Correlation between Tallimetry and Size for Spirometry in Older Adults

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KEYWORDS

spirometry, wingspan, tallimetry, older adults.

ABSTRACT

The research focuses on determining estimated spirometric values, measured by wingspan and tallimetry, in addition to analyzing the variability that may or may not exist between these two variables. The study population was 43 older adult participants between the ages of 65 and 90 years, data on weight, height, sex, age, and size were collected. Pulmonary function was evaluated by means of a spirometric examination and the parameters of FEV1, FVC, and Tiffeneau Index were analyzed. The design of the project was prospective-cross-sectional with a quantitative approach of a non-experimental-analytical-relational type. A single evaluation was made with the aforementioned variables that yielded numerical and categorical values and were analyzed with the Chi-square statistical test. Spirometric values were obtained for both tallimetry and wingspan. The statistical analysis yielded a result of p 0.000, which indicates perfect agreement between the variables studied in relation to the true hypothesis of the research, where it is mentioned that there is no variability between the values. In conclusion, the use of wingspan would be the most appropriate alternative to height for lung function analysis.

1. Introduction

Respiratory Diseases (RD) are one of the leading causes of death worldwide and are a relevant problem for the health system, especially with vulnerable populations such as the elderly (Oyarzo Saldivia et al., 2020). There are several tests that can identify obstructive and restrictive respiratory patterns, such as spirometry, which is under the Global Initiative for Chronic Obstructive Lung Disease (GOLD), a standard for the control of these characteristics in respiratory pathologies (Culver et al., 2017) The same respiratory diseases can increase in prevalence attributed to the large population growth along with the increase in longevity. The epidemiological reports of the World Health Organization (WHO) indicate that in 2021 people over 65 years of age represented 9.54% of the population and this percentage in recent times has doubled on a large scale the number of inhabitants over 65 years of age worldwide (*World Health Organization*, 2022). The aging process itself brings with it a number of diseases, including respiratory diseases. According to data from the National Institute of Statistics and Geography (INEGI), these affect 24204 people out of every 100 thousand inhabitants who are 65 years of age and older. Spirometry is the standardized test to support the diagnosis of respiratory pathology based on estimates through equations such as the Global Lung Function Initiative (GLI), proposed by the European Respiratory Society that help to have a more complete statistic about respiratory patterns in spirometric examinations in a fast and reproducible way. easy and painless, the same that was used in this research.

The interpretation of spirometry consists of fundamental parameters such as Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC) and the Tiffeneau index (FVC/FEV1), which are adjusted according to the variables of age, sex, height, weight and ethnicity (Caussade et al., 2019). In the elderly population, taking height in standing can have certain limitations due to different situations such as problems in the spine, at the spinal cord level, malformations in the rib cage or pathologies that prevent you from adopting that position (Mora et al., 2019). This measurement is of great importance because it serves to interpret spirometric values and identify restrictive and obstructive patterns (Gutiérrez C et al., 2014). Currently there are still paradigms with reference to the values that can be obtained in spirometry where the size is used as a substitute for tallimetry. The wingspan is the distance between both hands with the arms extended horizontally with the middle finger as a reference (Ramos Mejía et al., 2018). A study mentions that this anthropometric measurement can be an alternative to the height taken in standing and in their research this parameter was the most compatible to be used when there is no possibility for the patient to remain bipedal (China et al., 2020). Therefore, it is sought to validate the predicted spirometric results obtained by size, which aims to be an acceptable clinical variable to the tallimetry, which makes the use of these values totally viable without any repercussions on the results and interpretation within the pulmonary function test.

2. Materials and methods

It was a prospective-crossovers research, with a quantitative approach of a non-experimental relational analytical type, carried out at the Sacred Heart of Jesus Nursing Home, including those over 65 years of age, who are able to reach standing and supported by informed consent. A BTL brand spirometer**,** used for the evaluation of lung function objectively. It allows measuring the impact of a disease on lung function, assessing airway response capabilities, and predicting different lung conditions (Arce & Calabrese, 2021). Spirometry To perform the spirometric evaluation, the patient was asked to remain seated with the feet well attached to the floor and in a neutral position, with the spirometer placed in the patient's mouth, he was instructed that his lips are well glued to the mouthpiece of the spirometer to avoid air figs. The patient took a normal breath, then a gentle exhalation until their lungs fill or reach full lung capacity and after that they performed a strong and sustained exhalation for a time of 3 to 6 seconds (Benítez-Pérez et al., 2016). These steps were repeated 3 times in each participant to be considered a valid test. In addition, it has a specificity of 91.2% (Quadrelli et al., 2007). Tallimetry evaluations were performed with the patient standing, with the evaluator's hand on the patient's chin. It was taken into account that the shoulders should be relaxed and the hands straight at the sides of the body, the head and buttocks attached to the height meter. The measure of magnitude, The width of the arms was taken, as a reference point the middle finger of each hand and the measurement obtained was in centimeters.The statistical analysis of the data was developed through the statistical program SPSS version 29.0 for data analysis, it is a software that allows recording, analyzing and interpreting data through descriptive statistical tests. The distribution of the data was analyzed with the Shapiro-Will test determined by the sample size, in addition, the statistical significance tests were performed by analyzing the Mann Whitney u test in order to analyze a change in the variable between samples. Finally, the distribution of non-parametric data will be dealt with by the Sperman relationship test.

3. Results

A total of 43 participants aged between 65-90 years were part of this research, table 1 shows the sociodemographic data of the sample.

Table 1. Sociodemographic data

	Frequency	**Percentage (%)**
Gender		
Female	23	53,5
Male	20	46,5
Age		
61,00-70,00	14	32,6
71,00-80,00	17	39,5
81,00-90,00	12	27,9
Pathologies		
Depression	2	4,7
Dementia	7	16,3
Arthrosis	6	14,0
Alzheimer	3	7,0
Hypothyroidism	2	4,7
Heart Disease	2	4,7
Prostatic probe	1	2,3
Diabetes	1	2,3
Sleep disorder	2	4,7

Prostatic hypertrophy	1	2,3
High blood pressure (HTN)	1	2,3

The variables of FEV1, FVC and the tiffeneau index were identified according to the height of each participant, for the female gender the FEV1 was obtained with a mean of 1.52L ±0.83 of the predicted value, the FVC yielded a mean of 1.80L ±0.41 with a tiffeneau index of 75.48%. For males, FEV1 values of 2.25L ±0.51 and a tiffeneau index of 74.36% were obtained. The same variables were analyzed by size, with a mean of 1.59L ±0.36 for FEV1; 1.87L ±0.46 for FVC and a Tiffeneau index of 75.48% in the female gender. In the case of males, mean values of 2.37L ±0.53 for FEV1; Average of 3.09L ±0.61 for CFV and a Tiffeneau index of 74.21%. Tables 2 and 3 reveal this information in more detail.

Table 2. Spirometric values by gender belonging to height.

	FEV1		**FVC**		**Vef1/cvf (%) TIFFENEAU**		**P value**
FEMALE	**M**	**D.E**	**M**	**D.E**	**M**	**D.E**	
Real	1,84	0,58	1,98	0,57	92,45	6,47	>0.05
Predicted	1,52	0,33	1,80	0,41	75,48	2,33	
MALE							>0.05
Real	2,34	0,66	2,42	0,64	94,48	5,14	
Predicted	2,25	0,51	2,95	0,68	74,36	1,97	

Abbreviations: FEV1; Forced expiratory volume in one second, **FVC;** Forced Vital Capacity, **Vef1/cvf;** Tiffeneau index, **M;** Media, **D.E;** Standard deviation.

Table 3. Spirometric values by gender belonging to the wingspan.

	FEV1		**FVC**		**Vef1/cvf (%) TIFFENEAU**		**P value**
FEMALE	**M**	**D.E**	**M**	**D.E**	**M**	**D.E**	
Real	1,89	0,52	2,02	0,54	93,40	5,74	>0.05
Predicted	1,59	0,36	1,87	0,46	75,48	2,33	
MALE							>0.05
Real	2,34	0,66	2,48	0,64	94,48	5,14	
Predicted	2,37	0,53	3,09	0,61	74,21	1,83	

Abbreviations: FEV1; Forced expiratory volume in one second, **FVC;** Forced Vital Capacity, **Vef1/cvf;** Tiffeneau index, **M;** Media, **D.E;** Standard deviation.

On the other hand, the statistical analysis using the Mann-Whitney U statistical test resulted in a p = 0.48 for all spirometric variables, which means zero variability between height and wingspan, so that its interpretation indicates that the two measures can be used for the interpretation of the pulmonary function test. The relationship between variables showed a Spearman's Rho of 0.74 with a p value of 0.013. The values identified for the elderly population ranged from 70% to 80% of Tiffeneau and the obstructive, restrictive or normal spirometric patterns were evidenced according to age and the data used for the analysis of the expected and estimated values, this information is visualized in Table 4.

Table 4. Results of spirometric patterns obtained by size and wingspan.

	Predicted value by size		**Predicted value by wingspan**	
	Frequency	**percentage**	**Frequency**	**Percentage**
<70	0	0	0	0
70,01-80,00	42	97,7	42	97,7
80,01+	1	2,3	1	2,3
Total	43	100	43	100

4. Discussion

The study had a sample of 43 older adults between the ages of 65 and 90. Lung function was evaluated with spirometry with the measurement of tallimetry and an alternative to it, which was the wingspan. In the first variable, estimated values of FEV1 = 1.52L ±0.33 were obtained; FVC of 1.80L ±0.41; Tiffeneau index of 75.48% ±2.33 (Women). FEV1 2.25L ±0.51; FVC of 2.95L ±0.68;

Tiffeneau index 74.36% (Men). And for the second variable, estimated values of FEV1 1.59L ±0.36; FVC of 1.87L ±0.46; Tiffeneau index 75.48% (Women) and FEV1 2.37L ±0.53; FVC of 3.09L ±0.68; Tiffeneau index 74.21% (Men), obtaining a positive statistical result of p=0.000, which indicates low variability in the data estimated by size and tallimetry. Height is a relevant piece of information for spirometry in the evaluation of lung function. Roja et al. Height was used as a baseline anthropometric data to assess FEV1, FVC and FEV1/FVC. They obtained values of an average FVC of 1.98L ±0.44L and a range of 1.24L to 2.98L and for FEV1 it was 1,481L ±0.37; 4.08 l/s. Where they concluded that these values obtained with height are important to have them as a reference as estimated values in the elderly population (Rojas Ramos et al., 1999). In the event that it is impossible to take the size, the wingspan can be a good alternative in older adults when the usual measurement is not possible. Thus, in a study (Chura & Liistro, 2022) over young and older adult populations, used arm extension as a replacement for height under the premises of ERS – ATS. They estimated the values of the FEV1, FVC and Tiffeneau Index, their results are related to the FEV1 with values of 0.123±1.039; FVC 0.101 ±1.068 and Tiffeneau index of 0.075±0.917, concluding that the values found did not improve or worsen regardless of the variable they used, so the values found can serve as a reference for the population in which it was applied and the use of arm extension serves as an alternative (Chura & Liistro, 2022). In the same way, a study (Golshan et al., 2007) The authors found that this measurement predicts all spirometric parameters very well and the standard errors of the predictive equations were very minimal to those obtained with height, and the prediction of spirometric values and parameters with wingspan is just as reliable as doing so with equations based on standing height. As mentioned by John Jeneviv Nene et al. in their study, they used different variables to replace height, found positive correlations with values p= 0.000, and indicate that the use of anthropometric data is satisfactory for the assessment of lung function (John Jeneviv et al., 2022).Finally, in a study, height variables were used, such as the reference values of height for age, sex and wingspan itself, obtaining a value of p0.0001, which are assumed to be alternatives in case of being prevented from obtaining height and that could be factors of close studies to obtain more substitute variables to this anthropometric measurement (Parker et al., 1996).

The research project demonstrates the importance of the use of anthropometric measurements for the spirometric study of lung function and emphasizes the use of wingspan as a good quality substitute in those who are not able to assess height on a regular basis, such as our older adults. In addition, for the expected values of FEV1, FVC and the Tiffeneau Index the size was the most appropriate, and it was possible to predict the spirometric values with the two variables. A limitation of this study was the size of the population, it should be compared with a larger sample to obtain a greater amount of reference on the spirometric values estimated by the variables used, in addition to the fact that the majority of the population did not have a basic pathology and the age group was only over 65 years old. however, they can be applied as a reference for future studies.

5. Conclusions

According to our results, it can be assumed that the predicted values of spirometry taken by size and tallimetry are optimal for the interpretation of the pulmonary function test. The values of the size are very similar to those obtained by tallimetry. In addition, wingspan and height can be used without impact on the clinical outcome due to the perfect agreement between the values

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