 27.68 ± 4.12 kg/m^2 in assessment 3 (after all intervention was done).

However, this was different for fat mass percentage, since there was an increase from assessment 1 to 2, though insignificant ($p > 0.05$). There is a significant decrease ($p < 0.05$) in fat mass percentage from assessment 2 to 3, though in total, there is no significant decrease ($p > 0.05$) from assessment 1 to 3. This indicates an increase in fat mass percentage during the first half of intervention and a decrease in the second half.

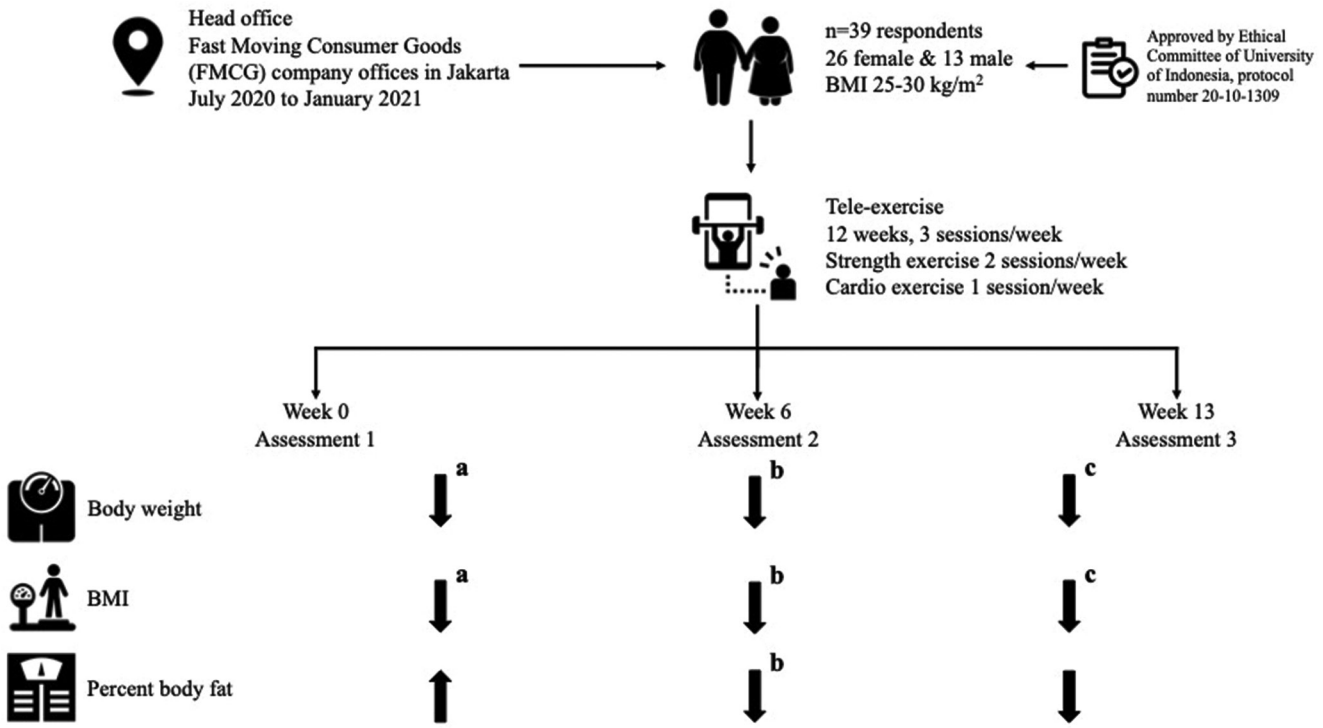

Figure 1: Change in body weight, BMI, and percent body fat on obese employees before and after intervention. a: There were significant differences before and after the intervention (t-test, p<0.05) assessment 1 to 2. b: There were significant differences before and after the intervention (t-test, p<0.05) assessment 2 to 3. c: There were significant differences before and after the intervention (t-test, p<0.05) assessment 1 to 3

Table 3 showed that there were improvements in some subjects' nutritional status, though most subjects indicated obesity after each assessment. Furthermore, subjects with normal nutritional status and obesity or overweight are increased and decreased in number, respectively, after each assessment.

Table 1: Change of variable pre-, during, and post-intervention

Variable Mean	Bodyweight (kg)	BMI (kg/m^2)	Fat Mass (%)
Assessment 1	77.35 ± 11.68	29.05 ± 4.39	32.82 ± 5.42
Assessment 2	75.48 ± 11.43	28.33 ± 4.43	33.27 ± 5.66
Assessment 3	73.6 ± 11.74	27.68 ± 4.12	32.36 ± 5.57

Figure 1 shows the overall changes and mean difference on all variables between group.

Table 2: Significance of change for every different assessment

Variable	p value for 1 to 2	p value for 2 to 3	p value for 1 to 3
Bodyweight	0.000*	0.000*	0.000*
BMI	0.000*	0.005*	0.000*
Fat Mass	0.243	0.013*	0.280

*denotes significant differences (t-test, p<0.05)

Discussion

Less physical activity time is one of the factor causing overweight and obesity. Employees are mostly busy with their office work. Works done by employees are mainly light in term of energy expended and do not need much physical work. Time spent in office (± 8 h a day) and activities that tend to be sedentary are the biggest cause of employees' physical inactivity [15]. This physical inactivity may cause the loss of muscle mass, thus increasing fat deposition. In other hand, physical activity increases energy expenditure [16].

Table 3: Nutritional status of subjects before, during, and after intervention

Nutritional Status	Assessment 1	Assessment 2	Assessment 3
Normal	0	8	12
Overweight	15	8	7
Obese	24	23	20

Physical activity, such as exercise, is necessary for every person, especially during the pandemic. However, the limitation from large–scale social distancing or other similar policies, like lockdown, restricts access to fitness centers or other places for exercise, such as running tracks, playing fields, or gymnasiums. Therefore, a way to keep people physically active while reducing the time needed, especially for those who have limited time must be provided.

This study showed that physical activity done 3 times per week, which takes smaller time since it is focused on strength rather than cardio training and is effective in improving BMI and reducing body weight for the employee who has a nutritional status of overweight and obese. This agrees with the research by Ramdhanni *et al*. [17], which stated that circuit training, a kind of strength training, is effective in improving BMI for obese adult women. Furthermore, another study showed that exercise intervention significantly reduces the mean BMI of obese people from > 30 kg/m^2 (obese) to 25–29.9 kg/m^2 (overweight) Kleist *et al*. [18]. Strength training, such as circuit training, done at least 3 times per week, is an effective method to reduce BMI in obese

adult women [19]. Furthermore, another study showed that 8-week exercise can significantly reduce BMI and body weight [20]. This study also proves that large-scale exercises improve body weight and BMI of obese people even without face-to-face intervention. Therefore, in the ongoing or even future pandemic period, tele-exercise is a viable solution in the fight against obesity.

Exercise training is one of main treatment plan for overweight or obese subjects, unrelated to weight loss goals [21]. According to Willis *et al*. 2012 [22], cardio training is the most optimum type of exercise to reduce fat and body weight for middle-aged overweight/obese individuals, rather than strength training or combination of strength and cardio training. However, another study showed that 12-week training program, consisted of moderate-interval training and strength training provided greater weight loss and fat loss than strength training alone in overweight and obese adults [23]. Another study Ramirez-Vélez *et al.* [24], also showed that the combination of strength training and cardio training did not have an additive effect on improving body mass and body composition compared with strength or cardio training alone, suggesting that combination training regimens do not provide significant further benefit. The result of this study also contrasts with the results of a 26-week study, where obese older adults were assigned to a weight-management and exercise program (cardio training, strength training, or combination of both) or to a control group [25]. They showed that body composition improves more by combination of strength and cardio training and strength training alone, when compared to cardio training. Considering that study, study's duration is quite long, it may be concluded that only long-term interventions might have substantial effect on body composition.

While the scalability of providing a large volume of facilitated sessions across a week is questionable, computer-assisted technology has shown promise for the delivery of workplace HIIT, thus eliminating the need for facilitated HIIT sessions [26]. While computer-assisted exercise may be regarded positively by some individuals, the subjects of the aforementioned study reported that they enjoyed group-based facilitated exercise, which highlights the need to cater to a wide range of exercise preferences in the workplace. Furthermore, in other research, it is shown that tele-exercise, with combination of tele-nutrition counseling, is effective on reducing obese office employee's body weight [27].

The insignificance of fat mass percentage loss indicated that a combined training only has a low impact on the reduction of body fat or other parts of body composition, such as bone or water mass. This study also suggested that other factors outside the scope of this study affect body fat, such as nutritional intake. Since diet was not monitored in the study, hence, the subjects' energy homeostasis may be positive, resulting in weight gain. According to Stinson *et al*. [28], high fat and sugar consumption during ad libitum intake predict weight gain.

White *et al*. [29] stated that skeletal muscle mass is broken down after strength exercise, marked by creatine kinase [30], [31]. also stated that there is an increase in muscle mass breakdown after strength training. However, protein, in its recovery process, plays an important role by pushing z-line disorder on skeletal muscle [32]. Therefore, the lack of protein consumption after strength training causes breakdown of muscle into its component without recovery. This leads to a decrease in lean body mass percentage and an increase in fat mass percentage.

The inconsistency of fat mass percentage may also be attributed to the inaccuracy of the assessment method, which was carried out using BIA (Bioelectrical impedance analyzer). BIA determines the electrical impedance or opposition to the flow of an electric current through body tissues, which estimate total body water. However, this estimation can be used to determine fat-free body mass and measure body fat by calculating the difference in body weight [33].

Since this method relies on total body water, hydration status may play a significant role in estimating fat mass percentage. Dehydration is a recognized factor affecting BIA measurements as it causes an increase in the body's electrical resistance. However, it can also cause a 5 kg underestimation of fat-free mass and an overestimation of body fat [34] which may relatively affect body composition assessment through BIA. Therefore, this observation may not be appropriate for the BIA to determine body composition [35].

The body fat mass percentage results were also affected by the timing of measurement as values were lower when measurements are taken shortly after consumption of a meal up to 4.2% of body fat [36], hence, a 90–120 min moderate exercise is not necessary before measurement. Therefore, moderate exercise before BIA measurements leads to an overestimation of fat-free mass and an underestimation of body fat percentage due to reduced impedance [37]. Furthermore, the nutrition knowledge, one of the factor affecting physical fitness [38] was also not analyzed in this study. This study is also limited due to the energy metabolism or genetic factors that could be determinants of the interindividual variance were not measured. It also should be noted that diets in the all groups were not monitored by any means. Despite these limitations, this study is the first to the best of our knowledge to assess the effect of tele-exercise on body composition and weight loss in obese employee in Indonesia.

Conclusion

Tele-exercise had a significant effect ($p < 0.05$) on BMI and body weight, while fat mass percentage only decreased significantly ($p < 0.05$) from the second

to third assessment. This proves that tele-exercise is a viable solution in the fight against obesity. This greatly benefits employee, who in general does not have much leisure time and live sedentarily, spending most of their time sitting in front of desk. Furthermore, the "online" nature of tele-exercise could further improve employee's BMI in this COVID-19 pandemic time, where access to direct, face-to-face exercise is limited. In the future research, the timing of measurement and hydration status should be considered to assess body composition, while nutrition knowledge and nutritional intake must be taken into consideration as well.

Declaration

Availability of data and material

Not available online nor offline.

Authors' contributions

All authors contributed equally on all aspects of this research.

Ethics approval

It was approved by Ethical Committee of University of Indonesia, protocol number 20-10-1309, on November 23, 2020.

Consent to participate

Consent to participate was given by all subjects of this study.

Consent for publication

Subjects consent for their data to be published in this study.

References

1. Devito NJ, French L, Goldacre B. Trends in obesity and severe obesity prevalence in US youth and adults by sex and age, 2007-2008 to 2015-2016. JAMA. 2018;319(16):2016-8. https://doi.org/10.1001/jama.2018.3060
   PMid:29570750
2. RISKESDAS. Riset Kesehatan Dasar 2018. Indonesia: Kementrian Kesehatan Republik Indonesia; 2018.
3. Shrestha N, Pedisic Z, Neil-Sztramko S, Kukkonen-Harjula KT, Hermans V. The impact of obesity in the workplace: A review of contributing factors, consequences and potential solutions. Curr Obes Rep. 2016;5(3):344-60. https://doi.org/10.1007/s13679-016-0227-6
   PMid:27447869
4. Tomlinson OW, Shelley J, Trott J, Bowhay B, Chauhan R, Sheldon CD. The feasibility of online video calling to engage patients with cystic fibrosis in exercise training. J Telemed Telecare. 2020;26(6):356-64. https://doi.org/10.1177/1357633X19828630
   PMid:30803323
5. Mascarenhas MN, Chan JM, Vittinghoff E, Van Blarigan EL, Hecht F. Increasing physical activity in mothers using video exercise groups and exercise mobile apps: Randomized controlled trial. J Med Intern Res. 2018;20(5):e179. https://doi.org/10.2196/jmir.9310
   PMid:29776899
6. Hong J, Kim J, Kim SW, Kong HJ. Effects of home-based tele-exercise on sarcopenia among community-dwelling elderly adults: Body composition and functional fitness. Exp Gerontol. 2017;87(A):33-9. https://doi.org/10.1016/j.exger.2016.11.002
   PMid:27838369
7. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc. 2009;41(2):459-71. https://doi.org/10.1249/MSS.0b013e3181949333
   PMid:19127177
8. Trost SG, Pate RR, Sallis JF, Freedson PS, Taylor WC, Dowda M, *et al*. Age and gender differences in objectively measured physical activity in youth. Med Sci Sports Exerc. 2002;34(2):350-5. https://doi.org/10.1097/00005768-200202000-00025
   PMid:11828247
9. Bellia A, Sallì M, Lombardo M, D'Adamo M, Guglielmi V, Tirabasso C, Giordani L, *et al*. Effects of whole body vibration plus diet on insulin-resistance in middle-aged obese subjects. Int J Sports Med. 2014;35(6):511-6. https://doi.org/10.1055/s-0033-1354358
   PMid:24227120
10. Kuswari M, Nuzrina R, Gifari N, Ronitawati P. HIIT and aerobic training effect on cardiorespiratory fitness among college students. Ann Nutr Metab. 2019;75:134.
11. Gifari N, Martianto D, Kuswari M. Effect of high-intensity interval training and pre-meal water consumption on lipid profile in overweight and obese students. Malaysian J Nutr. 2021;27(1):159-68.
12. Avissa A, Kuswari M, Nuzrina R, Gifari N, Melani V. Pengaruh program latihan olahraga dan edukasi gizi terhadap komposisi tubuh, lingkar perut dan lingkar panggul pada wanita usia produktif di depok. Phys Activ J. 2021;2(2):176-92.
13. WHO Global InfoBase Team. The SuRF Report 2-Surveillance of Chronic Disease Risk Factors: Country-level Data and Comparable Estimates. Geneva: World Health Organization; 2005.
14. Sugiyono S. Metode Penelitian Bisnis (Pendekatan Kuantitatif, Kualitatif Dan R and D). Nepal: Alfabeta; 2009.
15. Abadini D, Wuryaningsih CE. Determinan aktivitas fisik orang dewasa pekerja kantoran di Jakarta tahun 2018. J Prom Kesehatan Indones. 2019;14(1):15-28.
16. Egger A, Kreis R, Allemann S, Stettler C, Diem P, Buehler T, *et al*. The effect of aerobic exercise on intrahepatocellular and intramyocellular lipids in healthy subjects. PLoS One. 2013;8(8):e70865. https://doi.org/10.1371/journal.pone.0070865
   PMid:23967125
17. Ramdhanni D, Pitriani P, Mulyana M. Latihan sirkuit signifikan menurunkan berat badan dan BMI. JUARA J Olahraga. 2020;5(2):135-42. https://doi.org/10.33222/juara.v5i2.759

18. Kleist B, Wahrburg U, Stehle P, Schomaker R, Greiwing A, Stoffel-Wagner B, *et al*. Moderate walking enhances the effects of an energy-restricted diet on fat mass loss and serum insulin in overweight and obese adults in a 12-week randomized controlled trial. J Nutr. 2017;147(10):1875-84. https://doi.org/10.3945/jn.117.251744
PMid:28794207
19. Bocalini DS, Lima LS, de Andrade S, Madureira A, Rica RL, dos Santos RN, *et al*. Effects of circuit-based exercise programs on the body composition of elderly obese women. Clin Interv Aging. 2012;7:551-6. https://doi.org/10.2147/CIA.S33893
PMid:23271901
20. Salesi M, Gani S. Effects of exercise intervention to improve body composition and chemerin in middle-aged overweight women. J Phys Activ. 2018;2(2):1-12.
21. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS. The role of exercise and physical activity in weight loss and maintenance. Prog Cardiovasc Dis. 2014;56(4):441-7. https://doi.org/10.1016/j.pcad.2013.09.012
PMid:24438736
22. Willis LH, Slentz CA, Bateman LA, Shields AT, Piner LW, Bales CW, *et al*. Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. J Appl Physiol 2012;113(12):1831-7. https://doi.org/10.1152/japplphysiol.01370.2011
PMid:23019316
23. Ho SS, Dhaliwal SS, Hills AP, Pal S. The effect of 12 weeks of aerobic, resistance or combination exercise training on cardiovascular risk factors in the overweight and obese in a randomized trial. BMC Public Health BioMed Central. 2012;12(1):1-10. https://doi.org/10.1186/1471-2458-12-704
PMid:23006411
24. Ramirez-Vélez R, Izquierdo M, Castro-Astudillo K, Medrano-Mena C, Monroy-Diaz AL, del Pilar Castellanos-Vega, Triana-Reina HR, *et al*. Weight loss after 12 weeks of exercise and/or nutritional guidance is not obligatory for induced changes in local fat/lean mass indexes in adults with excess of adiposity. Nutr Multidiscip Digit. 2020;12(8):2231. https://doi.org/10.3390/nu12082231
PMid:32722652
25. Villareal DT, Aguirre L, Gurney AB, Waters DL, Sinacore DR, Colombo E, *et al*. Aerobic or resistance exercise, or both, in dieting obese older adults. N Engl J Med Mass Med Soc. 2017;376(20):1943-55.
26. Metcalfe RS, Atef H, Mackintosh K, McNarry M, Ryde G, Hill DM, Vollaard NB. Time-efficient and computer-guided sprint interval exercise training for improving health in the workplace: A randomised mixed-methods feasibility study in office-based employees", BMC Public Health. 2020;20(1):1-13.
27. Kuswari M, Rimbawan R, Dewi M, Gifari N. Effect of tele-exercise versus combination of tele-exercise with tele-counseling on obese office employee's weight loss. Arsip Gizi Dan Pangan. 2021;6(2):131-9.
28. Stinson EJ, Piaggi P, Ibrahim M, Venti C, Krakoff J, Votruba SB. High fat and sugar consumption during ad libitum intake predicts weight gain. Obesity. 2018;26(4):689-95. https://doi.org/10.1002/oby.22124
PMid:29504262
29. White JP, Wilson JM, Austin KG, Greer BK, St. John N, Panton LB. Effect of carbohydrate-protein supplement timing on acute exercise-induced muscle damage. J Int Soc Sports Nutr. 2008;5:5. https://doi.org/10.1186/1550-2783-5-5
PMid:18284676
30. Udani JK, Singh BB, Singh VJ, Sandoval E. BounceBack™ capsules for reduction of DOMS after eccentric exercise: A randomized, double-blind, placebo-controlled, crossover pilot study. J Int Soc Sports Nutr. 2009;6(1):14. https://doi.org/10.1186/1550-2783-6-14
PMid:19500355
31. Cooke MB, Rybalka E, Stathis CG, Cribb PJ, Hayes A. Whey protein isolate attenuates strength decline after eccentrically-induced muscle damage in healthy individuals. J Int Soc Sports Nutr. 2010;7:30. https://doi.org/10.1186/1550-2783-7-30
PMid:20860817
32. Helman EE, Huff-Lonergan E, Davenport GM, Lonergan SM. Effect of dietary protein on calpastatin in canine skeletal muscle. J Anim Sci. 2003;81(9):2199-205. https://doi.org/10.2527/2003.8192199x
PMid:12968694
33. Kyle UG, Bosaeus I, De Lorenzo AD, Deurenberg P, Elia M, Gómez JM, *et al*. Bioelectrical impedance analysis-Part I: Review of principles and methods. Clin Nutr. 2004;23(5):1226-43. https://doi.org/10.1016/j.clnu.2004.06.004
PMid:15380917
34. Lukaski HC, Bolonchuk WW, Hall CB, Siders WA. Validation of tetrapolar bioelectrical impedance method to assess human body composition. J Appl Physiol. 1986;60(4):1327-32. https://doi.org/10.1152/jappl.1986.60.4.1327
PMid:3700310
35. Demirkan E, Kutlu M, Koz M, Özal M, Güçlüöver A, Favre M. Effects of hydration changes on body composition of wrestlers. Int J Sport Stud Kowsar Med. 2014;4(2):196-200.
36. Slinde F, Rossander-Hulthén L. Bioelectrical impedance: Effect of 3 identical meals on diurnal impedance variation and calculation of body composition. Am J Clin Nutr. 2001;74(4):474-8. https://doi.org/10.1093/ajcn/74.4.474
PMid:11566645
37. Kushner RF, Gudivaka R, Schoeller DA. Clinical characteristics influencing bioelectrical impedance analysis measurements. Am J Clin Nutr. 1996;64(3):423S-7. https://doi.org/10.1093/ajcn/64.3.423S
PMid:8780358
38. Gifari N, Nuzrina R, Kuswari M, Hutami NT, Ghalda A. Relationship between nutrition knowledge and aerobic fitness in young gymnasts. Sci Gymnast J. 2020;12(2):195-224.