Original Article

# Overview of Peak Expiratory Flow Rate in Elementary School Students in the Coastal Area of Hutumuri Village

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## Abstract

**Background:** Respiratory diseases are the most common cause of death in children, in this case most of them are obstructive disorders. Peak expiratory flow (PEF) is a tool for detecting airway obstruction, which the value is influenced by host and environmental factors. Examination of PEF aims to describe the condition of the large-calibre airway. A decrease in PEF values indicates an expiratory airways resistance. This study aimed to determine how the condition of pulmonary physiology in children living in the coastal area, with peak expiratory flow parameters in elementary school students in coastal areas, area of Hutumuri Village.

**Methods:** The design used in this study was descriptive quantitative with cross-sectional method. This study took variables in the group of children aged 8-13 years, the group of children with weight between 15-36 kg, height of 118-139 cm, the group of children with a hobby of swimming, the group of children with a history of respiratory disease. The sampling technique used was total sampling with a total of 215 respondents in four elementary schools located in Hutumuri Village, South Leitimur District, Ambon City which included 53 Batu Gong Elementary School, Toisapu Elementary School, 52 Lawena Elementary School and Hutumuri Christian Elementary School.

**Results:** The value of PEF rate increased in the group of children with aged ≥12-13 years, the group of children with body weight ≥36 kg, the group of children with height ≥139 cm, the group of children who did not have a history of respiratory disease, and the group of children with swimming as hobby.

**Conclusion:** The average value of PEF in children who live in coastal areas had increased and of the 215 respondents studied, most were found in the normal PEF group or the percentage of 80-100% with 114 respondents (53.0%).

**Keywords:** coastal, obstructive disorder, peak expiratory flow rate

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## INTRODUCTION

One of the most common airway obstructive disorders in children is asthma.[1] About 235 million people live with asthma, which in Indonesia based on Basic Health Research (Riskesdas) in 2018 reached 4.5%. According to RISKESDAS in 2018, Maluku Province had 19,019 cases and the highest was Ambon city with 4,925 cases and the highest prevalence was found in children aged 5–14 years with 4,925 cases.[2]

To evaluate respiratory physiology, especially in children with impaired lung function, a pulmonary function test (PFT) can be examined. One of the pulmonary function test methods that is often used is the Peak Expiratory Flow (PEF) examination using a peak flow meter. Peak expiratory flow is one of examinations in which patient performs maximum expiration after maximum inspiration. Peak expiratory flow is the forced expiration of the total lung capacity measured using a peak flow meter which is a simple and easy to apply tool. The peak expiratory flow value describes the situation of the airway, especially the large-calibre airway, in which decreasing value indicates a resistance to expiratory airflow in the airway.[3,4]

Peak expiratory flow values are influenced by host and environmental factors. Host factors include age, height, weight, while environmental factors include history of respiratory diseases such as history of asthma, tuberculosis, exposure to cigarette smoke, and geographical factors.[5]

Hutumuri Village is one of the villages on the island of Ambon. Based on author's observation, many elementary school students have a habit of swimming around the coast when they finished school, where there have been many studies reporting that swimming may increase the value of peak expiratory flow. This is because during

swimming the endurance and strength of respiratory muscles will increase resulting in increased lung development and affecting the physiological function of the lungs.[6] This study aimed to identify the condition of pulmonary function in children living in coastal areas by using the parameters of peak expiratory flow.

## METHODS

This was a descriptive quantitative method with cross-sectional study. Data were collected from December 2022 through January 2023 at Inpres 53 Batu Gong Elementary School, Toisapu Elementary School, Inpres 52 Lawena Elementary School and Hutumuri Christian Elementary School located in Hutumuri Village, South Leitimur Subdistrict, Ambon City. The sampling technique that was used in this study was total sampling, in which all respondents who met the inclusion criteria were involved. The number of respondents included was 215 students.

The inclusion criteria in this study were students of Sekolah Dasar (SD) Inpres 53 Batu Gong Elementary School, Sekolah Dasar Negeri (SDN) Toisapu Elementary School, SD Inpres 52 Lawena and SD Kristen Hutumuri grades 4, 5 and 6, while the exclusion criteria were students who were not present at the time of the study, students who were experiencing respiratory system disorders such as coughing and tightness at the time of the research and guardians or patients who refused to participate.

Respondents who met the inclusion criteria were required to have the peak expiratory flow value measured with a peak flow meter, then continued with the measurement of height, weight, a brief interview regarding the respondent's identity, history of exposure to cigarette smoke, history of swimming hobbies, and history of respiratory disease. PEF measurement was performed by the subject in a position standing or sitting with an upright back and holding PEF in a horizontal or horizontal position without touching or disturbing the movement of the marker. The marker was in the lowest scale position (zero) was ensured. The subject took breath as deep as possible, then insert the mouthpiece into the mouth with lips closing flat around the mouthpiece, then participant was asked to exhale as soon and as strongly as possible as if blowing out all rows of candles strongly in one blow. Repeat 2-4 times to record the highest result. The data from the study was then processed in Microsoft excel and SPSS to get the average value of the respondent's peak expiratory flow rate.

## RESULT

The study was involved 215 respondents who met the inclusion criteria and around 36 respondents who were excluded due to 9 respondents who were congested during the study, 5 respondents who were coughing, 10 respondents who were not present, and 12 guardians who did not fill in the informed consent form.

Table 1. Characteristics of Respondents

| Description | N | % |
|---|---|---|
| Age | | |
| ≥8-9 years | 52 | 24.2 |
| ≥10-11 years | 150 | 69.8 |
| ≥12-13 years | 13 | 6.0 |
| Weight | | |
| ≥15-35 kg | 191 | 88.8 |
| ≥36 kg | 24 | 11.2 |
| Height | | |
| ≥118-138 cm | 127 | 59.1 |
| ≥139 cm | 88 | 40.9 |
| Swimming hobbies | | |
| Yes | 190 | 88.4 |
| No | 25 | 11.6 |
| Respiratory disease history | | |
| Yes | 17 | 7.9 |
| No | 198 | 92.1 |

The most prevalent age of respondents in this study was ≥8–9 years and the fewest at the age of ≥12–13 years. The most weight was found to be between 15–35 kg and the fewest in children with weight ≥36 kg. The most BMI data was found in the group of children with normal weight and the fewest in the group of children with obesity. There were also higher number of children who have a hobby of swimming than those who do not like to swim. For the respiratory disease history, the most common disease included asthma and tuberculosis and also the data in this study obtained higher number of

children who had exposure to cigarette smoke.

The highest peak expiratory flow was found in the group of children aged ≥12–13 years with a mean value of 253.38 L/min, while the lowest peak expiratory flow was found in the group of children aged ≥8–9 years with a mean value of 206.34 L/min (Figure 1).

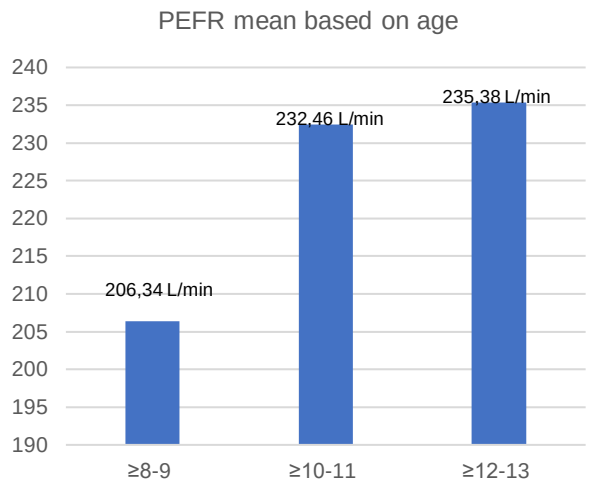


Figure 1. PEFR mean based on age

Children with body weight ≥36 kg had the highest mean peak expiratory flow with a mean value of 246.67 L/min, while the lowest peak expiratory flow was found in the group of children with body weight ≥15–35 kg with a mean value of 223.08 L/min (Figure 2).

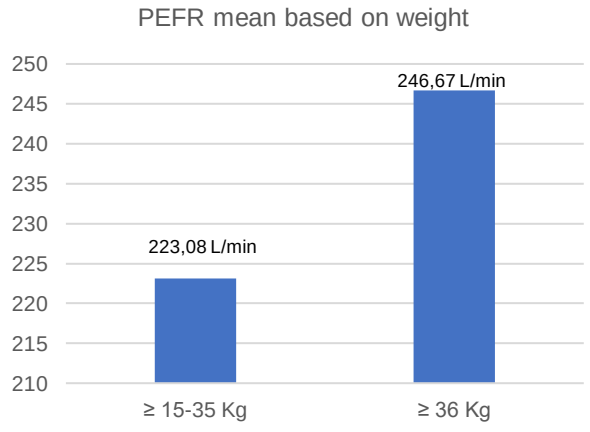


Figure 2. PEFR mean based on weight

The highest peak expiratory flow was found in the children with height ≥139 cm with an average value of 239.43 L/min, while the lowest peak expiratory flow was found in the children with height ≥118–138 cm with an average value of 216.21 L/min (Figure 3).

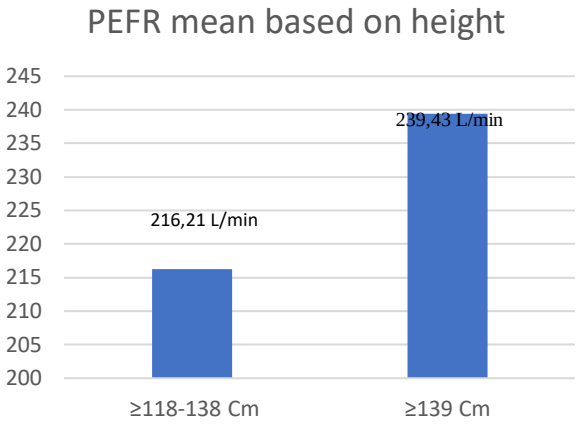


Figure 3. PEFR mean based on weight

The group of children who liked swimming had a higher mean value of peak expiratory flow than the group who did not like swimming, where the mean value of PEF for the group of children who liked swimming was 227.15 L/min, while the mean value of PEF for the group of children who did not like swimming was 214.80 L/min (Figure 4).

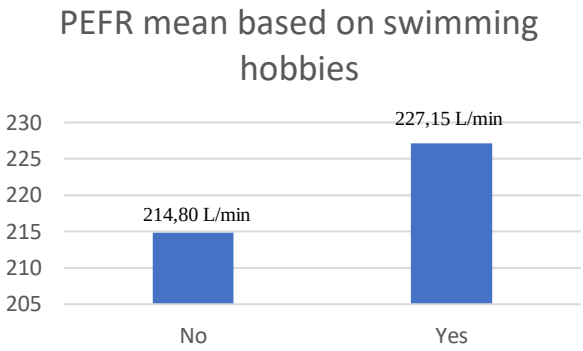


Figure 4. PEFR mean based on swimming hobbies

Based on the duration of swimming days, it was found that the highest mean peak expiratory flow value was found in the group of children who swam for seven days a week with an mean PEFR of 257.14 L/min, while the lowest mean peak expiratory flow value was found in the group of children who swam only one day a week with an mean PEFR of 221.60 L/min.

Based on the swimming duration time, it was revealed that the highest mean value of peak expiratory flow was found in the group of children who swam with a duration of 121–180 minutes where the mean PEFR was 248.33 L/min, while the lowest mean value of peak expiratory flow was found in the

group of children who swam with a duration of ≤60 minutes where the mean PEFR was 224.20 L/min.

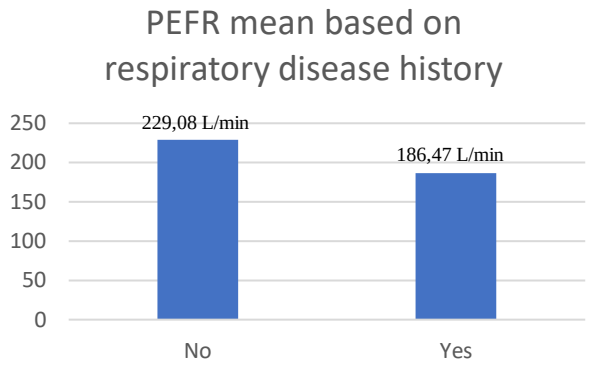


Figure 5. PEFR mean based on respiratory disease history

The group of children who did not have a history of respiratory disease had a higher mean peak expiratory flow than the group of children who had a history of respiratory disease, where the mean PEFR value of the group of children who did not have a history of respiratory disease was 229.08 L/min, while the group of children who had a history of respiratory disease had a mean PEFR value of 186.47 L/min (Figure 5).

## DISCUSSION

Figure 1 shows that the highest mean value of peak expiratory flow was found in the group of children with age ≥12–13 years, while the lowest mean value of peak expiratory flow was found in the group of children with age ≥8–9 years. This is in line with study conducted by Shubhankar M in 2015 in India, involving 708 respondents aged 5–14 years, in which children aged 5–6 years had the lowest mean value of peak expiratory flow of 146 L/min, while in the group of children aged 13–14 years had the highest mean value of peak expiratory flow of 285 L/min.[1] Rosetya's study in 2011 in Semarang stated that age had a significant relationship with the value of peak expiratory flow, where the value of lung function will increase with age and reach the optimal value at the age of 22 years, then progressively decrease as the age increases.[7]

Figure 2 shows that the highest mean value of peak expiratory flow was obtained in the group of children with body weight ≥36 kg, while the lowest mean value of peak expiratory flow was obtained in the group of children with body weight ≥15–35 kg. This is certainly contradicting other studies result, including research conducted by Kusumo in 2015, in which body weight affected lung function, one of which was peak expiratory flow.[8] Another study conducted by Sudarmawan in 2018 in Semarang reported that there was no significant relationship between children's weight and peak expiratory flow because there were factors that may affect changes in a person's lung capacity. Low body weight may also lower respiratory muscle strength, thus affecting the PEF value.[9]

Data in Figure 3 shows that the highest mean value of peak expiratory flow is found in the group of children with height ≥139 cm and the lowest in the group of children with height ≥118–138 cm. This is in line with research conducted by Shubhankar M in 2015 in India, where out of 29 child respondents with a height of 110–120 cm they had a mean value of peak expiratory flow of 136 L/min, while out of 25 child respondents with a height of 150–160 cm had a higher mean value of peak expiratory flow of 291 L/min.[1] Body height greatly affects lung function because someone with taller stature can make the ventilation function of his lungs higher than people who have a short posture.[10]

The results in Figures 4 show that the highest peak expiratory flow values were obtained in the group of children who regularly swam every day of the week and the lowest in the group of children who only swam one day a week. In a study conducted by Rosetya in 2011 at Semarang found that in the group of respondents who liked swimming exercise experienced significant changes in peak expiratory flow than respondents who were not fond of swimming.[7]

In this study also found that respondents who routinely swam every day and the duration of swimming 121–180 minutes proved a significant increase in peak expiratory flow than respondents who only swam <60 minutes and one day in a week. This result is in accordance with the theory that physical activity such as swimming can increase the

strength of the muscles of the respiratory system, where the diaphragm muscles and intercostal muscles become stronger and cause increased recoil and expansion of the lungs. This leads to an increase in the amount of inspiratory air that contains a lot of oxygen as well as an increase in the amount of expiratory air which leads to the increase in a person's vital capacity.[11]

Based on Figure 5 shows that the group of children who do not have a history of respiratory disease had a higher peak expiratory flow mean value than the group of children who have a history of respiratory disease. This is in line with research conducted by Shiyas KP in 2017 in India, reporting differences in peak expiratory flow in groups of children with a history of respiratory diseases such as tuberculosis (TB) and asthma. Out of 25 child respondents with a history of TB had a low mean peak expiratory flow value of 233 L/min, while out of 485 child respondents with no history of TB had a higher mean peak expiratory flow value of 265 L/min. Furthermore, 55 child respondents with a history of asthma also had a lower mean peak expiratory flow value of 242 L/min compared to 455 respondents with no history of asthma who had a mean peak expiratory flow value of 260 L/min.[12] According to several studies, a history of respiratory disease can affect the occurrence of lung function disorders. This is because the strength of the respiratory muscles can be reduced due to respiratory diseases such as asthma, post-TB, and COPD (adults) so that it can affect the value of peak expiratory flow.[13,14]

## LIMITATION

This study is included in cross sectional research, where the data collected is data obtained at specific point of time, meaning that if a student at the time of the research is experiencing coughing and tightness, then the student cannot be included in the research sample. In this study, 215 elementary school student in grades 4–6 were included in the inclusion criteria for research, due to the large number of respondents involved, authors had limited energy and time during the study. In addition, there were many respondents who still did not understand when maneuvering the use of the peak flow meter tool.

## CONCLUSION

The group with the highest peak expiratory flow mean value was found in the group of children with age ≥12–13 years, body weight group ≥36 kg, height group ≥139 cm, group with no history of respiratory disease, group with swimming hobby and routine for seven days per week and swimming duration 121–180 minutes. The lowest peak expiratory flow group was found in children aged ≥8–9 years, children with body weight ≥15–35 kg, height ≥118–138 cm, group with a history of respiratory disease, and group of children who did not like swimming.

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## CONFLICT OF INTEREST

Due to the fact that this study used a peak flow meter tool on elementary school students, as a result there were many respondents who did not understand the procedure for checking peak expiratory flow, for this reason, the examiner must always carry out instructions on peak flow meter maneuvers correctly and always ensure that the respondents under study are able to maneuver properly in order to avoid biased peak expiratory flow values.

## FUNDING

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