International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 7, 2020
ISSN: 1475-7192

Factors Correlated to Body Fat Percentage, Bone Density, Muscle Mass, and Muscle Strength in Women Practicing Zumba and Aerobics Exercise

Istinur Alifah[1], Tiyas Kusumaningrum[1*], Aria Aulia Nastiti[1]

Abstract--- *Many believe that practicing Aerobics or Zumba helps lose weight and increase muscle strength. The purpose of this study was to analyze factors correlated to body fat percentage, bone density, muscle mass and strength in women practicing Zumba and Aerobics exercise. This study was a correlational study targeted at women practicing Aerobics or Zumba exercise. There were 114 participants selected through inclusion and exclusion criteria. Factors being investigated were Body Mass Index (BMI), milk and supplements consumption, parity, breastfeeding history, frequency of exercise, the length of participation for Zumba and Aerobics exercise, and other physical exercise activity. The data were collected using questionnaires, Bio impedance Analysis TANITA BC-541 and Wall Sit Test (WST). Data were analyzed using Spearman's Rho Test and Mann Whitney with a significance level of $\alpha=0.05$. Results showed that factors correlated to body fat percentage were parity, breastfeeding history, frequency of exercise, the length of participation, also other physical exercise activity ($p<0.05$; $r>0.28$). Factors correlated to bone density were milk and supplements consumption, breastfeeding history, and frequency of exercise ($p<0.05$; $r\leq2.1$). Factors associated with muscle mass and strength were BMI, frequency of exercise, and practicing other physical exercise ($p<0.05$; $r>0.25$). From these data, it was concluded that not all factors studied were related to body fat percentage, bone density, muscle mass and strength. However, the results of this study also show that the frequency of exercise per week correlates with all dependent variables. This shows that practicing Zumba or Aerobics can improve women's fitness.*

Keywords--- *Body Fat; Bone Density; Muscle; Women; Zumba; Aerobics; Exercise*

I. INTRODUCTION

A survey conducted by the American College of Sports Medicine (ACSM) in 2018 stated that "Group Training", an exercise involving dance movements, was again becoming popular [1]. Aerobics and Zumba exercises are among the popular group training targeting women. Aerobics exercise is a repetitive and gradual physical activity that causes the metabolic system to use oxygen to produce energy [2], while Zumba is a physical exercise inspired by Latin dance developed from aerobic movements combined with various dance movements ranging from Salsa to hip-hop [3]. Several studies related to Zumba and Aerobics exercises suggested that both exercises help women to lose weight and improve body fitness [4]–[7]. In addition to the positive results shown from several studies related to Zumba and Aerobics exercise, there are also studies revealing that the target of weight loss and improving fitness using those

[1] *Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia*

Corresponding author
Tiyas Kusumaningrum
Email tiyas-k@fkp.unair.ac.id

exercise were apparently not significant enough [6], [8]. Muscle strength, cardiorespiratory capacity, agility, energy and flexibility are the components of general fitness [9]. Some research revealed that the fitness component is closely related to body composition such as muscle mass, body fat composition and bone density [3], [10]. Several factors can affect fitness including nutritional status, diet, parity, and physical activity. The purpose of this study was to analyze factors such as Body Mass Index (BMI), milk and supplements consumption, parity, breastfeeding history, frequency of exercise, the length of participation in Zumba and Aerobics exercise, and other physical exercise activity correlations to body fat percentage, bone density, muscle mass and strength in women practicing Zumba and Aerobics exercise.

II. METHOD

The design of this study was a correlational study with one-time data collection. The population was made up of all women of reproductive age practicing Zumba or Aerobics exercise. There were 114 participants obtained from a purposive sampling technique with inclusion criteria: aged 25 to 45 years who had given birth, had attended at least 4 weeks of training, and routinely came at least once a week. Pregnant women were excluded from this study. The independent variables in this study were Body Mass Index (BMI), milk and supplements consumption, parity, breastfeeding history, frequency of exercise, the length of participation in Zumba and Aerobics, and the other physical exercise activities. The dependent variables in this study were body fat percentage, bone density, muscle mass and strength. BMI measurement was performed by comparing body weight and height. Data on milk consumption and supplementation, parity, history of breastfeeding, frequency of exercise, duration of training, and the presence of other sports activities were obtained through questionnaires. Data on body fat percentage, bone density, and muscle mass were measured with a Bio impedance Analysis tool TANITA BC-541. Data on muscle strength were obtained from Wall-Sit Test (WST) results. The data obtained were analyzed using Spearman and Mann-Whitney statistical tests. This study received ethical approval from The Research Ethic Committee, Faculty of Nursing Universitas Airlangga with Letter of Approval No: 987-KEPK.

III. RESULTS

Table 1. Participants' characteristics (n=114)

Characteristics	n	%
Age		
25—30 yld*	21	18.4
31—35 yld	25	21.9
36—40 yld	33	28.9
41—45 yld	35	30.7
Education Level		
Elementary	1	0.9
Junior high	11	9.6
Senior high	56	49.1
Higher degree	46	40.4
Occupation		
Private employee	43	37.7
Business owner	15	13.2
Public servant	1	0.9
Homemaker	55	48.2
Body Mass Index (BMI)		
Normal	72	63.2
Overweight	39	34.2
Obese	2.6	2.6
Milk consumption		
Yes	54	47.4

Characteristics	n	%
No	60	52.6
Supplement consumption		
Yes	4	3.5
No	110	96.5
Birthing frequency		
≤2 times	77	67.5
≥3 times	37	32.5
Breastfeeding		
6—12 months	56	49.1
13—24 months	36	31.6
>24 months	22	19.3
Frequency of exercise/week		
≤2 times	63	55.2
>3 times	51	44.8
Length of participation in Zumba or Aerobics		
1—3 months	5	4.4
4—6 months	9	7.9
7—12 months	18	15.8
>12 months	82	71.9
Other exercise activity		
Yes	8	7
No	106	93
Percentage of body fat		
Healthy	74	64.9
Overweight	36	31.6
Obese	4	3.5
Bone density		
Low	58	50.9
Normal	16	14
High	40	35.1
Muscle mass		
Low	109	95.6
Average	5	4.4
Muscle strength		
Very poor	12	10.5
Below average	50	43.9
Average	47	41.2
Excellent	5	4.4

Data from Table 1 show that the majority of participants in this study were homemakers aged between 41 and 45 years old (30.7%) with a senior high school education background (49.1%). Most participants had a normal BMI (63.2), were not consuming milk or supplements, had one or two children, breastfed their child for up to 12 months (93%), at a maximum attended two exercise classes per week, had participated Zumba or Aerobics for more than twelve months and did other physical exercise activity. Most participants had a percentage of fat in the healthy level (64.9%) and low level of bone density (50.9%). The majority of participants had low level of muscle mass, while muscle strength levels were below average (43.9%). The average percentage of body fat in participants was 32.39%, the mean bone density was 2.23 kg, muscle mass was 36.03 and muscle strength was 32.32 seconds.

Table 2. Spearman-rho test statistical analysis results (n=114 α=0.05)

	Percentage of body fat		Bone density		Muscle mass		Muscle strength	
	p	*r*	*p*	*r*	*p*	*r*	*p*	*r*
Body Mass Index	0.168	-	0.542	-	0.000	0.326	0.003	0.280
Milk consumption	0.297		0.000	0.760	0.650	-	0.307	-
Supplement consumption	0.298	-	0.000	0.210	0.051	-	0.128	-
Parity	0.000	0.793	0.283	-	0.817	-	0.682	-
Breastfeeding	0.170	-	0.000	-0.689	0.060	-	0.420	-
Frequency of	0.000	-0.794	0.003	-0.273	0.007	0.253	0.012	0.234

	Percentage of body fat		Bone density		Muscle mass		Muscle strength	
	p	*r*	*p*	*r*	*p*	*r*	*p*	*r*
exercise/week								
Length of participation in Zumba or Aerobics	0.000	-0.790	0.343	-	0.300	-	0.651	-
Other physical exercises	0.002	-0.290	0.689	-	0.000	0.442	0.000	0.400

From Table 2 we learnt that BMI showed a significant positive correlation with mass and muscle strength with moderate correlation levels. Milk and supplement consumption had a significant and positive correlation with bone density. Among those, milk consumption showed the strongest correlation (r=0.760) while supplement consumption had a low correlation (r=0.210). From the table above, it can also be seen that there was a very strong positive correlation between parity and fat percentage (p = 0.000; r = 0.793), while there was no correlation with other independent variables. The history of breastfeeding showed a significant correlation with bone density. The direction of the correlation was negative at a very strong level (r=-0.689). The frequency of exercise per week showed a negative correlation with percentage of body fat and bone density. The correlation between exercise frequency and fat percentage was very strong, while bone density was moderate. The frequency of exercise per week showed a positive correlation with muscle mass and muscle strength. However, the level of correlation was weak. The existence of other physical exercise activities negatively correlated with the percentage of fat (r=-0.290), but positively correlated with muscle mass (r=0.442) and muscle strength (r=0.400).

IV. DISCUSSION

Body fat percentage is usually associated with obesity and focuses on body fat distribution. Several factors related to fat distribution, especially visceral fat, are: age, sex, race, diet, and sedentary behavior [11]. More than 60% of participants in this study had a percentage of fat at a healthy level, while the age range was between 25 and 45 years. Fat metabolism in women closely related with estradiol (E2) level [12]. During childbearing age, E2 levels help prevent the accumulation of visceral fat in women, but it changes during menopause when E2 levels drop dramatically resulting in the accumulation of visceral fat and weight gain [13], [14]. In this study, parity number was proven to have a strong relationship with fat percentage. The higher the parity, the more fat percentage occurred. In pregnancy, there is an increase in lipids, lipoproteins, and apolipoproteins. These lipids then deposit in the central part of the body to be used by the fetus along with their development [15]. However, when the deposit is more than what the fetus needs, the deposit of lipid stays after pregnancy. In this study, exercise frequency per week, length of participation, and other physical exercise related negatively to body fat presentation. This study supports the results of other studies that mention physical exercise involving aerobic movements helps in the distribution of body fat [16]–[18].

The results of this study indicate that the factors of milk consumption and nutritional supplementation are positively correlated with bone density. Milk consumption has a very strong correlation with bone density. There are many factors that affect bone density. These factors are genetic, sex, nutrition, physical activity, hormones, other risk factors (e.g. alcohol consumption, smoking) and the presence of comorbidities [19]. There are various types of milk that humans consume, but among them cow's milk is the most popular. Cow's milk has fat, lactose, protein, energy, calcium, phosphorus, vitamin A and vitamin D. The content, especially calcium, has a positive effect on bone health and prevention of osteoporosis [20], [21]. For many decades, health care personnel have suggested that people should take supplements such as calcium and vitamins that increase bone density. Vitamin D helps stimulate gastrointestinal absorption of calcium thereby increasing bone health, but the amount of consumption for elderly people need careful

consideration [22]–[24]. The history of breastfeeding in this study also had a correlation with bone density in women who participated in Zumba and Aerobics, with a strong negative correlation. The longer a woman feeds her baby, the lower the bone density she has. This confirms some studies that state that during breastfeeding, bone loss occurs due to a high demand for calcium [25], [26]. Bone loss during breastfeeding can be avoided with good care and by restoring the metabolism to how it was in the period before pregnancy [27]. Surprisingly, Zumba and Aerobics exercise frequency per week showed a negative correlation with bone density. This contradicts various references which mention that routine exercise helps in increasing bone density and preventing and overcoming osteoporosis [28]–[30]. However, there is concern that exercise must be taken with caution, especially in the elderly and people with musculoskeletal diseases, to prevent injury.

BMI showed a positive correlation with muscle mass and muscle strength. This result supports previous studies that suggested that an increase in BMI will be followed by increased muscle mass and performance [31]–[33]. Physiologically, muscle mass takes 40 to 50 percent of the overall body mass of an adult and there were several factors that affected muscle mass or muscle strength. Those were ethnicity, age, physical activity, gender, and body mass index (BMI) [31]. Other studies suggest that BMI is also related to body balance [32]. It is predicted that with normal BMI there is the potential for better muscle strength and body balance of women who participate in Zumba or Aerobics. The frequency of Zumba or Aerobics exercise per week and doing other physical exercises was proven to be correlated with muscle mass and muscle strength in this study. These results support other studies which state that aerobic exercise increases skeletal muscle contraction, which causes muscle hypertrophy, and increases muscle mass [34]. Several studies have shown similar results that regular physical exercise increases physical capacity including muscular strength and improved fitness [10], [35], [36].

V. CONCLUSION

This study revealed that the greater the Body Mass Index (BMI), the greater the muscle mass and muscle strength. Women who consume milk and nutritional supplements have better bone density than those who do not. Women who breastfeed for a longer time have lower bone density. In women with a higher frequency of exercise, the percentage of fat is lower, while muscle mass and muscle strength are higher. Women's participation in other physical exercise activities besides Zumba and Aerobics decreases the percentage of fat, increasing muscle mass and muscle strength. It can be concluded that women who regularly participate in Zumba or Aerobics get benefits in reducing body fat percentage, increasing muscle mass and muscle strength. However, doing other physical exercises beyond the Zumba or Aerobics schedule and consuming milk or nutritional supplements has the potential to increase training benefits.

CONFLICT OF INTEREST

There are no conflicts of interest for this article.

REFERENCES

[1] [1] W. R. Thompson, “WORLDWIDE SURVEY OF FITNESS TRENDS FOR 2019,” *ACSM’s Heal. Fit. J.*, vol. 22, no. 6, pp. 10–17, Nov. 2018.
[2] R. Millstein, “Aerobic Exercise BT - Encyclopedia of Behavioral Medicine,” M. D. Gellman and J. R. Turner, Eds. New York, NY: Springer New York, 2013, pp. 48–49.
[3] A. Ljubojević, V. Jakovljević, and M. Popržen, “Effects of Zumba fitness program on body composition of women,” *SportLogia*, vol. 10, no. 1, pp. 29–33, 2014.
[4] Berliana, “Weight Reduction and Body Fat Through Zumba Dance Training and Aerobic High Impact,”

in *IOP Conference Series: Materials Science and Engineering*, 2017, vol. 180, p. 12193.

[5] P. A. Domene, H. J. Moir, E. Pummell, and C. Easton, "Salsa dance and Zumba fitness: Acute responses during community-based classes," *J. Sport Heal. Sci.*, vol. 5, no. 2, pp. 190–196, Jun. 2016.

[6] C. Micallef, "The effectiveness of an 8-week Zumba programme for weight reduction in a group of Maltese overweight and obese women," *Sport Sci. Health*, vol. 10, no. 3, pp. 211–217, Jul. 2014.

[7] K. Hižnayová, "Exercise intensity during Zumba fitness and Tae-bo aerobics," *J. Hum. Sport Exerc.*, vol. 8, no. 2 SUPPL, pp. 228–241, 2013.

[8] D. F. Williamson, M. K. Serdula, R. F. Anda, A. Levy, and T. Byers, "Weight loss attempts in adults: Goals, duration, and rate of weight loss," *Am. J. Public Health*, vol. 82, no. 9, pp. 1251–1257, 1992.

[9] M. Gilang, *Penjasorkes SMA kls 11*. Jakarta: Ganeca Exact, 2007.

[10] T. G. LOHMAN *et al.*, "Relationships among Fitness, Body Composition, and Physical Activity," *Med. Sci. Sport. Exerc.*, vol. 40, no. 6, pp. 1163–1170, Jun. 2008.

[11] M.-A. Cornier *et al.*, "Assessing adiposity: a scientific statement from the American Heart Association.," *Circulation*, vol. 124, no. 18, pp. 1996–2019, Nov. 2011.

[12] K. J. Leveno *et al.*, *Williams Obstetrics, 25th Edition*. McGraw-Hill Education, 2018.

[13] R. P. A. Barros and J. Å. Gustafsson, "Estrogen receptors and the metabolic network," *Cell Metabolism*, vol. 14, no. 3. Cell Press, pp. 289–299, 07-Sep-2011.

[14] B. T. Palmisano, L. Zhu, and J. M. Stafford, "Role of estrogens in the regulation of liver lipid metabolism," in *Advances in Experimental Medicine and Biology*, vol. 1043, Springer New York LLC, 2017, pp. 227–256.

[15] E. Isganaitis, S. Venditti, T. J. Matthews, C. Lerin, E. W. Demerath, and D. A. Fields, "Maternal obesity and the human milk metabolome: associations with infant body composition and postnatal weight gain," *Am. J. Clin. Nutr.*, vol. 110, no. 1, pp. 111–120, 2019.

[16] S. E. Keating *et al.*, "Continuous Exercise but Not High Intensity Interval Training Improves Fat Distribution in Overweight Adults," *J. Obes.*, vol. 2014, p. 834865, 2014.

[17] I. Ismail, S. E. Keating, M. K. Baker, and N. A. Johnson, "A systematic review and meta-analysis of the effect of aerobic vs. resistance exercise training on visceral fat," *Obes. Rev.*, vol. 13, no. 1, pp. 68–91, 2012.

[18] M. Rosenkilde, P. Auerbach, M. H. Reichkendler, T. Ploug, B. M. Stallknecht, and A. Sjödin, "Body fat loss and compensatory mechanisms in response to different doses of aerobic exercise—a randomized controlled trial in overweight sedentary males," *Am. J. Physiol. Integr. Comp. Physiol.*, vol. 303, no. 6, pp. R571–R579, Sep. 2012.

[19] R. M. Daly and M. A. Petit, *Optimizing Bone Mass and Strength: The Role of Physical Activity and Nutrition During Growth*. Karger, 2007.

[20] P. C. Pereira, "Milk nutritional composition and its role in human health," *Nutrition*, vol. 30, no. 6. Elsevier Inc., pp. 619–627, 01-Jun-2014.

[21] R. Rizzoli, "Dairy products, yogurts, and bone health," *Am. J. Clin. Nutr.*, vol. 99, no. 5, pp. 1256S-1262S, May 2014.

[22] S. M. Verschueren *et al.*, "The effects of whole-body vibration training and vitamin D supplementation on muscle strength, muscle mass, and bone density in institutionalized elderly women: A 6-month randomized, controlled trial," *J. Bone Miner. Res.*, vol. 26, no. 1, pp. 42–49, Jan. 2011.

[23] R. Bouillon and M. R. Laurent, "Vitamin D and Bone Health: Basic and Clinical Aspects," in *Contemporary Endocrinology*, Humana Press Inc., 2020, pp. 71–87.

[24] J. J. B. Anderson, K. J. Roggenkamp, and C. M. Suchindran, "Calcium Intakes and Femoral and Lumbar Bone Density of Elderly U.S. Men and Women: National Health and Nutrition Examination Survey 2005–2006 Analysis," *J. Clin. Endocrinol. Metab.*, vol. 97, no. 12, pp. 4531–4539, Dec. 2012.

[25] E. N. Lee, "Effects of Parity and Breastfeeding Duration on Bone Density in Postmenopausal Women," *Asian Nurs. Res. (Korean. Soc. Nurs. Sci).*, vol. 13, no. 2, pp. 161–167, May 2019.

[26] P. Salari and M. Abdollahi, "The influence of pregnancy and lactation on maternal bone health: a systematic review.," *J. Fam. Reprod. Heal.*, vol. 8, no. 4, pp. 135–48, Dec. 2014.

[27] F. M. F. Grizzo *et al.*, "How does women's bone health recover after lactation? A systematic review and meta-analysis," *Osteoporos. Int.*, vol. 31, no. 3, pp. 413–427, 2020.

[28] L. D. Fernandes Moreira, M. L. de Oliveira, A. P. Lirani-Galvão, R. V. Marin-Mio, R. N. dos Santos, and M. Lazaretti-Castro, "Exercício físico e osteoporose: Efeitos de diferentes tipos de exercícios sobre o osso e a função física de mulheres pós-menopausadas," *Arq. Bras. Endocrinol. Metabol.*, vol. 58, no. 5, pp. 514–522, 2014.

[29] C. R. Russo, "The effects of exercise on bone. Basic concepts and implications for the prevention of

fractures," *Clinical Cases in Mineral and Bone Metabolism*, vol. 6, no. 3. CIC Edizioni Internazionali, pp. 223–228, Sep-2009.

[30] B. Z. Leder and M. N. Wein, *Osteoporosis*. Cham: Springer International Publishing, 2020.

[31] R. H. Wattimena, V. Vitriana, and I. R. Defi, "Correlation between Body Mass Index, Gender, and Skeletal Muscle Mass Cut off Point in Bandung," *Int. J. Integr. Heal. Sci.*, vol. 5, no. 2, pp. 47–51, Sep. 2017.

[32] N. Valentina, P. M. Kurniawati, and M. M. Maramis, "Correlation of Lower Limb Muscles and Body Mass Index with Body Balance in the Elderly," *Folia Medica Indones.*, vol. 55, no. 1, p. 58, Apr. 2019.

[33] R. Hardy *et al.*, "Body Mass Index, Muscle Strength and Physical Performance in Older Adults from Eight Cohort Studies: The HALCyon Programme," *PLoS One*, vol. 8, no. 2, Feb. 2013.

[34] A. R. Konopka and M. P. Harber, "Skeletal muscle hypertrophy after aerobic exercise training," *Exercise and Sport Sciences Reviews*, vol. 42, no. 2. Lippincott Williams and Wilkins, pp. 53–61, 2014.

[35] K. Liberman, L. N. Forti, I. Beyer, and I. Bautmans, "The effects of exercise on muscle strength, body composition, physical functioning and the inflammatory profile of older adults: A systematic review," *Current Opinion in Clinical Nutrition and Metabolic Care*, vol. 20, no. 1. Lippincott Williams and Wilkins, pp. 30–53, 2017.

[36] M. L. Sbardelotto *et al.*, "Improvement in muscular strength and aerobic capacities in elderly people occurs independently of physical training type or exercise model," *Clinics*, vol. 74, 2019.

.