ORIGINAL ARTICLE

Value of Peak Cough Flow (PCF) in Healthy Middle Adulthood and Late Adulthood and the Affecting Factors

Nury Nusdwinuringtyas[1], Roy Dwi Indra[1], Tresia Fransiska Ulianna Tambunan[1], Aria Kekalih[2]

[1] Rehabilitation Medicine Department, Medicine Faculty, University of Indonesia, Jakarta, Indonesia.
[2] Comunity Medicine Department, Medicine Faculty, University of Indonesia, Jakarta, Indonesia.

ABSTRACT

Introduction: Cough is a symptom that is felt by all humans and it is important for the protection which maintains mucus secretion, foreign substances, and infections of the larynx, trachea and bronchi. The purpose of this study is to find out the PCF value in healthy middle adulthood and late adulthood and the factors that influence it.

Methods: This study is a cross-sectional study involving 99 subjects. Subjects were patients in the clinic for medical rehabilitation of middle adulthood and late adulthood healthy respiration. Subjects who fulfilled the inclusion and exclusion criteria were examined with spirometry to ensure healthy respiration and after that, the PCF examination was carried out with a peakflowmeter device and the correlation was observed with age, gender and, height.

Results: The PCF value in healthy middle adulthood is 190-540 L / minute (41-50 years 465 L / minute, ages 51-60 years 405 L / minute) and healthy late adulthood is 245-520 L / minute with median 352.5 L / minute. Men have a greater PCF value than women, but at the age of 61 years and over there not significantly different. The higher age, the lower the PCF value obtained and there was a statistically significant decrease in the PCF value at 61-70 years of age compared to 41-50 years of age. Subjects with high height have a tendency for a larger PCF value and height will affect the PCF value.

Conclusion: Obtained PCF values in middle adulthood and late adulthood with healthy respiration and there is a relationship between sex, age and height factors for the PCF value.

Keywords: *Age, height, Peak Cough Flow, peakflow meter, sex.*

ABSTRAK

Pendahuluan: Batuk adalah gejala yang dirasakan oleh semua manusia dan penting untuk perlindungan dan perlindungan yang menjaga dari sekresi lendir, zat asing, dan infeksi pada laring, trakea, dan bronkus. Tujuan penelitian ini adalah untuk mengetahui nilai PCF pada orang dewasa dewasa menengah dan lanjut sehat serta faktor-faktor yang mempengaruhinya.

Metode: Penelitian ini merupakan penelitian cross-sectional yang melibatkan 99 subjek. Subjek penelitian adalah pasien di klinik untuk rehabilitasi medis usia dewasa menengah dan pernapasan sehat orang dewasa lanjut. Subjek yang memenuhi kriteria inklusi dan eksklusi diperiksa spirometri untuk memastikan respirasi yang sehat dan setelah itu pemeriksaan PCF dilakukan dengan alat peak flow meter dan korelasi diamati dengan usia, jenis kelamin dan tinggi badan.

Hasil: PCF pada orang dewasa madya sehat antara 190-540 L / menit (41-50 tahun 465 L / menit, usia 51-60 tahun 405 L / menit) dan dewasa lanjut sehat antara 245- 520 L / menit dengan nilai tengah 352,5 L / menit. Pria memiliki nilai PCF yang lebih besar daripada wanita, tetapi pada usia 61 tahun ke atas PCF pria tidak berbeda secara signifikan dari wanita. Semakin tinggi usia, semakin rendah nilai PCF yang diperoleh dan ada penurunan nilai PCF yang signifikan secara statistik pada usia 61-70 tahun dibandingkan dengan usia 41-50 tahun. Subjek dengan tinggi tinggi memiliki kecenderungan untuk nilai PCF yang lebih besar dan tinggi akan mempengaruhi nilai PCF.

Kesimpulan: Memperoleh nilai PCF pada orang dewasa madya dan dewasa lanjut sehat respirasi dan ada hubungan antara jenis kelamin, faktor usia dan tinggi untuk nilai PCF.

Kata Kunci: *PCF, peak flow meter, usia, jenis kelamin, tinggi badan.*

Correspondent Detail:
Nury Nusdwinuringtyas
Email: nury_nus@yahoo.com
Department of Physical Medicine and Rehabilitation, Dr. Cipto Mangunkusumo Hospital, University of Indonesia, Jakarta, Indonesia

INTRODUCTION

Cough is a symptom that all humans feel and it's vital for protection that protects the process of removing mucus, foreign substances, and infections of the larynx, trachea and bronchi. Coughing becomes the most efficient mechanism for cleansing the upper airway and can be called a defense mechanism in the body. Disruption or absence of a coughing mechanism can be disruptive and/ or dangerous in sickness. Coughing depends on the strength of the respiratory muscles, especially on the strength of the inspiring muscles. The method used for cough evaluation is obtained by measuring the Peak Cough Flow (PCF).

PCF is the most reliable way to evaluate cough strength, measured using a peak flow meter

(PFM).[6] In middle adulthood, the age between 41-60 years begins the aging process compared with young adults (18-40 years) on the small airway and alveoli, after the age of 50, there is an increased incidence of degeneration of elastin fibers in the bronchioles of the lungs and alveoli. Collagen fibers in the lung parenchyma will exceed the amount of elastin.

This causes a lack of lung elasticity and increased rigidity of the chest wall. Also, there is a decrease in strength and endurance of the respiratory muscles, which reduces the maximum pressure of inspiration (from the age of 20) and expiration (from the age of 50) so that the vital lung capacity and cough function decline.[4] In late adulthood (> 60 years), there is a change in the respiratory system compared to young and middle adulthood. Changes that occurred in the form of decreased lung elastic recoil and thoracic compliance capacity and decreased respiratory muscle strength which will result in decreased APE and can result in decreased coughing ability resulting in decreased PCF value.[4]

There have been many studies on the PCF value in healthy young adults, but the PCF value in healthy middle adulthood and late adulthood has not been much studied. Freitus et al (2010) say the average PCF value in healthy late adulthood in Brazil is 309.2 L/minute in women and 434.4 L/minute in man. There is still no research for PCF value in healthy middle and late adulthood in Indonesia.

In their study, Lee et al. (2015) said the average PCF value of Caucasian races in England was 652 L / min. Fauzan (2016) said the PCF value in young adults in Indonesia (Mongoloid race) ranged from 310-645 L / min, with PCF values in men between 463 - 607 L / min and in women 366 - 472 L / min and found a decrease in PCF value along with increasing age. In both races, there was a significant difference in the PCF value. This is because there were differences in average height in the UK (average 177.6 cm) and Indonesia (average 158 cm). However, no studies are examining whether gender, age, and height factors significantly influence PCF values in healthy middle adulthood and late adulthood in Indonesia.[17,19]

Healthy individuals based on spirometry examination are individuals whose lung function has no restriction or obstruction in the airways, do not have a history of neuromuscular disease, respiratory system of acute or chronic normal phases, and normal chest expansion measurement to age and sex.

Based on the background above, it is important to know the objective value of healthy individuals' cough function capacity in determining respiration rehabilitation programs. At present, there is no research on the PCF value in healthy middle adulthood and late adulthood, which is important to know as a baseline PCF value in Indonesia. For this reason, researchers conducted a study to determine the PCF value in middle adulthood and late adulthood using PFM tools and the correlation between age, sex and height on the PCF value.

METHOD

The research design used is cross-sectional to measure the PCF value and the factors that influence it in healthy middle and late adulthood who are analytic because it is tested statistically. The target population is healthy subjects aged

over 40 years with both parents coming from Indonesia. The affordable population is a subject in the RSCM environment and Jakarta communities that meet the acceptance criteria. Samples that meet the acceptance criteria are not included in the rejection criteria until the number of research samples is met and willing to follow the research by filling out informed consent. Inclusion criteria are. Healthy subject respiration, ages 41-70 years, is willing to participate in research voluntarily by signing the consent form after explanation, having normal cognition (MMSE), no hearing loss, and speaking Indonesian.

Exclusion criteria are subject not able and understanding in the work instructions from technical research, has contraindications for conducting spirometry and PCF checks, namely: abdominal/ thoracic surgery in the last one month, brain, eye and Ear Nose Throat surgery in the last 2-3 months, pneumothorax in the last 2-3 weeks, myocardial infarction in the past one week, aortic aneurysm in the past one week, hemoptysis, pulmonary embolism in the past one week, acute diarrhea, angina, severe hypertension (systolic blood pressure >200 mm Hg, diastolic >120 mmHg), dementia, infection.

Sample size estimation is using numerical descriptive for men using 51 standard deviations and 38 women based on references.[18] Absolute error used 5% of the highest average peak cough current value. Based on statistical analysis, the age variable will be divide into ages 41-50 years, 51-60 years and, 61-70 years. The calculation results get a sample size for men are 16 people and women 17 people for each age group (41-50, 51-60, and 61-70 years), so that the sample needed is 33 people for three age groups, therefore a total of 99 people needed. Methods and Data Collection

Techniques are the subject selection and the signing of informed consent.

Researchers then conduct examinations. After that, subjects underwent spirometry and chest expansion tests and the results were interpreted. If there are normal spirometry and chest expansion values after converting grades from the Indonesian pneumobile team, the subject is given education on how to conduct PCF examination through video as a lesson. Finally, all subjects carry out an PCF check. Statistical analysis was done using SPSS version 20.0.

We measure the mean for quantitative data with normal distribution, and for not normal distribution we measure the median. For categorical data we measure the frequency and the percentage of frequency. Statistical analysis using multivariate, for numerical data using independent t- test if the data qualifies and Mann Whitney if not qualifies. Categorical data using chi-square for the tables and Fisher if not qualifies. The threshold value is set in $p < 0.05$.

RESULT

The research was conducted at the Polyclinic of the Cipto Mangunkusumo National Center General Hospital (RSUPNCM) Jakarta General Hospital after receiving a letter of approval from the research ethics committee (Letter number: 0263/ UN2.F1/ ETIK/ 2018) conducted from August to October 2018 with Research subjects are middle adulthood and late adulthood who have met the inclusion and exclusion criteria based on history taking and physical examination and explained and if they are willing to participate in the study. The subject is asked to sign an informed consent.

Each subject was given an oral explanation and shown using video media how to measure PCF appropriately. Subjects took measurements three times with a break of at least two minutes at each measurement interval. The total number of subjects from an affordable population that met the inclusion and exclusion criteria determined in this study were 99 subjects. The measurement of the PCF value is carried out according to the procedure that has been described in the research method.

In the implementation of the number of research subjects who met the inclusion and exclusion criteria and were agree to participate in the study were 99 people. The subjects of this study determined 48 male and 51 female. The subjects of this study obtained an age with an average value of 55.81 ± 8.84 years, with an age range from 41-70 years based on the methodology categorized into ages 41-50 years there were 33 subjects, ages at 51-60 years there were 33 subjects, and aged 61-70 years there were 33 subjects, according to the proportional consecutive sampling method to get the equivalent of 33 people per age category. The number of female subjects was 17 subjects and men were 16 subjects for each specified age category. Subject height in centimeters obtained average of 159 cm with a range of 141 to 175 cm. The mean BMI of the study subjects was 25.28 ± 3.56 kg / m^2 (overweight). A history of smoking was found in 20 subjects with a prevalence of 20.2%. In this study, the proportion of sex divided by each group of male as many as 48 research subjects and female group as much as 51 research subjects.

Table 1. Demographic of research subjects

Characteristics	n (%)
Sex	
Male	48 (48.5)
Female	51 (51.5)
Age (years)	
41-50	33 (33.3)
51-60	33 (33.3)
61-70	33 (33.3)
Height (cm)	
140-149	9 (9.1)
150-159	41 (41.4)
160-169	43 (43.4)
Height (Median)	159 cm (141-175 cm)
BMI	25.28 kg/m^2 ± 3.56 kg/m^2

BMI : Body Mass Index

Obtained the median PCF for males aged 41-50 years is 465 (330-540) L / min, ages 51-60 years are 405 (315-490) L / min, and 61-70 years are 352.5 (290-520) L / min while in female groups the median PCF age 41-50 years is 360 (290-425) L / min, age 51-60 years is 340 (190-420) L / min and age 61 -70 years is 330 (245-460) L / min. Obtained the median value of the PCF measurement results is statistically significantly greater in each age group in the group of men compared to women at the age of 41-50 years and 51-60 years (p <0.05), but at the age of 61 years and over there was a decrease in the PCF value where the median value of the PCF results for men was not significantly different from women (p >0.05).

Based on statistical analysis, height variables were simplified into several categories with an area span of ten centimeters. The height value

in this study obtained a range of height 140- 179 cm. Research subjects with height 140-149 cm have nine subjects, body height 150-159 cm have forty-one subjects, subjects with height 160- 169 cm have forty-three subjects, and height 170- 179 cm has six subjects.

Table 2. PCF categorized by sex and age

Age	Sex						P (Mann Whitney)
	Men PCF			Woman PCF			
	Median	Min	Max	Median	Min	Max	
41 - 50	465	330	540	360	290	425	0.001
51 - 60	405	315	490	340	190	420	0.002
61 - 70	352.5	290	520	330	245	460	0.08

*PCF:Peak Cough Flow

Obtained PCF value in the group height 140-149 cm is 320 (270-390) L/ minute, height 150-159 cm is 345 (190-540) L/ minute, height 160-169 cm is 410 (290- 540) L/ min, and height 170-179 cm is 460 (405-520) L / min. Subject obtained greater PCF value at a higher height.

The variable height of men and women influences the PCF value with weak correlation strength, but the correlation's strength is weaker in the female sex.

Table 3. PCF categorized by Height and it's correlation

Characteristics	n (%)	PCF (minimum - maximum)
Height (cm)		
140-149	9 (9.1)	320 (270-390) L/ minute
150-159	41 (41.4)	345 (190-540) L/ minute
160-169	43 (43.4)	410 (290-540) L/ minute
170-179	6 (6.1)	460 (405-520) L/ minute

*PCF:Peak Cough Flow

Table 4. Correlation between PCF with Height

	Correlation strength (r)	P value
Height (male)	0.316	0.029 spearman
Height (female)	0.295	0.036 pearson

*PCF:Peak Cough Flow

Table 5. PCF categorized by Age

Age	PCF			p (Kruskall Wallis)	P (Mann Whitney)
	Median	Min	Max		
41 - 50	390	290	540	0.008	Ref
51 - 60	360	190	490		0.073
61 - 70	340	245	520.0		0.002

PCF:Peak Cough Flow

From the results of the study, the median PCF at age 41-50 years was 390 (290-540) L / min, age 51-60 years was 360 (190-490) L / min and at age 61-70 years was 340 (245 -520) L / minute. Based on the analysis found a statistically significant relationship between the age variable and the PCF value, i.e. the higher the age, the lower the PCF value obtained ($p < 0.05$) and there was a significant decrease in the PCF value at age 61-70 years compared to age 41- 50 years ($p < 0.05$).

DISCUSSION

The subjects in this study were men or women between the ages of 41 to 70 who had healthy respiration in the RSUPNCM environment taken by consecutive sampling. The number of samples is 99 people. The subjects' characteristics based on the sex that has been determined were 48 men (48.5%) and 51 women (51.5%) with ages up to 70 years, with an average value of 55.81± 8.84 years. Based on the report of the Central Statistics Agency (BPS) in 2010 in Indonesia there were 61 million people aged over 40 years with a percentage of 25.82 of the total population of Indonesia, and at the age of 41-70 years it was found that gender characteristics 49.83% were women and 50.17% were male, which did not match the sex characteristics of the study subjects. But for body mass index, the characteristics are following the population with body weight of 40 kg to 99 kg with an average value of 63.13 kg and the category of BMI (Body Mass Index) 17.3 kg / m2 to 36.1 kg / m² with an average 25.28 kg / m² ± 3.56 kg / m² (overweight). This is the following research by Wang et al. (2016), which states that most are overweight in subjects aged 40-70 years, with a prevalence of overweight 42.2%. The reason for the researchers to take the age limit from 41 to 70 years is based on previous research conducted by Freitas et al (2010) in Brazil for older adults with age over 60 years and there is no research yet on the value of the PCF in healthy middle- age adult. Based on the understanding by Hurlock (2001), that middle adulthood is between 41 and 60 years of age, and late adulthood is 61 years of age until death, but to be taken is between 41-70 years due to normal spirometry values for Indonesians (pneumomobile) only until the age of 70. Determinating number of age and sex proportions in this study was not adjusted to national proportions, because it was designed to obtain normal range values for each category. For the sex of the study subjects, each was determined as many as 48 men and 51 women from a total of 99 research subjects. This is consistent with the PCF study by Cardoso (2012) with more female than male subjects (252: 232).[18] This is not following the 2010 Central Statistics Agency (BPS) report that Indonesia's male population is 119 million and 118 million women with a sex

ratio of 101 which means there are 101 men for every 100 women and the 2013 BPS report that states that 50.25% of Indonesia's population is male and 49.75% is female. At the age of 41-70 years, it was found that sex characteristics were 49.83% female and 50.17% male.[23]

Subjects in this study found that 20 people had a history of smoking, with a prevalence of 20.2% of the total sample. The Sirait study (2002) says that at the age of 40-44 years in Indonesia 74.4% of men smoke and will decrease to 64.7% at 65-69 years. A history of smoking was not included as a study exclusion criterion due to trying to obtain a sufficient number of male samples for the 41-70 age range and because the subjects of this study were middle and late adulthood with healthy respirations screened by spirometry examination. All subjects who participated in this study were explained the research in groups or individually. After that the subjects were screened by spirometry examination. If normal spirometry results are obtained without obstruction or restrictions adjusted for the value of Indonesian pneumomobile results based on age, sex and height. Then the subject is to be further examined, namely the PCF measurement.

In male gender PCF values are obtained with 290 L / min to 540 L / min and in women obtained range of 190 L / min to 460 L / min. Table 2 shows the statistically significant difference in PCF values between men and women. The obtained mean value of the PCF measurement results is statistically more significant in the age group 41-50 years and 51-60 years in the group of men compared to women, but at age 61 years and over there is a decrease in the value of the PCF where the median value of the PCF men are not significantly different from women.

This is consistent with research by Freitas et al (2010) saying the average PCF value in healthy late adulthood in Brazil is 309.2 L / min in women and 434.4 L / min in men where the PCF value in men is significanctly greater than in women (p <0.001). 5 Research by Cardoso (2012) also said PCF values in healthy young adults (18-40 years) Caucasian race in Brazil in women between 242-355 L / min and in men between 316-499 L / min.[18] Research by Fauzan (2016) says the PCF value in young adults in Indonesia (Mongoloid race) in males is between 463 - 607 L / min and in women 366 - 472 L / min. Moreover, that type of sex is a factor that influences the PCF value.[20] This is because women have the capacity of a lung capacity 20-25% smaller than men. Research by Yawata (2017) says there are significant differences in examining lung function, respiration muscle strength and chest expansion in men compared to women (p <0.05). This happens because the value of height and weight of men is significantly greater than women. Height and weight are factors that affect respiration function and respiration muscle strength, also affect chest expansion. Pulmonary function, respiratory muscle strength and chest expansion are all factors that influence the inspiratory, compressive, and expulsive phases of the coughing process so that the ability to cough in women is lower than men.[25]

Based on this study's results, it was found that subjects with higher height had a greater PCF value. It was also found that male and female height variables affected PCF values with weak correlation strengths but weaker correlation strengths on female height.

This is consistent with research by Lee et al. (2015), which says the average PCF value of

Caucasian races in England is 652 L / min.[24] Research by Fauzan (2016) says the PCF value in young adults in Indonesia (Mongoloid race) is around 310- 645 L / min with a mean of 477.17 L / min and that the higher height correlates with, the greater PCF (Correlation coefficient: 0.741).[20] In the two races, there was a significant difference in median height in England (mean 177.6 cm) and in Indonesia (mean 158 cm).

The normal PCF value in Indonesia tends to be lower than other reference PCF values from England. This is because of the higher height factor in England compared to Indonesians. This may be influenced by the influence of the vital lung capacity which is physiologically affected by height. The higher the height, the higher the vital lung capacity value.[22] So that this will affect one's inspiration, which will affect cough as assessed by the PCF.

Table 5 shows a statistically significant relationship between the age variable and the PCF value, i.e., the higher the age, the lower the PCF value obtained and there is a significant decrease in the PCF value at age 61-70 years (older adults) compared to 41-50 years of age (middle adulthood). The median PCF for ages 41- 50 years is 390 L / min (290-540 L / min), 51-60 years old is 360 L / min (190-490 L / min) and the age of 61-70 years is 340 L / min minutes (245- 520 L / minute).

Research by Cardoso (2012) says the PCF value in healthy young adults (18-40 years) of Caucasian race in Brazil is between 240-500 L / min, and the results decrease with age.[18] Fauzan (2016) says the PCF value in adults young people in Indonesia (Mongoloid race) range from 310-645 L / min and a decrease in PCF value is obtained with increasing age. [20]

Significant reductions in PCFs above 50 years of age are considered for the following reasons. In middle and late adulthood, lung parenchyma and chest wall become less elastic due to an increase in collagen, which is more rigid and reduced elastin. Also, the ability of microsilia to secrete decreases and the strength and endurance of respiration muscles decreases due to type IIa muscle atrophy. Type I and IIb muscles are more dominant, indicating the decondition of respiratory, especially in the abdominal muscles. Diaphragm strength decreases 25% in healthy late adulthood compared to young adults, accompanied by weakening of the muscles of the abdominal expiration and chest wall so that it cannot empty the lungs in normal breathing due to reduced maximal inspiratory pressure (from 20 years old) and expiration (from 50 years old). This causes a decrease in the lung's vital capacity so that the ability to cough is reduced. [2,4-6]

In this study, limitations are samples of subjects who, although they are following the references, are still not representative enough to represent in general data for middle and late adulthood populations in Jakarta and Indonesia because they do not represent equally in each region in Jakarta and Indonesia

Strengths in this study include that this study's results have accurate results for healthy subjects because they are based on spirometry examinations, thereby getting rid of obstructive and restrictive respiratory system disorders.Also, this is the first study in assessing the range of PCF values in healthy middle adulthood and late adulthood in Indonesia (Mongoloid race).

CONCLUSION

From our research, we found that the PCF value in healthy middle adulthood ranges from 190-540 L / minute with the median value of age 41-50 years 465 L / minute, age 51-60 years 405 L / min and in healthy late adulthood, PCF values ranging from 245-520 L / minute with median values 352.5 L / min. Based on sex, men have a higher PCF value compared to women, but at the age of 61 years and over, there is a decrease in the value of the PCF where the median value of the PCF results of men is not significantly different from women. The higher the age, the lower the PCF value obtained, and there is a statistically significant decrease in the value of the PCF at the age of 61-70 years compared to the age of 41-50 years. Based on height, subjects with higher height tend to a higher PCF value and height will affect the PCF value.

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