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Adequate cardiorespiratory fitness during pregnancy for a better quality of childbirth

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Abstract

Inadequate Cardiorespiratory Fitness (CRF) during childbirth can lead to potential problems, including preterm birth, hypertensive disorders of pregnancy, pain and discomfort during pregnancy, cesarean birth, and postpartum weight gain. This study aimed to assess the relationship between cardiorespiratory fitness during pregnancy and the quality of childbirth. An observational analytic study with a prospective cohort design was conducted among 52 pregnant women in their third trimester of gestation. Respondents were selected based on the purposive sampling technique. The variables - cardiorespiratory fitness, indicated by

VO₂max value, and the quality of childbirth - were respectively measured using the six-minute walk test and the Quality Childbirth Questionnaire, modified from the Pregnancy and Childbirth Outcome Set (PCB), the Childbirth Experience Questionnaire (CEQ), and the Birth Satisfaction Scale (BSS), which were declared valid and reliable. Data analysis used descriptive and bivariate analysis with the Chi-Square test with a Risk Ratio (RR). The results showed a p-value of less than 0.001, confirming the hypothesis. There is a meaningful link between high VO₂ max scores and improved childbirth experiences, with a RR of 6.882 at a 95% confidence interval. This suggests that pregnant women with better cardiorespiratory fitness are 6.882 times less likely to have an adverse labor and delivery outcome. Improving cardiorespiratory fitness through strategic antenatal physical activity with aerobic exercises is recommended to gain a positive childbirth experience.

Introduction

Maternal health during childbirth is crucial for the well-being of both the mother and the child.¹ It encompasses both mental and physical health and is influenced by various social and economic factors. Thus, the World Health Organization (WHO) stated that to ensure women and their babies reach their full potential for health and well-being, every stage of maternity should be a positive experience.²⁻⁴ It provides a very satisfying and empowering birth experience for a woman, both clinically related to childbirth as well as psychological and emotional. Women who experience a very positive birth feel happy, safe, and in control during labor.⁵

On the contrary, labor accompanied by problems or traumatic experiences can be negative or detrimental. This will have a long-term negative impact on the health and well-being of the

mother and her family because it affects the quality of life of women.^{6,7} Problems that arise include delivery complications, postpartum depression, Post-Traumatic Stress Disorder (PTSD), or postpartum blues, psychological trauma in the form of fear and decreased self-confidence, complications of newborns, disorders of mother and child bonding, breastfeeding disorders, feelings of hatred for children, disturbances in child development, refusing to have more children, and infertility,⁸⁻¹¹ causing lactation problems, affecting the mother's decision to have sex, having more children in the future with a tendency to undergo cesarean section.^{12,13} Cardiorespiratory Fitness (CRF), defined as the ability of the respiratory and cardiovascular systems to provide oxygen to cells and tissues during physical activity,¹⁴ plays an important role during childbirth. Physiological changes such as increased blood pressure, heart rate, and respiratory rate require adequate cardiorespiratory fitness to cope with anxiety, tension, fear, and stress, which can cause severe consequences.¹⁵ Inadequate fitness can lead to potential problems, including preterm birth,¹⁶ hypertensive disorders of pregnancy,¹⁷ pain and discomfort during pregnancy, cesarean birth, and postpartum weight gain.¹⁸

However, CRF during pregnancy is physiologically lower than in non-pregnant women. Baena-García *et al.* (2020)¹⁹ stated that CRF values in pregnant women decreased from week 16 to week 34. Furthermore, CRF in adult women aged 22 years who were born at term was detected at a value of 33.0 mL/kg per minute,¹⁸ aged 30 years between 27-37 mL/kg per minute,²⁰ while CRF in pregnant women aged 32 years was between 19.85±3 mL/kg per minute.¹⁶ Pregnant women experience significant structural and hemodynamic changes in the cardiovascular system. Weight gain causes a progressive decrease in performance; there is an increase in blood volume and heart rate, maximal heart rate is reduced, and blood has a lower hemoglobin concentration during pregnancy. This can affect the cardiorespiratory fitness of pregnant women.²¹

Studies on maternal CRF have been conducted in the context of advancing at term gestation,¹⁸ to improve CRF in response to exposure to exercise training,^{17,22,23} to test different fitness among active and inactive women,²⁴ and to observe its association with the infant. However, evidence regarding CRF and a comprehensive feature on the birthing process is limited. In fact, this is utmost important, with the potential benefits of improving maternal health from pregnancy to postpartum, promoting better birth outcomes,²⁵ preventing cardiovascular disease, encouraging a healthy lifestyle, identifying risk factors,²⁶ and providing information to the decision-making process regarding necessary maternal health and childbirth initiatives. Thus, this study aimed to investigate the relationship between CRF among pregnant moms and the quality of childbirth experience obtained during labor and delivery.

Materials and Methods

Research design

This study was observational analytics with a prospective cohort design. Pregnant women in their third trimester of gestation participated in CRF measurement using the Six-Minute Walking Test (6MWT) to denote VO₂ max level. It is a submaximal exercise test to assess aerobic capacity and endurance by walking for 6 minutes on the provided track path, reaching the furthest possible distance, and assessing blood pressure and pulse immediately after completing the test. As the subjects were pregnant women, the 6MWT was carried out considering the health conditions of the mother and fetus, which were previously examined and conducted under the supervision of a registered physiotherapist.

Subsequently, they were followed until one week after giving birth to respond to the quality childbirth questionnaire, modified from the Pregnancy and Childbirth Outcome Set (PCB), Childbirth Experience Questionnaire (CEQ),^{27,28} and modified Birth Satisfaction Scale (BSS).²⁹⁻³¹ This set of questions interprets whether the quality of labor and delivery is valued

as a positive childbirth level. It assesses the health of the mother in terms of delivery methods, pain during delivery, medicalization experienced during delivery, length of delivery, perception of the ability to be self-aware of physical and strength conditions to control power during delivery, perception of feeling safe during birth, perception of the ability to control emotions to participate in decision-making about the actions needed in childbirth. Additionally, valued newborn health refers to parameters like birthweight, the ability to cry immediately, and Apgar score. The accumulated total score from 28 questions is between 47.2 and 124, with a threshold of 54.8. A higher score indicates better quality and a more positive childbirth.

Data were collected from February to May 2023 at the Community Health Center in East Jakarta. First, respondents who met the criteria and were keen to take part in this study were informed about what to do in the research. Then, an appointment schedule for variable measurements was arranged.

The value of VO_2 max as an indicator of the CRF variable was measured through the following 6MWT test procedure from Tiksanadi, Ambari, and Adriana (2019) and Cassano *et al.* (2023).^{32,33} One day before the measurements were taken, research subjects were informed to get enough sleep and not to consume drinks and foods containing caffeine and alcohol, as well as drugs that could affect blood pressure. On the day before the test begins, the physiotherapist prepares equipment, including a pulse oximeter, a portable oxygen device (to be used if needed by the patient), a chair, a Borg scale, a stopwatch, and two small cones. Then, preparations were made to create the path track by placing cones at the start and end points in a straight line and a chair in between the 90-degree cones. Afterward, the physiotherapist focused on the performance test steps as follows: i) allow the respondent to rest for about 10 minutes before the test starts; ii) measure heart rate, oxygen saturation, and dyspnea for baseline data; iii) set up the timer and lap counter; iv) inform the mother on how to walk on the path track during the test; v) assign the mother at the starting mark cone and allow her to walk as fast as possible but

stay comfortable once the test begins; vi) focus the attention on research subjects during the test by encouraging them to continue and informing them of time left every minute that passes; vii) assess and record dyspnea, fatigue levels, blood pressure, heart rate and oxygen saturation, the number of laps to count total distance walked. Finally, the gathered data was inputted into the Nury formula. In relation to gathering quality childbirth data, enumerators conducted an interview to fill in the questionnaire while visiting mothers.

Study participants

The sample size in this study was determined using the Slovin formula. A total of 52 samples were obtained through purposive sampling based on predetermined criteria: pregnant mother in the third trimester of gestational age; willing to consistently participate in the study until completion (informed consent). Mothers with high-risk and complicated pregnancies who had already become the subject of other research were excluded from the study.

Data analysis

Data were analyzed using the IBM SPSS version 21 software package (IBM Corp; Armonk, USA). Characteristics of the sample, including age, height, body mass index, and VO₂ max, were separately evaluated using univariate analysis. However, the hypothesis of the study is to investigate the relationship between the independent variable, namely CRF. The significance of the results obtained from the Chi-Square Test for the dependent variable, quality of childbirth, was assessed at a value of <0.05. Additionally, the Risk Ratio (RR) was calculated as an additional measure to examine the association between variables further.

Ethical clearance

This study was managed in accordance with ethical rules, including consideration not to endanger respondents, respecting data confidentiality, voluntarily allowing respondent involvement, and providing compensation guarantees in the event of *force majeure* affected by the research. The researcher explained ethical issues before all subjects provided written informed consent for data collection. The ethical clearance of the study was approved by the Health Research Ethics Commission, Semarang State University, as stated in certificate number 201-KEPK. During the research, the researcher pays attention to these ethical principles: information to consent, respect for human rights, beneficence, and non-maleficence.

Results

Table 1 shows that the minimum age for the sample in this study is 20 years, while the maximum age is 42 years. The average respondent age is 29 years, with a median of 28 years and a standard deviation of 5.09. Additionally, the average height is 157.77, with a standard deviation of 5.02. The height measurements reveal a minimum value of 143 cm and a maximum value of 170 cm. The average VO₂ max measurement result is 17.45 mL/kg per minute, with a standard deviation of 1.98. The minimum rate is 12.94 mL/kg per minute, and the maximum is 22.25 mL/kg per minute. According to Table 2, it can be observed that 2 respondents are thin (3.8%), 20 mothers are of normal weight (38.5%), 5 are overweight (9.6%), and 25 are obese (48.1%). Related to the hypothesis, VO₂ max was categorized into two types: good and fair, to form a 2x2 matrix for the Chi-Square Test. On the other hand, the quality of childbirth was also classified as positive and negative. Data for both variables are illustrated in Table 3.

Table 3 describes that 34 mothers have poor cardiorespiratory fitness, while 18 mothers have good VO₂ max. Meanwhile, in the assessment of birth quality, 24 mothers gained positive birth quality, and 28 mothers obtained negative birth quality. After carrying out the Chi-Square Test, 8 pregnant women (23.5%) with poor CRF experienced positive labor, while 26 (76.5%)

obtained negative labor. Among those with good CRF, only 2 (11.1%) had negative birth quality, while the majority, 16 ladies (88.9%), resulted in positive childbirth. These data explain that there is a significant association between CRF and the quality of childbirth with a p-value of 0.000 and RR=6.882 established.

Discussion

The research results highlight a strong association between CRF and the quality of childbirth. It is clear that women with good CRF during pregnancy are likely to benefit from a better quality of childbirth 6.882 times more than those with poor CRF. In fact, childbirth is a physiological process that gives the mother experience related to exerting quite a lot of energy, controlling the use of energy, controlling feelings, severe pain, fear, and anxiety, maintaining stamina for a long time, and making decisions about choosing the type of delivery. Hence, this study is in accordance with theories that provide an overview of how a higher level of CRF can contribute to coping with the challenges mentioned.

The first is fulfilling the energy needed. Adequate CRF can improve cardiovascular function to help the mother's body adapt to the physiological changes that occur during pregnancy, maintain healthy blood pressure and heart rate, and reduce the risk of hypertensive disorders of pregnancy.^{15,34-36} Furthermore, this also expands muscular strength, elasticity, and flexibility, supporting muscle power control during labor.³⁷ Thus, mothers have sufficient endurance and stamina to make the birthing process more manageable.

Secondly, there is the role in managing feelings and pain. As CRF is produced from exercise, when an individual engages in physical activity, such as running or cycling, the body releases endorphins that help reduce feelings of pain and promote a sense of well-being. These endorphins bind to receptors in the brain, triggering positive feelings and reducing stress.¹⁵

Therefore, good CRF benefits developing a better mood, relaxation, and suppressing discomfort during labor and delivery.

Regarding the mode of delivery, Baena¹⁹ stated that women with higher CRF levels during pregnancy have been found to have better oxygen values in the umbilical artery blood and a lower rate of cesarean section. This suggests that women with higher CRF have better respiratory and circulatory capacity to supply oxygen to their bodies during the physically demanding process of labor, potentially reducing the need for a cesarean delivery. This will be a solution for all women who generally prefer vaginal delivery.

Yet, understanding the facts that CRF affects the quality of childbirth in the results of this study potentially inspires practical implications for maternal healthcare and prenatal care. This can lead to the development of targeted interventions and strategies to improve the childbirth experience for women and their children. Several potential applications include designing and promoting customized prenatal exercise programs to increase maternal CRF. It has the potential to lead to better lives for children later in life.^{18,22} Informing the development of individualized care plans for pregnant women. Healthcare providers can assess CRF levels and adjust treatment plans to support women with lower CRF, thereby potentially mitigating the risks associated with delivery and labor problems.^{17,26} Health education initiatives to increase knowledge among pregnant women about the potential impact of CRF on childbirth. Thus, by encouraging physical activity and healthy lifestyle choices, women can be empowered to play an active role in self-increasing CRF.^{23,38} The postpartum recovery support program, in the form of guidance on beneficial postpartum exercise and lifestyle habits, helps women rebuild their CRF and supports their overall well-being after giving birth.^{19,25,39} Development of maternity care guidelines that emphasize the importance of assessing and supporting maternal CRF by integrating CRF assessment into routine prenatal care. Thus, healthcare providers can identify women who may benefit from additional support and interventions.^{17,26}

Indeed, the findings provide benefits for health program developers to address better antenatal care, help build pregnant women's self-awareness in meeting their needs, and mobilize more pregnant women towards non-pharmaceutical activities, especially antenatal exercise, which increases CRF to prepare for childbirth and even overcome problems during pregnancy.⁴⁰ This will be a solution to improve the health of pregnant women at a more affordable price.

Despite the strength of the study describing comprehensive birth quality measurement for maternal and child health as an innovation, data collection a week after delivery is a limitation that allows subjective data modification. Hence, it is recommended that further research is able to measure the quality of childbirth during the process to obtain exact data on conditions at the time while it is taking place.

Conclusions

The research results demonstrate a strong association between CRF and the quality of childbirth. This implies that increasing CRF is a necessity in improving the health of pregnant mothers. By applying this theory in prenatal care, healthcare providers can practically work towards enhancing the childbirth experience for women, promoting better maternal and neonatal outcomes, and supporting the long-term health and well-being of mothers and their children. The development and promotion of strategic and extensive antenatal exercise tailored to improve CRF are recommended.

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Table 1. Characteristics of respondents (n=52).

	Min	Max	Mean±SD	Median	CI 95%
Age (years)	20	42	28.68±5.09	28.00	27.31-30.04
Height	143	170	157.77±5.02	157.50	156.42-159.11
VO ₂ max	12.94	22.25	17.45±1.98	17.58	16.91-17.98

Table 2. Body Mass Index (BMI) of respondents.

BMI	Frequency	Percentage
Underweight	2	3.8 %
Normal	20	38.5 %
Overweight	5	9.6 %
Obese	25	48.1 %
	n=52	100%

Table 3. Research hypothesis testing results.

6 MWT (VO ₂ max)	Quality of childbirth				p-value	Risk Ratio	CI 95%
	Negative		Positive				
	n	%	n	%			
Poor	26	76.5%	8	23.5%	0.000	6.882	(1.839-25.760)
Good	2	11.1%	16	88.9%			

6MWT, Six-Minutes Walking Test

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