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Original Research Article

Correlation between Handgrip Strength and Lung Function in Apparently Healthy Young Adults

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Abstract

Background: Handgrip strength serves as an indicator of muscular fitness and health, while pulmonary function indicates respiratory efficiency. Evaluating the relationship between these factors may help identify early functional decline and support preventive health assessments.

Objectives: A study evaluates the relationship between handgrip strength and pulmonary function in healthy young adults, assessing handgrip strength and spirometric parameters, determining correlations between muscle strength and lung function, and exploring handgrip strength as a simple screening marker.

Methods: A cross-sectional study was conducted at teritary care centre, over a period of one year among healthy adults aged 18–30 years. After ethical approval and informed consent, demographic data, handgrip strength using dynamometer, and pulmonary function parameters using spirometry as per ATS/ERS guidelines were assessed.

Results: Total of 60 healthy young adults, primarily aged 21–25 (43.33%), were studied, with a majority being male (88.33%). Most had normal BMI (50%), followed by overweight (28.33%), underweight (16.67%), and obese (5%). Participants reported no smoking, alcohol use, medical illnesses, or injuries. Mean handgrip strength was similar for both hands (27.92 ± 2.26 kg vs 27.39 ± 2.24 kg, p=0.202). Pulmonary function showed normal values: FVC (3.71 ± 0.59 L), FEV_1 (3.06 ± 0.59 L), PEFR (6.14 ± 2.15 L/sec), and FEV_1/FVC ratio (82.30 ± 7.29%). Significant correlations were found between handgrip strength and FVC/FEV_1, while no associations existed with FEV_1/FVC or PEFR.

Conclusion: Handgrip strength has a positive correlation with key pulmonary function parameters, particularly FVC and FEV_1, among healthy young adults. Handgrip assessment is a simple, inexpensive, and practical tool for evaluating physical fitness and respiratory health. Maintaining muscle strength may support better lung function.

Keywords: Handgrip strength; Lung function; Pulmonary function test; Spirometry; Forced vital capacity; Forced expiratory volume; Peak expiratory flow rate; Healthy young adults; Muscle strength; Respiratory fitness.

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Introduction

Physical fitness encompasses muscular strength, endurance, cardiovascular capacity, and respiratory efficiency. Handgrip strength (HGS) serves as a reliable, non-invasive measure of overall muscle strength and health, correlating with general health status and disease outcomes. Studies indicate that HGS is linked to cardiometabolic risk, frailty, and quality of life. Research shows that reduced HGS is associated with lower health-related quality of life (HRQoL) scores in various populations, suggesting that HGS reflects physical competence and well-being. Overall, HGS may act as a surrogate marker for respiratory efficiency and functional autonomy. [1-4] Pulmonary function measures the respiratory system's effectiveness in air exchange, assessed via spirometry with metrics such as Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1), Peak Expiratory Flow Rate (PEFR), and the FEV_1/FVC ratio. FVC indicates maximum exhaled air volume post-inhalation, FEV_1 measures air volume exhaled in the first second, and the FEV_1/FVC ratio is crucial for diagnosing obstructive conditions. PEFR measures maximum expiratory flow. Maintaining healthy pulmonary function is vital for oxygen delivery and physical activity. Research shows lung capacity declines from early adulthood into the sixth and seventh decades, affected by lifestyle, environmental exposure, tobacco use, inactivity, and comorbidities.[5-7] Early identification of slight declines in lung function is crucial for targeting at-risk populations and averting long-term respiratory issues. Spirometry stands as the gold standard for pulmonary assessment, yielding objective metrics vital for diagnosing both obstructive and restrictive ventilatory impairments. Accurate spirometric interpretation must consider demographic factors such as age, sex, stature, and ethnicity, as highlighted by Hall et al. (2021) and Stanojevic et al. (2022), requiring comparisons to normative data from large population studies. Reductions in FVC or FEV_1/FVC ratios may signal airway obstruction, while concurrent decreases in both metrics suggest restrictive physiology.[5-8] However, the implementation of spirometry can be hindered by the need for specialized personnel and standardized tools, posing challenges in resource-limited environments or extensive health assessments.

The respiratory system relies significantly on both lung tissue and the strength and endurance of respiratory muscles, particularly the diaphragm and accessory muscles. A reduction in muscle strength can hinder effective ventilation and diminish respiratory efficiency. Factors such as physical activity, body composition, nutritional status, and age may influence both skeletal muscle strength and pulmonary function. Consequently, handgrip strength may act as an indirect indicator of respiratory muscle performance and lung capacity. Research indicates that individuals with higher muscular strength often exhibit superior pulmonary function compared to those with weaker muscles.[9-11]

Handgrip dynamometry is a practical tool in clinical and research settings due to its ease of use and low cost. It effectively screens for individuals at risk of reduced physical function and health problems, with studies linking low handgrip strength (HGS) to increased morbidity and poor quality of life. HGS is also recognized as a prognostic marker for chronic diseases and has been correlated with lung function measures like FEV_1 and FVC.[12,13] Factors such as physical fitness and systemic inflammation affect both muscle strength and lung function, with notable gender differences in muscle mass and respiratory capacity. Variations in assessment methods can influence the understanding of HGS and lung function relationships. There is a call for more research on how these relationships vary by demographics, particularly concerning early intervention in respiratory health.[14,15] Young adulthood is crucial for physical development and the relationship between muscle strength and pulmonary function, yet few studies explore the correlation between handgrip strength (HGS) and spirometric parameters in this demographic. Understanding this link is important for using HGS as an indicator of respiratory fitness.[16,17] HGS is influenced by factors such as age, sex, and physical activity level, and it plays a role in assessing nutritional status and chronic illnesses. In low- and middle-income countries, high mortality from respiratory disorders is compounded by inadequate physical activity and underutilization of spirometric evaluations.[18,19] This study aims to clarify the relationship between HGS and lung function in healthy young adults, seeking accessible markers for evaluating physical fitness and respiratory health.

The study aims to investigate the relationship between handgrip strength (HGS) and lung function parameters in healthy young adults. The objectives include assessing HGS through standardized techniques, evaluating lung function metrics (such as FEV_1, FVC, FEV_1/FVC ratio, and PEFR) via spirometry, determining the correlation between HGS and lung function indices, and exploring HGS as a potential screening marker for individuals at risk of reduced lung function.

Methods

This was a cross sectional study conducted in Department of Physiology, King Georges Medical University, and Lucknow over a period of one year. All Participants apparently healthy young adults aged between 18 and 30 years. Healthy adults giving written informed consent was taken were included. Individuals with skeletal anomalies of the upper limb, recent hand or wrist surgery (within three months), obesity, asthma, a history of respiratory disease, or existing/past cardiovascular issues, including smokers, were excluded.

The study, approved by the institutional ethical committee, Sociodemographic data, including age, gender, weight, height, and BMI, were collected via a questionnaire at the study's onset. Handgrip strength was measured using a Camry hand dynamometer through three trials per hand, with averages recorded. Lung function was assessed via spirometry, adhering to ATS/ERS guidelines, measuring vital capacity, forced expiratory volume, and peak expiratory flow. The portable spirometer measured FEV1, FVC, and PEFR using a disposable mouthpiece. Participants inhaled maximally, sealed lips around the mouthpiece, and exhaled forcefully until no air remained. A minimum of three trials ensured repeatability, with FEV1 and FVC values needing to be within 0.150 L of each other; the higher of the two values was accepted. The highest PEFR value was also recorded as the accepted measure. The Camry hand dynamometer measured handgrip strength in participants, who were seated comfortably with standardized posture as per the American Society of Hand Therapists. Hand dominance was noted, and measurements involved a maximum 6-second squeeze, with three readings taken for each hand. The average of these readings was recorded for analysis. The statistical analysis was performed with SPSS version 21.0. The data were presented in the form of mean (standard deviation) and percentage (%). The chi-square test was used to compare categorical variables, while the independent t-test was used to assess discrete variables between groups. An analysis of variance (ANOVA) was used to compare more than two groups. Correlation analysis was conducted using Pearson's correlation coefficient to evaluate the strength and direction of the relationship between continuous variables. A p-value of 0.05 was considered statistically significant.

Results

Total 60 healthy young adults, predominantly aged 21–25 years (43.33%), with a notable number aged 20 years or younger (36.67%). Participants aged 26–30 years were the smallest group (20%).

A considerable majority were male (88.33%) compared to females (11.67%). Regarding body mass index (BMI) categories, the normal weight group was the largest, consisting of 30 participants (50.00%), followed by overweight individuals (17 participants, 28.33%), underweight participants (10 participants, 16.67%), and a small number of obese participants (3 participants, 5.00%). Clinically, all participants had no history of smoking, alcohol consumption, past medical illnesses, or family histories of respiratory or cardiovascular diseases, and none had undergone recent surgery or experienced injuries. (Table 1)

Table 1: Distribution of Study Participants According to demographic details, Body Mass Index (BMI) Categories and Clinical and Lifestyle characteristics

		n	%
Age (years)	≤20	22	36.67
	21-25	26	43.33
	26-30	12	20.00
Gender	Male	53	88.33
	Female	7	11.67
Dominant Hand	Right	60	100.00
	Left	0	0.00
Occupation	Student	60	100.00
BMI category			
Underweight	< 18.5	10	16.67
Normal weight	18.5 – 24.9	30	50.00
Overweight	25.0 – 29.9	17	28.33
Obese	≥ 30.0	3	5.00
Total		**60**	100.00
Clinical & Lifestyle characteristics			
Smoking / Alcohol History	Yes	0	0.00
	No	60	100.00
Past Medical History	Yes	0	0.00
	No	60	100.00
Family History (Resp/Cardio Disease)	Yes	0	0.00
	No	60	100.00
Recent Surgery / Injury	Yes	0	0.00
	No	60	100.00

The study presents a comparison of handgrip strength between dominant (right) and non-dominant (left) hands, revealing that the dominant hand has an average strength of 27.92 ± 2.26 kg, while the non-dominant hand measures 27.39 ± 2.24 kg. Statistical analysis shows that this difference is not significant ($t = 1.28$, $p = 0.202$). For the dominant hand, three grip strength measurements yielded a range from 20.67 kg to 31.00 kg, demonstrating good consistency. The non-dominant hand's measurements ranged from 20.33 kg to 30.33 kg, contributing to the overall assessment of grip strength variability in both hands. (Table 2)

Table 2: Comparison of Handgrip Strength between Dominant and Non-Dominant Hands

	Dominant Hand		**Non-Dominant Hand**		**t**	**p - Value**
	Mean	±SD	Mean	±SD		
Average Hand Grip strength (Kg)	27.92	2.26	27.39	2.24	1.28	0.202
Average Hand Grip strength(Kg)						
Right	27.92	2.26				
Left	27.39	2.24				

The descriptive statistics for pulmonary function parameters among study participants indicate a mean Forced Vital Capacity (FVC) of 3.71 ± 0.59 liters, with values ranging from 2.71 to 5.66 liters. The median FVC of 3.60 liters suggests that most participants had lung volumes close to this mean. The mean Peak Expiratory Flow Rate (PEFR) was recorded at 6.14 ± 2.15 L/sec, with a range from 3.62 to 15.18 L/sec, and a median of 5.75 L/sec. Forced Expiratory Volume in one second (FEV_1) averaged 3.06 ± 0.59 liters, spanning a minimum of 2.22 liters to a maximum of 5.22 liters, with a median of 3.01 liters.

The FEV_1/FVC ratio had a mean of 82.30 ± 7.29%, ranging from 68.32% to 96.69%, indicating that the majority of participants maintained a normal expiratory airflow pattern. (Table 3)

Table 3: Descriptive Statistics of Pulmonary Function Parameters among Study Participants

	Mean	**Median**	**Std. Deviation**	**Minimum**	**Maximum**
FVC (Litres)	3.71	3.60	0.59	2.71	5.66
PEFR (Litres/sec)	6.14	5.75	2.15	3.62	15.18
FEV1 (Litres)	3.06	3.01	0.59	2.22	5.22
FEV1/FVC Ratio	82.30	82.06	7.29	68.32	96.69

The study investigates the correlation between grip strength and lung function parameters.

For right-hand grip strength, significant positive correlations were observed with Forced Vital Capacity (FVC) (r = 0.305, p = 0.018) and Forced Expiratory Volume in 1 second (FEV_1) (r = 0.285, p = 0.027). However, the correlations with the FEV_1/FVC ratio (r = 0.073, p = 0.578) and Peak Expiratory Flow Rate (PEFR) (r = 0.118, p = 0.368) were not statistically significant.

In analyzing left-hand grip strength, significant positive correlations were found with FVC (r = 0.479, p < 0.001) and FEV_1 (r = 0.419, p = 0.001), while no significant correlation existed with the FEV_1/FVC ratio (r = 0.030, p = 0.819) or PEFR (r = 0.211, p = 0.105). (Table 4)

Table 4: Correlation between Average Right-Hand and-Left Hand Grip Strength and Lung Function Parameters

		FVC (Litres)	**FEV1 (Litres)**	**FEV1/FVC Ratio**	**PEFR (L/sec)**
Avg Right Hand Grip (kg)	Pearson Correlation	0.305*	0.285*	0.073	0.118
	p-Value	0.018	0.027	0.578	0.368
Avg Left Hand Grip (kg)	Pearson Correlation	0.479**	0.419**	0.030	0.211
	p-Value	<0.001	0.001	0.819	0.105

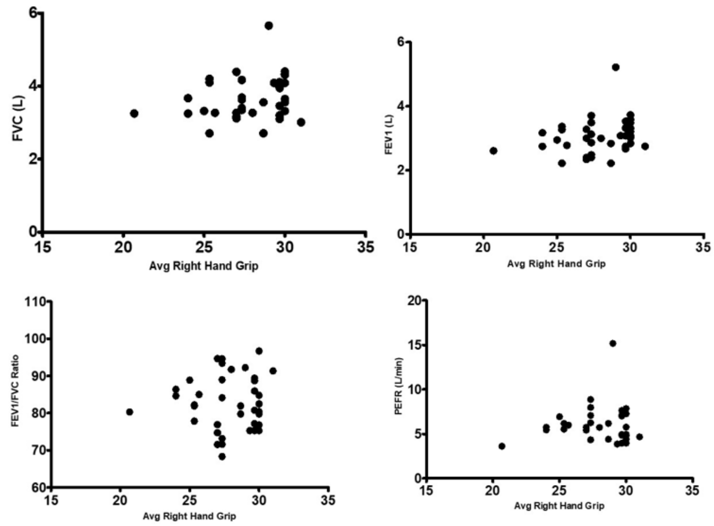

Figure 1: Correlation between Average Right Hand Grip Strength and Lung Function Parameters

Discussion

Our survey revealed that the majority of participants were young adults, with 43.33% aged 21–25 years, 36.67% aged 20 or younger, and 20% aged 26–30. This aligns with prior research, such as Alajam et al. (2024) who found a mean age of 21.72 years, and Azmi et al. (2021) with a mean age of 22.09 years.[20,21] Bhattacharjya et al. (2022) noted a strong positive correlation between handgrip strength and pulmonary function in healthy young adults.[22] Mgbemena et al. (2019) also highlighted that this demographic is optimal for studying the link between muscle strength and lung function.[4] Comparatively, older demographics (Deng et al. 2025 and Chen et al. 2020) showed declines in muscle strength and respiratory performance, reinforcing that younger age groups maintain better muscle and lung function.[12,23]

Our study identified a significant male predominance, with males comprising 88.33% and females 11.67%. This gender imbalance affects handgrip strength and pulmonary function, as prior research indicates men generally exhibit greater metrics. For example, Deng et al. (2025) noted average handgrip strengths of 40.2 kg for men compared to 24.4 kg for women ($p < 0.001$).[23] Males were also taller (169.5 cm vs. 156.3 cm) and heavier (70.2 kg vs. 56.0 kg), contributing to superior grip strength and lung capacity. Supporting studies by Mgbemena et al. (2019) and Smith et al. (2018) also document higher strength and lung function in males, highlighting the importance of gender-related differences in body composition and hormonal profiles in these outcomes.[4,18]

The study analyzed 30 participants, revealing that 50% had a normal BMI, 28.33% were overweight, 16.67% were underweight, and 5% were obese. This distribution suggests a predominantly healthy dietary profile, which is crucial as body mass can influence handgrip strength and respiratory function. Notably, a sex-based disparity was observed, with more males classified as overweight and more females as underweight ($\chi^2 = 78.85$, $p < 0.001$). The mean BMI was consistent with previous studies, showing alignment with Deng et al. (2025) and Alajam et al. (2024).[20,21,23] Healthy BMI ranges were linked to better respiratory mechanics, indicating a clearer relationship between handgrip strength and lung function due to a lower incidence of extreme BMI categories among participants.

Our study involved 30 participants, with 50% classified as having a normal BMI, 28.33% overweight, 16.67% underweight, and 5% obese. The majority showed a healthy dietary profile, important since body mass affects handgrip strength and respiratory function. Results mirrored findings by Deng et al. (2025), who reported 60.8% normal BMI, 34.3% overweight, and sex-based disparities in BMI categories. Correspondingly, mean BMI values were reported by Deng et al. (23.8 kg/m²) and Alajam et al. (24.4 kg/m²).[21,23] Our findings suggest a clear link between handgrip strength and lung function, with minimal interference from nutritional issues, supporting the importance of maintaining a normal BMI for health.

The study determined that the mean handgrip strength was 27.92 kg for the dominant right hand, with a range of 20.67 kg to 31.00 kg, and 27.39 kg for the non-dominant left hand, ranging from 20.33 kg to 30.33 kg. Comparison between both hands showed a marginally higher strength in the dominant hand (27.92 ± 2.26 kg) compared to the non-dominant (27.39

± 2.24 kg), though this difference was not statistically significant ($t = 1.28$, $p = 0.202$). Although the dominant hand typically showed greater strength, the overall grip strength between both hands was relatively similar. These results align with previous literature, though the absolute values observed were lower than those in male-dominant populations, such as the

34.1 ± 9.5 kg reported by Deng et al. (2025), where men had notably higher strength (40.2 ± 6.1 kg) compared to women (24.4 ± 4.4 kg).[23] Alajam et al. (2024) also noted a dominant hand strength of 33.37 ± 7.76 kg and a non-dominant strength of 31.38 ± 6.15 kg.[21] Differences in grip strength are typically linked to muscle mass, hormonal differences, occupational tasks, and the habitual use of the dominant hand. The lower average values in the current study may be attributed to factors such as body size, ethnicity, sex distribution, and methodological variations. Overall, the study concludes that handgrip strength is symmetrical between hands and relevant for examining its relationship with lung function.

Our study measured Forced Vital Capacity (FVC) at a mean of 3.71 ± 0.59 liters (range: 2.71 to 5.66 liters), with an average Forced Expiratory Volume in one second (FEV_1) of 3.06 ± 0.59 liters, yielding a FEV_1/FVC ratio of 82.30 ± 7.29%. This indicates normal expiratory airflow in most subjects. The Peak Expiratory Flow Rate (PEFR) averaged 6.14 ± 2.15 L/min, displaying notable variability. Our findings are consistent with previous studies, such as Alajam et al. (2024), which reported mean vital capacity (VC) at 3.66 ± 0.70 L, FVC at 3.54 ± 0.49 L, and FEV_1 at 3.43 ± 0.47 L, confirming typical lung volumes in healthy young individuals.[21] Additional research indicates variations in pulmonary function by sex and body size, as noted by Mgbemena et al. (2019), and a consistent increase in spirometric volumes linked to grip strength in German teenagers, as observed by Smith et al. (2018). Age-related decreases in FVC and FEV were identified by Chen et al. (2020), while Kim et al. (2023) highlighted superior lung function in middle-aged adults compared to older populations.[4,12,15,18] Overall, our results support the conclusion that healthy young adults maintain adequate lung function, setting the stage for further exploration of the correlation between lung function and handgrip strength.

Our study revealed a robust positive correlation between average right-hand grip strength and both Forced Vital Capacity (FVC) ($r = 0.305$, $p = 0.018$) and Forced Expiratory Volume in one second (FEV_1) ($r = 0.285$, $p = 0.027$). In contrast, relationships with the FEV_1/FVC ratio ($r = 0.073$, $p = 0.578$) and Peak Expiratory Flow Rate (PEFR) ($r = 0.118$, $p = 0.368$) were not statistically significant. Participants with greater dominant handgrip strength exhibited higher lung volumes and improved expiratory performance, specifically reflected in FVC and FEV_1, although this connection did not extend significantly to airflow ratio or peak flow within our sample. These results are consistent with previous research. Alajam et al. (2024) reported significant positive correlations between dominant handgrip strength and Vital Capacity (VC) ($r = 0.47$, $p < 0.001$), FVC ($r = 0.55$, $p < 0.001$), and FEV_1 ($r = 0.56$, $p < 0.001$), remaining significant after adjustments for BMI, smoking, and physical activity.[21] Similarly, Mgbemena et al. (2019) found strong positive correlations in healthy young adults, especially for FEV_1.[4] Smith et al. (2018) identified that each additional kilogram of grip strength significantly improved FEV_1 and FVC in healthy adolescents.[18] Zhao et al. (2023) employed Mendelian randomization to confirm a favorable causal relationship between right-hand grip strength and both FVC and FEV_1, omitting the FEV_1/FVC ratio.[24] Han et al. (2018) also noted significant associations between handgrip strength and the same lung function parameters after adjustments.[25] Therefore, our findings strongly suggest that dominant handgrip strength serves as an indicator of overall muscular fitness, associated positively with enhanced lung volume performance, albeit with minimal or no connection to the FEV_1/FVC ratio in healthy individuals.

This study indicates a strong positive correlation between average left-hand grip strength and pulmonary function metrics, particularly forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1), with correlation coefficients of $r = 0.479$ ($p < 0.001$) and $r = 0.419$ ($p = 0.001$), respectively. However, no significant correlation was identified with the FEV_1/FVC ratio and peak expiratory flow rate (PEFR). The results corroborate previous research by Alajam et al. (2024), who reported significant positive correlations between non-dominant handgrip strength and vital capacity (VC), FVC, and FEV_1. Notably, the correlation remained robust after adjustments.[21] Further corroboration comes from Alajam (2025) and Zhao et al. (2023), both of whom found significant associations between left-hand grip strength and FVC/FEV_1 without similar findings for the FEV_1/FVC ratio.[21,24] Ja'afar et al. (2023) reported a moderate positive association between non-dominant handgrip strength and lung function metrics, emphasizing the strength of this relationship.[13] Collectively, these findings suggest that both non-dominant and dominant handgrip strength may serve as practical surrogate indicators of pulmonary function, especially for FVC and FEV_1.[4]

Our investigation found no significant correlation between right-hand or left-hand grip strength and the FEV_1/FVC ratio, a conclusion supported by prior studies. Notably, research by Deng et al. (2025) indicated that while there is a negative or inconsistent link between handgrip strength and the FEV_1/FVC ratio, the correlation is stronger with FVC than FEV_1, which may explain the absence of a distinct positive connection with the ratio.[23] Similarly, Zhao et al. (2023) and Noji et al. (2024) reported no significant correlations in their respective studies.[24,26] However, some research, including that of Han et al. (2018) and Kumar et al. (2025), showed a relationship between grip strength and PEFR, suggesting that such correlations may vary based on factors like age, health status, and sample size.[8,25] Importantly, the lack of significant correlation between the FEV_1/FVC ratio and PEFR does not detract from the main conclusion: handgrip strength may be a more reliable indicator of lung volume and respiratory muscle function than airway obstruction or peak expiratory effort.

The study presents several limitations that affect its findings. Firstly, the small sample size of 60 individuals restricts the generalizability of the results. The population was predominantly male, with very few female participants, which might skew measurements related to handgrip strength and lung function. Additionally, the research centered on seemingly healthy young adults within a specific age range, thus limiting its applicability to children, older adults, or those with chronic conditions. Furthermore, key lifestyle factors such as physical activity, nutrition, and occupational activities were not thoroughly examined, which could influence both muscle strength and pulmonary function. Finally, the cross-sectional design of the study does not permit the establishment of a causal relationship between handgrip strength and lung function.

Conclusion:

This study concluded that handgrip strength shows a significant positive association with important pulmonary function parameters, particularly Forced Vital Capacity (FVC) and

Forced Expiratory Volume in one second (FEV_1), among healthy young adults. The participants demonstrated normal spirometric values and comparable strength between dominant and non-dominant hands. The absence of major confounding factors such as smoking, alcohol use, or chronic illness strengthened the observed relationship. Handgrip strength assessment, being simple, inexpensive, and non-invasive, may serve as a useful indicator of respiratory fitness and overall muscular health. Maintaining adequate muscle strength may contribute to better pulmonary performance and general well-being.

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