


## Functional capacity and fragility of the elderly with pulmonary tuberculosis sequelae

### Capacidade funcional e fragilidade de idosos com sequela de tuberculose pulmonar

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**ABSTRACT | INTRODUCTION:** Tuberculosis (TB) is an infectious and contagious disease, with a chronic evolution that is caused by *Mycobacterium tuberculosis*, as it is considered a chronic disease among the aged because it can cause sequelae and result in impaired lung capacity and thus contribute to a clinical picture of worse prognosis it is interesting to study the relationship between TB and frailty syndrome and functional capacity in the old age. **OBJECTIVE:** To analyze the functional capacity of elderly people with pulmonary TB sequelae treated at a pulmonology service in Belém-PA, and to investigate the occurrence of frailty in this population. **MATERIALS AND METHODS:** This is a cross-sectional study with the quantitative-correlational method, conducted from August to November 2017 at the physiotherapy outpatient clinic of the João de Barros Barreto University Hospital, Belém/PA. Frailty by the Tilburg Frailty Indicator (TFI) instrument and functional capacity by the "ADL-Glitter Test" (TGlitter) were evaluated. The "Spearman correlation" between TFI and TGlitter was used. P-value was adopted  $\leq 0.05$ . **RESULTS:** The average age was  $68,37 \pm 6.01$  years, 66.7% were female, all individuals were literate, the majority with incomplete primary education (45.8%). The presence of frailty was 70.5% (95% CI 48.9-87.4), with a female predominance (82.4%). The average time on TGlitter was  $5,77 \pm 1,71$  minutes. There was a moderate positive correlation between TFI and TGlitter ( $p=0.42$ ,  $p=0.03$ ). **CONCLUSION:** This study identified frailty and functional impairment in the elderly with pulmonary TB sequelae, with a high prevalence of frailty compared to other Brazilian studies with the elderly population, besides presenting a moderate positive correlation between functional capacity and frailty, suggesting that these aspects deserve special attention in rehabilitation programs for functional maintenance or recovery in this profile of patients.

**KEYWORDS:** Pulmonary tuberculosis. Elderly health. Frail elderly. Daily activities.

**RESUMO | INTRODUÇÃO:** A tuberculose (TB) é uma doença de caráter infectocontagiosa, de evolução crônica, causada pela *Mycobacterium tuberculosis*. Uma vez considerada como doença crônica entre idosos por poder gerar sequelas e resultar em comprometimento da capacidade pulmonar, e desta forma contribuir para um quadro clínico de pior prognóstico é essencial estudar a relação da TB com a síndrome da fragilidade e a capacidade funcional em idosos. **OBJETIVO:** Analisar a capacidade funcional de idosos com seqüela de TB Pulmonar e investigar a ocorrência de fragilidade nesta população. **MATERIAIS E MÉTODOS:** Trata-se de um estudo transversal com método quantitativo-correlacional, realizado no período de agosto a novembro de 2017, no ambulatório de fisioterapia do Hospital Universitário João de Barros Barreto, Belém/PA. Avaliou-se a fragilidade pelo instrumento Tilburg Frailty Indicator (TFI) e a capacidade funcional pelo "Teste de AVD-Glitter" (TGlitter). Utilizou-se a "correlação de Spearman" entre TFI e TGlitter. Adotou-se  $p$ -valor  $\leq 0,05$ . **RESULTADOS:** Avaliaram-se 24 idosos com diagnóstico clínico de TB Pulmonar, apresentando alterações e/ou sequelas pulmonares. A média de idade foi de  $68,37 \pm 6,01$  anos, 66,7% era do sexo feminino. A presença de fragilidade foi de 70,5% (IC95% 48,9-87,4), com predomínio feminino (82,4%). A média do tempo no TGlitter foi de  $5,77 \pm 1,71$  minutos. Houve correlação moderada positiva entre TFI e TGlitter ( $p=0,42$ ,  $p=0,03$ ). **CONCLUSÃO:** Este estudo identificou a fragilidade e comprometimento funcional em idosos com sequela de TB pulmonar, com prevalência alta de fragilidade se comparada aos outros estudos brasileiros com a população idosa, além de apresentar correlação moderada positiva entre a capacidade funcional e fragilidade, mostrando que essa população merece atenção especial nos programas de reabilitação para a manutenção ou recuperação funcional.

**PALAVRAS-CHAVE:** Tuberculose pulmonar. Saúde do idoso. Idoso fragilizado. Atividades cotidianas.

## Introduction

Tuberculosis (TB) is an infectious disease of chronic evolution, caused by *Mycobacterium tuberculosis* and transmitted predominantly by air, which mainly affects the lungs. This disease has affected the world for thousands of years and is still considered a serious public health problem and an important cause of morbidity and mortality<sup>1,2</sup>, as shown by the WHO data, which reveal that approximately 10,4 million people fell ill with TB in 2016 worldwide, with 6,3 million new cases reported and around 1,5 million deaths, and it is estimated that almost all of them occur in developing countries<sup>3</sup>, with Brazil among the 22 countries with the highest prevalence<sup>4</sup> and the states in the Northern region, Pará ranked first in notifications of new cases in the period from 1990 to 2014<sup>5</sup>.

In Brazil, the demographic and epidemiological transition occurs in an atypical way, characterized both by the reemergence or constant presence of infectious and parasitic diseases and by the higher prevalence of non-communicable diseases and chronic diseases<sup>6</sup>. In this sense, the elderly, due to the senescence process of biological systems, such as the immune and respiratory systems, are often more vulnerable to the action of *M. tuberculosis*, both to exogenous infection and to the reactivation of foci containing bacilli in a state of latency<sup>7</sup>. In addition, this population is very likely to have sequelae of pulmonary TB if it has been exposed during childhood, a period in which the prevalence of the disease was high and the therapeutic schemes less effective<sup>8</sup>.

TB can lead to a series of harmful consequences, among which, the presence of extensive pulmonary lesions can be a predictor of permanent disability due to respiratory failure secondary to tissue destruction, Cor Pulmonale, in addition to a predisposition to opportunistic infections, which results in impaired functional capacity and quality of life, in addition to becoming one of the risk factors involved in mortality from the disease<sup>9</sup>.

Studies by Chaves et al.<sup>2</sup> and Lourenço and Lopes<sup>8</sup> demonstrate that elderly individuals who died or were hospitalized with or due to tuberculosis had a greater chance of not reporting that younger adults, reinforcing the hypothesis of older people's access to the Tuberculosis Control Program and possible chronification of the disease, thus being considered more of chronic lung disease among the elderly, and since chronic lung disease participates significantly in a worse clinical picture, it is interesting to study its relationship with the frailty syndrome, which presents as dominant manifestations: decreased muscle strength, tired feeling, involuntary weight loss, slowness, and inactivity<sup>10,11</sup>, and is associated with adverse outcomes, such as decline and functional disability and restricted activities among the elderly<sup>12</sup>.

Functional capacity, in turn, is defined as the absence of difficulties in performing specific gestures and certain activities of daily life, which encompasses all body functions and the individual's ability to perform relevant tasks in their daily routine<sup>11</sup>. Because these aspects are essential, instruments capable of simulating the daily situations of these patients are of great importance and should be included in your assessment. However, studies that have performed tests or specific functional assessment instruments for patients with sequelae of pulmonary TB are unknown, and there is a lack of information in the literature on the functional capacity of these individuals, there are also few studies that assess frailty in elderly with sequelae of TB, as well as very few were found with the application of TFI to the elderly Brazilian population.

Given the above, this research aimed to analyze the functional capacity of elderly people with pulmonary tuberculosis sequelae seen at a pulmonology service in Belém-PA, as well as to investigate the occurrence of frailty in this population.

## Material and methods

That is a cross-sectional study with a quantitative-correlational method, carried out following Resolution 466/2012 for research involving human beings, approved by the Research Ethics Committee of the João de Barros Barreto University Hospital of the Federal University of Pará (CEP / HUIBB / UFPA), under opinion No. 64545617.7.0000.0017, which took place from August to November 2017.

Sampling was done for convenience, and the sample consisted of individuals of both sexes, aged 60 years or over, with a clinical diagnosis of pulmonary TB, with pulmonary alterations and/or sequelae. The elderly were referred for participation in the research by the medical staff of the HUIBB pulmonology outpatient clinics. It should be noted that the elderly may or may not have other lung diseases.

The elderly who had severe dyspnea on the modified Borg scale (5 to 10) were excluded from the study; intense pain complaints (8, 9,10) on the Visual Analog Scale; individuals in wheelchairs or with some other musculoskeletal and/or neuromuscular impairment that limited the performance of the functional test, being allowed to use auxiliary resources for visual or auditory correction; and also, those who had a comprehension deficit.

After signing the Free and Informed Consent Form, the elderly responded to a form produced by the researchers containing data such as: age, sex, education, marital status, treatment interruption, pharmacological treatment as soon as they discovered it, comorbidities, age at which acquired TB, duration of treatment, weight, height, BMI and sensation of dyspnea, followed by the assessment of frailty using the Brazilian version of the Tilburg Frailty Indicator (TFI) instrument, validated by Santiago and Mattos<sup>14</sup>, which consists of 15 objective, self-questions evaluative, distributed in the "physical" domains (questions related to self-rated health, weight loss, walking and balance, hearing and visual impairment, weakness in the hands and perception of tiredness), "psychological" (related to the condition of memory , feeling of sadness, nervousness or anxiety and facing problems) and "social" (issues related to living alone, if you miss someone s next to you or support), who were assigned a score of "zero" or "one".

The scores for these domains vary, respectively, from 0-8, 0-4 and 0-3. The final score can vary between zero and 15 points and the higher the score, the greater the degree of fragility or, alternatively, scores  $\geq 5$  points indicate the individual as fragile. In this research, the individual who obtained a total score equal to or greater than five in the TFI<sup>14</sup> was considered fragile.

Subsequently, the functional condition was assessed using the "AVD-Glittre Test" (TGlittre), which was developed and validated for patients with COPD<sup>15</sup>, but which has recently been applied to different patient profiles. It involves a set of tasks in a circuit that consists of getting up from a chair, walking along a 10-meter track carrying a backpack on the back weighing 2.5 kg for women and 5 kg for men (which resembles the weight of supplementary oxygen equipment), going up and down a ladder with two steps (17 cm high and 27 cm wide each step) shelf and transfer three objects one by one (weighing 1 kg each) from the high shelf (at the height of your shoulders) to the low shelf (at the height of the pelvic girdle), then down to the floor, again return with the objects to the low shelf and finally to the high shelf. Then the patient returns on doing the same route until he sits in the chair again; immediately, he restarts another lap running through the same ADL circuit until completing five laps. The patient is encouraged to perform the task as quickly as possible and he can stop to rest, but with the timer on<sup>15</sup>.

Blood pressure was measured using the Premium® sphygmomanometer and Littmann® stethoscope, the peripheral oxygen saturation and heart rate were measured by the Oxy-Go® oximeter, and the level of dyspnea was obtained using the modified Borg scale 16. Such evaluations were performed at the beginning and the end of the TGlittre test performance. The total time to complete the test was recorded and used as an outcome. The longer the time to perform the test, the worse the patient's functional capacity<sup>15</sup>.

Through the obtained data, the processing started with the data entry in Microsoft Windows Excel 2007®. The descriptive statistical analysis of the categorical variables was presented in absolute number, relative frequency, and 95% confidence interval (95% CI). The numerical figures were presented as mean, standard deviation, maximum and minimum. For the correlations between TGlittre and TFI, the "Spearman's correlation coefficient" was applied, adopting a significance level of 5% ( $p \leq 0.05$ ).

The programs used for the analysis were the Software Epi Info 7.1.5 and the program Bioestat 5.3, from this analysis the graphs and tables were generated.

## Results

31 patients with sequelae of pulmonary TB were referred during the study period, however, 7 were excluded from these 3 due to their age, as they were not 60 years old, 2 because they did not finish the assessment during the research period, as they lived in the countryside, and 2 for dropping out of the research.

Thus, the survey obtained a sample of 24 elderly persons, with an average age of 68,37±6,01 years, 62,5% female, and 50,0% married. As for the level of education, all individuals were literate, with the majority attending only the first school years, having incomplete primary education with 45,8% of the sample (Table 1).

The mean age at which they presented the disease was 35,16±4.6 years, and, as for the treatment of TB, the majority of individuals, 79,2% of the sample, concluded the medication regimens without interruption (Table 1), with an average duration of treatment of 6,75±5,44 months, with most of them starting as soon as diagnosed, also, most 66,7% had no associated comorbidities (Table 1).

**Table 1.** Characterization of the elderly with pulmonary tuberculosis sequel treated at the HUIBB (n = 24) according to the categorical variables. Belém, PA, 2017

Variables		Absolute Number	Relative Frequency (%)	CI 95%
<b>Gender</b>				
	Men	9	37,5	18,8-59,4
	Women	15	62,5	40,6-81,2
<b>Marital Status</b>				
	Married	12	50,0	29,1-70,9
	Single	8	33,3	15,6-55,3
	Widower	4	16,7	4,7-37,4
	Incomplete Primary Education	11	45,8	25,6-67,2
	Complete Primary Education	9	37,5	18,8-59,4
	High School	3	12,5	2,7-32,4
	University Education	1	4,2	0,1-21,1
<b>Treatment Interruption</b>				
	Yes	4	16,7	4,7-37,4
	No	19	79,2	57,8-92,9
	No treatment	1	4,2	0,1-21,1
<b>Treated immediately</b>				
	Yes	20	83,3	62,6-95,3
	No	4	16,7	4,7-37,4
<b>Comorbidities*</b>				
	Yes	8	33,3	15,6 - 55,3
	No	16	66,7%	44,7 - 84,4

Comorbidities \* (hypertension, diabetes, asthma, chronic obstructive pulmonary disease).

Anthropometric data show an average height of 1,53±0,09 m, a weight of 62,50± 13,75 kg, and a BMI of 26,54±5,23 kg/m<sup>2</sup>, the sensation of dyspnea on the day of the evaluation showed an average of 2,12±0,67. The frailty analyzed by the TFI obtained a total score of 6,12±2,90 points, whereas the functional capacity assessed by the TGlitter obtained an average of 5,75±1,71 in minutes.

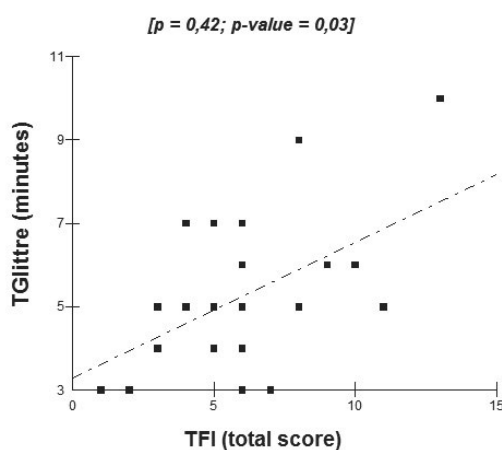
The prevalence of frailty estimated for the sample, according to the cutoff point proposed for the TFI, was 70,5% (95% CI 48,9-87,4), and the item most mentioned in this scale was the feeling of tiredness as aspects that cause problems daily, which was equivalent to 75% of positive responses, with 94,44% of those characterized as fragile reporting tiredness.

**Table 2.** Characterization of the elderly with sequelae of pulmonary tuberculosis treated at the HUIBB (n = 24) according to the numerical variables. Belém, PA, 2017

Variables	Average	Standard deviation	Maximum - minimum
<b>Anthropometry</b>			
Height (m)	1,53	±0,09	1,70-1,39
Weight(kg)	62,50	±13,75	86,90-39,30
BMC (kg/m <sup>2</sup> )	26,54	±5,23	38,73-17,99
<b>Dyspnea sensation</b>			
Modified Borg scale	2,12	±0,67	4-1
<b>Fragility- TFI</b>			
Physical domain	3,75	±1,87	7-1
Psychological domain	1,50	± 1,10	4-0
Social domain	0,91	±0,65	2-0
Total score	6,12	±2,90	13-1
<b>Functional capacity</b>			
TGlitter (minutes)	5,75	±1,71	10,20-3,80

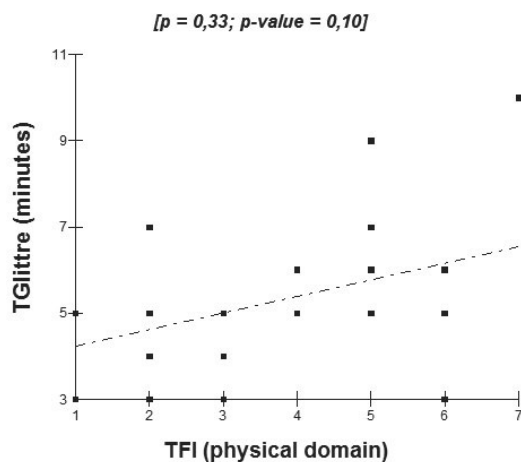
The correlation analysis showed that the total score obtained in the TFI showed a moderate positive correlation with the time of execution of the TGlitter with a statistically significant “p” value ( $\rho = 0,42$ , p-value = 0,03), (Figure 1).

**Figure 1.** Spearman's correlation between time to perform TGlitter and total score obtained on TFI by elderly patients with sequelae of pulmonary tuberculosis from HUIBB. Belém, PA, 2017



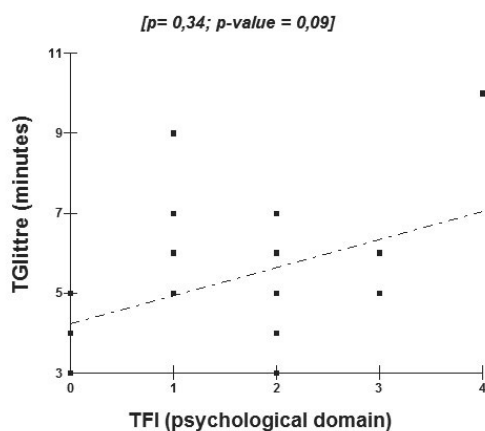
In the following figures, correlations were made with each domain of the TFI, in figure 2 there is a weak positive correlation between the physical domain and time of execution of the TGlittre, and this correlation was not statistically significant ( $\rho = 0,33$ ,  $p\text{-value} = 0,10$ ).

**Figure 2.** Spearman's correlation between the time to perform TGlittre and the physical domain of TFI by elderly patients with sequelae of pulmonary tuberculosis from the HUIBB. Belém, PA, 2017



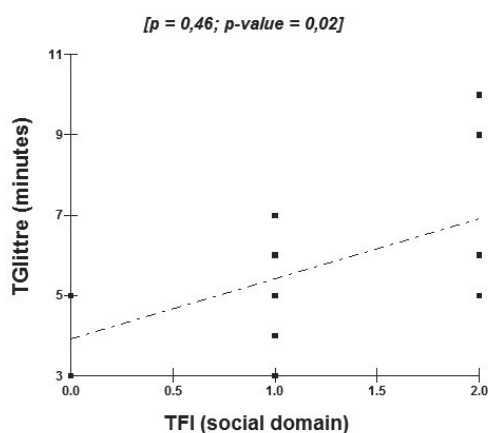
In relation to figure 3, we can also see a weak positive correlation between the psychological domain and time of execution of TGlittre, and this correlation was not statistically significant ( $\rho = 0,34$ ,  $p\text{-value} = 0,09$ ).

**Figure 3.** Spearman's correlation between the time to perform TGlittre and the psychological domain of TFI by elderly patients with sequelae of pulmonary tuberculosis from HUIBB. Belém, PA, 2017



Finally, in figure 4, it can be seen that the correlation between the social domain and the TGlittre execution time showed a moderate positive correlation with a statistically significant "p" value ( $\rho = 0,46$ ,  $p\text{-value} = 0,02$ ).

**Figure 4.** Spearman's correlation between the time to perform TGIITRE and the social domain of TFI by elderly patients with sequelae of pulmonary tuberculosis from HUIBB. Belém, PA, 2017



## Discussion

In the present research, it can be observed that the functional capacity was impaired, since the average time to perform was longer with  $5,75 \pm 1,71$  minutes, also, the frailty had a high average of  $6,12 \pm 2,90$  in the present study, and the correlations between the TGIITRE execution time and the total TFI runoff showed that the longer the time to perform the functional capacity test, the higher the total frailty score, thus having a moderate positive correlation with significance statistic ( $\rho = 0,42$ ,  $p\text{-value} = 0,03$ ).

One of the findings of the present study was the prevalence of frailty according to the cutoff point proposed for the screening instrument used, which was equivalent to 70,5% of the sample, with an average total score of  $6,12 \pm 2,9$  points, showing to be high, when compared with other Brazilian studies. In a survey conducted with an institutionalized elderly population, the prevalence of frailty analyzed using the TFI was 52%, with an average total score of  $4,9 \pm 2,5$  points<sup>14</sup>, whereas in a study with community-based elderly, the prevalence was 48,5%, with an average of  $4,77 \pm 2,7$  points<sup>17</sup>. On the other hand, the study by Fried et al.<sup>18</sup> observed that although elderly people may suffer frailty without the associated disease, however, there may be an overlap between frailty and comorbidities, especially with chronic diseases, that can be verified by current research, which studied frailty in elderly people with TB sequelae.

Also, it is known that the degree of functional capacity in the elderly is often aggravated by the appearance of chronic diseases and their cumulative harmful effects during the aging process, increasing the risk of adverse health events. Considering these aspects, the finding of a high prevalence of frailty in the present study may suggest a relationship with pulmonary TB sequelae since these can lead to chronic pulmonary impairment and, in turn, these conditions result in a greater likelihood of the elderly becoming frail, in addition, a study indicates a relationship between tuberculosis and pathological sarcopenia, one of the common findings in cases of frailty<sup>10</sup>.

For this population, whether TB results from endogenous reactivation or exogenous reinfection (new contagion), the frailty syndrome could be both an expression of primary forms, where the reduction in the functional reserve associated with aging would be the main pathophysiological mechanism, as well as the secondary form, where the appearance of certain morbidities would accelerate the functional losses, reaching more quickly the critical level from which the signs, symptoms and frequent complications among the frail elderly would appear<sup>19</sup>.

Although there is no consensus on the definition of frailty syndrome<sup>10,11</sup>, some aspects that characterize it were evidenced in the studied population, in which the report of tiredness was the most referred to in the TFI as an aspect that causes problems in daily life; the most mentioned issue was the difficulty to walk. It is noteworthy that these aspects can be evidenced in post-tuberculosis patients due to respiratory or systemic changes, as they may present limited tolerance to exercise, favoring systemic deconditioning and impairment to the detriment of activities of daily living<sup>20</sup>, in addition, it is known that respiratory muscle strength is related to reduced mobility in the elderly, regardless of the level of physical activity and the strength of the lower limbs<sup>21</sup>.

As for the assessment of functional capacity using TGlittre, the average time obtained by this population for the test to be performed was greater than that achieved by individuals with COPD. As in the study by Corrêa et al.<sup>22</sup>, which correlated the 6MWT and TGlittre in healthy elderly and COPD elderly (age: 64±10; FEV1% pred.: 38,1±11,8), in which the COPD group presented worse performance compared to healthy people in TGlittre (5,29± 2,9 min. vs 3,3±0,3 min., p <0,05) and also when compared to studies by Gulart et al.<sup>15</sup>, in which individuals with COPD (age = 63,9±8,1) reached an average time equal to 4,5±1,2 minutes to perform the test.

Although the majority of studies<sup>15,23,24</sup> using TGlittre have been carried out with patients with COPD, since the instrument was designed for this population profile, its use for the evaluation of the target population of this study becomes relevant, as well as the comparison between the results found in these populations, because despite the differences between their primary pathophysiology, similarities are observed between the two groups, such as dyspnea and limited functional capacity, due to structural changes, pulmonary parenchyma, ventilatory pattern, among others<sup>15,23,24</sup>.

In the study, Gulart et al.<sup>15</sup>, also found that TGlittre, when compared to the 6MWT, was the best predictor of the perception of functional limitation in the studied population. It is noteworthy that the ability to perform activities of daily living (ADL) are better predicted by means of global tests than by tests focused on isolated components of functional activity, and this instrument is a good alternative for functional evaluation because it consists of activities that simulate everyday life and involve both lower and upper limbs<sup>23</sup>.

The correlation between the results obtained in the TFI and TGlittre indicated that the higher the total score in the TFI (greater degree of fragility), the greater the time spent to perform the functional test. This result corroborates the studies by Fried et al.<sup>18</sup>, who state that functional disability, frailty, and comorbidities, are distinct clinical entities that do not necessarily occur in the association but interact with each other and, according to this author, frailty and comorbidity predict functional disability, and this, in turn, can aggravate frailty and comorbidity, while the latter can contribute at least additively to the development of frailty<sup>11,18</sup>.

Besides, correlations were made between TGlittre execution time with each TFI domain, a weak positive correlation was found between the physical and psychological domains and a moderate correlation in the social domain, with these pioneering correlations found in the present study.

Some limitations of this study must be clarified, one of them is a small sample size, as it could have interfered with the statistical power and be responsible for the absence of some associations. However, important associations were demonstrated, answering positively the primary questions of the present study. In addition, because it is a non-probabilistic sampling for convenience, the study does not allow the generalization of the results for all the elderly. Finally, the study design was cross-sectional, which did not allow establishing a cause-and-effect relationship between the variables investigated and the study outcome.



This study contributed to the identification of frailty and functional impairment in elderly people with pulmonary TB sequelae and, apparently, was a pioneer in evaluating this population profile, using the TGlitter and TFI instruments, as well as in correlating them. In this way, the results of this research cooperate for clinical practice, giving greater support to the application of these instruments for the evaluation of similar populations. It is emphasized that more studies are needed that are dedicated to assessing functional and fragility aspects in a larger number of individuals, as well as the responsiveness of these assessments to interventions, such as pulmonary rehabilitation.

## Conclusion

This study analyzed that the functional capacity of elderly people with pulmonary TB sequelae was impaired, as noted by the time to perform TGlitter, which was higher than that obtained by both healthy individuals and COPD, indicating greater impairment.

As well as the occurrence of frailty in this population, which was relatively high compared to other Brazilian studies, suggesting that the pulmonary TB sequelae may be related, however, as this syndrome has a multifactorial character, more studies must be carried out taking into account a wider range of aspects.

A moderate positive correlation between functional capacity and total frailty score was also identified, pointing out that these patients deserve special attention in rehabilitation programs for both maintenance and functional recovery.

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## Author contributions

Costa BDOS participated in the conception, design, search, and statistical analysis of the re-search data, interpretation of the results, writing of the scientific article. Glória LM participated in the conception, design, data collection, writing of the scientific article. Silva CA participated in the data collection, helped in the classification of patients who had the sequel of tuberculosis, helped to write the research method. Pinto DS, helped to write the research method, participated in the statistical analysis of the research results. Sarges ESNF participated in the writing of the results and the discussion. Nascimento RG guided the research and critically reviewed the manuscript.

## Competing interests

No financial, legal, or political conflicts involving third parties (government, companies and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to, grants and funding, participation in advisory council, study design, preparation of the manuscript, statistical analysis, etc.).

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