

Factors associated with the Physical Fitness of Lactating Mothers in an Urban Area

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Abstract. An urban area is characterized by increased sedentary lifestyle (SL) and reduced physical fitness (PF) among various populations, including lactating mothers. Adequate physical fitness is essential for lactating mothers to support breastmilk production during the lactating period. This study used an observational method with a cross-sectional design that aims to analyze factors associated with physical fitness among lactating mothers in an urban area. This study included 61 lactating mothers selected through systematic random sampling in Magelang City. Physical fitness status was assessed by a six-minute walk test. Trained enumerators collected data using validated instruments for each variable. Data were analyzed using Chi-square and Fisher's exact tests. The results showed that most subjects had moderate PF (68.3%), while only 34.9% engaged in vigorous physical activity. In addition, only 3.2% of subjects were well-hydrated, and a significant portion had inadequate calcium (76.2%) and iron (61.9%) intake. However, no significant correlation was found between physical activity, nutritional intake (total energy, calcium, and iron), hydration status, and physical fitness among the lactating mothers ($p > 0.05$). Therefore, future research should consider incorporating additional variables such as biochemistry and environmental factors.

1 Introduction

An urban area is characterized by human settlement and high population density [1]. This area is supported by well-developed public infrastructure and facilities [2]. Residents in urban areas are frequently exposed to rapid technological advancements [3,4]. The use of technologies, including the Internet of Things (IoT), are integral to their daily lives [4]. This phenomenon has contributed to the increasing prevalence of sedentary lifestyles (SL) in recent years [5,6]. A previous study showed that individuals living in urban areas are susceptible to adopting SL [7]. A study in Indonesia showed that most urban populations across various demographic groups exhibit high levels of SL, which in turn reduces their engagement in physical activities (PA) [8]. Various studies have established PA as a key factor influencing physical fitness (PF) [9–11], as it impacts muscle mass, strength, and

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endurance. Therefore, reduced PA leads to diminished PF across populations, with lactating mother being no exception [12–14].

Lactating mothers require adequate PF for several reasons, including maintaining their health status, lowering the risk of severe stress and depression, improving the quantity and quality of breast milk, and ensuring optimal nutritional status for their babies [15–20]. PF becomes a fundamental factor for successful breastfeeding, yet research focusing on the PF of lactating mothers remains limited, presenting a novelty of this study. However, previous research has extensively examined PF in pregnant women, revealing that approximately 85.7% of pregnant women exhibit low PF [21]. Similar research found that 60.9% of pregnant women in their third trimester also exhibit low PF [22]. This is concerning as this period is essential for preparing for lactation [23]. Low PF in lactating mothers can result in lower breastmilk quantity and quality, as well as increased risks of severe malnutrition and cardiovascular endurance in their babies [18–20]. Given the importance of PF, it is essential to identify factors associated with PF in lactating mothers, particularly in urban areas where sedentary lifestyle is prevalent. Despite the harmful long-term consequences of low PF, specific programs addressing this issue are lacking in many countries. Therefore, this study aims to identify the factors associated with the physical fitness of lactating mothers in an urban area.

2 Materials and methods

2.1. Study design and subjects

This study used a quantitative method with a cross-sectional design. The subjects were 61 lactating mothers in Magelang City, Central Java Province, Indonesia, selected through systematic random sampling. The inclusion criteria were as follows: (1) willing to participate by signing the informed consent, (2) being physically and mentally healthy, and (3) residing within the service areas of Magelang Utara and Magelang Tengah Primary Health Care (PHC). Subjects who met these criteria proceeded with data collection and statistical analysis.

2.2. Data collection and research instruments

Data were collected by trained enumerators through interviews and measurements. The collected data included both independent and dependent variables, such as physical fitness, subject characteristics, body composition, physical activity, nutritional intake, and hydration status. Interviews were conducted to collect data on subject characteristics using a validated questionnaire, physical activity using a 24-hour activity recall form, and nutritional intake using a 2 x 24-hour food recall form. Physical fitness was assessed using a six-minute walk test, body composition using a bio-impedance analyzer (BIA), and hydration status using a urine analyzer with specific gravity analysis.

2.3. Data analysis and interpretation

Physical fitness data were categorized into three levels, namely low (<300 meters), moderate (300 to 400 meters), and adequate (>500 meters) based on distance covered during the six-minute walk test [24]. Physical activity was recorded for all activities performed by the subjects in a day. The data were converted into physical activity level (PAL) scores and categorized into three levels, namely low (<1.76), moderate (1.76 to 2.09), and vigorous

(>2.09) [25]. Hydration status was determined using urine samples analyzed using a urine analyzer (Urit-50). Specific gravity (SG) was used as the key indicator of hydration status. The SG scores were categorized as dehydrated (SG < 1.015), and well-hydrated (SG ≥ 1.015) [26]. Nutritional intake data were collected via interviews about the food consumed by the subjects over two days, representing both weekdays and weekends. The data were analyzed using the NutriSurvey software and categorized according to the Recommended Dietary Allowance (RDA) as adequate (meeting the RDA) and inadequate (not meeting the RDA) [27].

The data were coded, edited, cleaned, and entered into statistical software. Univariate and bivariate analysis was performed to determine the mean and median values for subject characteristics, including age, body mass index (BMI), body fat percentage, physical fitness, physical activity, hydration status, and nutritional intake. Bivariate analysis was used to determine the associations between physical activity, hydration status, and nutritional intake with the physical fitness of the subjects. The Chi-square and Fisher’s exact tests were used for the bivariate analysis, with a *p*-value of less than 0.05 indicating statistical significance.

2.4. Ethical clearance

This study received ethical approval from the Health Research Ethics Committee, Faculty of Public Health, Universitas Diponegoro with a certificate number 351/EA/KEPK-FKM/2024.

3 Results and discussion

In this study, most subjects were young mothers with a median age of 30 years. The average BMI of the subjects was 23.77 ± 4.18 and the average body fat percentage was 33.42 ± 6.37, indicating that the majority of subjects were classified as overweight. A significant proportion of the subjects (33.3%) engaged in high levels of physical activity, and the majority had moderate physical fitness (68.3%). In addition, the energy intake of most subjects was classified as adequate (63.5%), while 96.8% of the subjects were found to be dehydrated. Micronutrient intake was generally inadequate, with 76.2% of subjects having inadequate calcium intake and 61.9% having inadequate iron intake.

Table 1. Demographic characteristics, physical fitness, physical activity, hydration status, and nutritional intakes of the subjects

Variables	Results
Age (year) (median, min – max)	30 (19 – 49)
Body Mass Index (mean ± SD)	23.77 ± 4.18
Body fat percentage (mean ± SD)	33.42 ± 6.37
Physical fitness	
Low (n, %)	17 (27)
Moderate (n, %)	43 (68.3)
Adequate (n, %)	1 (1.6)
Physical activity	
Low (n, %)	21 (33.3)
Moderate (n, %)	18 (28.6)
Vigorous (n, %)	22 (34.9)

Variables	Results
Hydration status	
Dehydrated (n, %)	59 (96.8)
Well-hydrated (n, %)	2 (3.2)
Energy intake	
Inadequate (n, %)	21 (33.3)
Adequate (n, %)	40 (63.5)
Calcium intake	
Inadequate (n, %)	48 (76.2)
Adequate (n, %)	13 (20.6)
Iron intake	
Inadequate (n, %)	39 (61.9)
Adequate (n, %)	22 (34.9)

The bivariate analysis was conducted to determine the associations between physical activity, hydration status, and nutritional intake, specifically energy, calcium, and iron intake, with the physical fitness of the subjects ($p < 0.05$) (Table 2).

Table 2. Associations between physical activity, hydration status, and nutritional intake with the physical fitness of lactating mothers (n = 61)

Variables	Physical Fitness		p
	Less	Moderate - Adequate	
Physical activity			
Low – Moderate (n, %)	12 (30.8)	27 (69.2)	0.501 ^a
Vigorous (n, %)	5 (22.7)	17 (77.3)	
Hydration Status			
Dehydrated (n, %)	16 (27.1)	43 (72.9)	0.483 ^b
Well-hydrated (n, %)	1 (50)	1 (50)	
Energy intake			
Inadequate (n, %)	4 (19)	17 (81)	0.266 ^a
Adequate (n, %)	13 (32.5)	27 (67.5)	
Calcium intake			
Inadequate (n, %)	12 (25)	36 (75)	0.486 ^b
Adequate (n, %)	5 (38.5)	8 (61.5)	
Iron intake			
Inadequate (n, %)	10 (25.6)	29 (74.4)	0.605 ^a
Adequate (n, %)	7 (31.8)	15 (68.2)	

^a Chi-square test

^b Fisher’s exact test

3.1. Demographic characteristics, physical fitness, physical activity, hydration status, and nutritional intakes of lactating mothers

Breastfeeding is a critical phase in life closely related to child growth and development. Breast milk is a key factor in promoting this process. The quantity and quality of breast milk are influenced by several factors, including the mother's age and breastfeeding ability [28,29]. In this study, the median age of lactating mothers was 30 years, which is still considered within the young category. At this age, there should be minimal impact on the quantity of breast milk. However, another important factor that influences the quantity and quality of breast milk is the mother's physical fitness [18,19].

Physical fitness refers to the ability to perform daily activities without any significant burden [30]. Most lactating mothers in this study were found to have moderate physical fitness. Previous studies have shown that high cardiorespiratory fitness had a strong association with longer breastfeeding durations [31,32]. In addition, the physical activity levels of lactating mothers in this study were predominantly categorized as either vigorous or low, suggesting that awareness of optimal physical activity for this population may be lacking. Previous studies have shown that physical activity, particularly when combined with caloric restriction, can assist lactating mothers in weight loss and improve body composition by preserving fat-free mass and decelerating bone loss [14,33]. Regular physical activity during the postpartum period can also improve cardiovascular fitness and overall physical fitness [33]. In addition to physical activity, physical fitness in lactating mothers is closely related to food and fluid intake. However, in this study, fluid and micronutrient intake levels were still low. Most lactating mothers experienced dehydration, despite adequate energy intake. This finding is concerning, given the well-established relationship between hydration and physical fitness. Dehydration negatively affects physical performance, including muscle strength and endurance [34]. Since lactation is an energy-intensive process, maintaining proper hydration is crucial for milk production and overall health. Proper hydration supports the quality and quantity of breast milk, which is vital for both the mother and the child [35]. Proper intake of specific nutrients such as protein, calcium, and iron is also crucial for maintaining physical fitness and overall health [36,37].

3.2. Correlation between physical activity, hydration status, and nutritional intake with the physical fitness of lactating mothers

Physical fitness plays a crucial role in overall health and well-being, including for lactating mothers. Several factors, including physical activity, hydration status, and nutritional intake, influence physical fitness. In this study, no significant correlation was found between physical activity and physical fitness. Lactating mothers who engaged in light to moderate physical activity tended to have lower physical fitness, while those with vigorous physical activity tended to have moderate to adequate physical fitness. This suggests that physical fitness is one of the indicators related to muscle intensity during movement. Individuals with more frequent and intense skeletal muscle movements, as seen in vigorous physical activities, are likely to experience better physical fitness. A previous study has found that lactating mother with higher physical activity levels tend to have improved cardiovascular and overall physical fitness [33].

Physical fitness is closely related to hydration status, as cellular respiration requires adequate body fluids. These fluids contain several ions that are very important in energy metabolism, including sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), and magnesium (Mg^{2+}) [38]. Electrolyte balance, particularly involving Na^+ , K^+ , Ca^{2+} , and Mg^{2+} , is crucial for maintaining acid-base balance and osmotic pressure, which are essential for optimal physical fitness [39]. Intense physical activity increases plasma Mg^{2+} levels, while submaximal

physical activity decreases them, influencing physical fitness [40]. In this study, hydration status did not influence the physical fitness of lactating mothers. Lactating mothers who experienced dehydration in this study still demonstrated high levels of physical fitness, a finding contradicting the theory. Dehydration of more than 2% of body weight can impair physical performance, particularly in prolonged and intense activities [41]. Nonetheless, the physical fitness test used in this study did not require significant aerobic metabolism, and thus the fluid loss was minimal, possibly influencing the physical fitness of lactating mothers.

Nutritional intake is another key determinant of physical fitness, as it is directly related to energy metabolism. Macronutrients and micronutrients from food intake are essential for cellular respiration, ultimately generating adenosine triphosphate (ATP) for muscle contraction [42]. In this study, lactating mothers with adequate nutritional intake exhibited moderate to adequate levels of physical fitness. This was also true for calcium and iron intake, where lactating mothers with adequate calcium and iron intake exhibited moderate to adequate physical fitness, although these three variables were not statistically significant. One challenge in establishing a relationship between nutritional intake and physical fitness is the variability in individual nutritional requirements, which complicates the development of generalized dietary recommendations. The correlation between nutritional intake and physical fitness is complex and influenced by multiple factors, such as energy restrictions, supplementation, and the timing of macronutrient consumption [43,44]. This complexity can make it challenging to establish a straightforward correlation.

4 Conclusion

Physical fitness is a critical indicator of overall well-being for lactating mothers, significantly contributing to their quality of life. Achieving and maintaining adequate physical fitness in urban areas presents challenges due to the rapid development of technology, which may reduce physical activity. Lactating mothers in this study mostly exhibited moderate physical fitness, with no correlation observed between their physical activity and hydration status. Although energy intake showed a weak correlation with physical fitness, further analysis of individual factors is necessary because many complex variables may contribute to this relationship. Additionally, future research should consider incorporating additional variables such as blood and environmental parameters.

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