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ORIGINAL ARTICLE

Potential predictor of pulmonary health in collegiate staff: A Correlational study

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ABSTRACT
Hand grip strength serves as a significant indicator of poor physical performance. Limited information exists regarding the correlation between hand grip strength &lung function in teachers and administrative staff. The purpose of the undertaken research was to establish the relationship between hand grip strength & pulmonary function tests (PFT) amid both teaching and non-teaching personnel within a collegiate setting. For this correlational study, a total of 60 participants were selected through convenience sampling. They were divided into two groups: Group 1 consisting of teaching staff and Group 2 comprising administrative staff. The selection of participants for each group was based on specific inclusion and exclusion criteria. Prior to data collection, informed consent was obtained from all participants, and their demographic information was recorded. Baseline assessments were conducted as well. Pulmonary function tests (PFT) were administered to all participants, and hand grip strength was measured. The collected data were analyzed using SPSS version 24. In Group-1(Teaching staff), hand grip strength of right hand shows positive correlation with FVC (p= 0.017), FEV1 (p=0.019) and also with PEFR (p= <0.05) and hand grip strength of left hand shows positive correlation with FVC, FEV1 & PEFR with p- value < 0.05 in all the three variables. In Group- 2(Administrative staff), hand grip strength of right hand does not show significant correlation with FVC (p= o.13), FEV1 (p=0.125), whereas Hand grip strength of right hand shows positive correlation with PEFR (p= < 0.05). Hand Grip Strength of left hand does not show any significant correlation with FVC (p=0.177), FEV1 (p=0.157) & PEFR (p= 0.151). Handgrip strength seems to appear a potential predictor of pulmonary health in collegiate staff.
KEYWORDS*- Respiratory functions, Pulmonary health, Hand grip strength, collegiate staff, teaching staff*

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INTRODUCTION

Grip strength refers to the coordinated contraction of muscles during a single muscle contraction. It is a reliable and objective measure used to assess the functional capability of the hand within the musculoskeletal system. A hand dynamometer can be used to quantify grip strength by measuring the amount of static force the hand can exert when squeezing the dynamometer [1].

Reduced hand grip strength is often observed in individuals with upper extremity musculoskeletal disorders (MSDs), which can be caused by factors such as decreased bone mineral density, poor nutrition, or underlying musculoskeletal pathologies. Lower grip strength serves as an important indicator of impaired physical performance [2].

In recent years, upper extremity MSDs have become a significant cause of disability, resulting in increased healthcare costs and higher rates of work absenteeism among the working population. Occupational factors such as repetitive tasks, excessive physical load, awkward working postures, inadequate rest, and exposure to hand-arm vibration have been linked to the onset of upper extremity MSDs [1].

Studies on the prevalence of MSDs among teachers have reported rates ranging from 12% to 84%. Various predictors of MSDs across different occupations have identified work involving strenuous effort, heavy lifting, uncomfortable positions, and repetitive tasks as contributing factors to MSDs among workers [1]. Given the diverse range of activities and responsibilities, teachers are also susceptible to physical and emotional factors that contribute to MSDs [2]. Physical factors such as exertion, prolonged maintenance of static or awkward positions (sitting or standing), repetitive actions, working with hands elevated for extended periods, and frequent lifting of heavy objects have been strongly associated with neck and shoulder pain among teachers. These factors possess biomechanical characteristics that make them potential risk factors for MSDs [3,4]. Additionally, prolonged standing, poor sitting posture, and activities like carrying papers and books, moving equipment, and walking both inside and outside the building may also impact the occurrence of MSDs [3].

PFTs encompass a range of tests that measure different parameters, such as spirometry, which assesses lung volume and airflow; diffusion capacity, which evaluates the transfer of gases across the lungs; and lung volume measurements, which provide insights into the total lung capacity and residual volume. By performing PFTs, healthcare professionals can gain valuable insights into the overall function and health of the respiratory system. These tests aid in the diagnosis, staging, and monitoring of respiratory conditions such as chronic obstructive pulmonary disease (COPD), asthma, interstitial lung diseases, and pulmonary vascular disorders. They also help in evaluating treatment effectiveness and guiding therapeutic interventions [5].

In addition to being linked to respiratory problems like bronchitis and pneumonia, impaired pulmonary function is also linked to cardiovascular disease and overall mortality. Reduced lung function is strongly linked to an increased risk of cardiovascular conditions like coronary artery disease, heart failure, and stroke, according to research. Moreover, weakened pneumonic capability has been recognized as a critical indicator of all-cause mortality, demonstrating its importance as an overall wellbeing marker. As a result, determining who is at risk for various respiratory and cardiovascular disorders as well as overall mortality necessitates assessing and monitoring pulmonary function [6, 7]. A respiratory response can be elicited by prolonged isometric contractions of a small muscle, such as the finger flexors during hand gripping. Ventilation (breathing rate) and oxygen consumption have been shown to rise during these contractions, particularly when they are performed at around 40 percent of maximum voluntary contraction (MVC). As a result, the respiratory system is working overtime to supply more oxygen. Skeletal muscle mass naturally decreases with age, including the diaphragm and other respiratory muscles. The function of the respiratory system may be affected by this decrease in muscle mass and strength. In older people, diminished diaphragm muscle mass and strength may cause respiratory limitations and contribute to decreased respiratory efficiency. Understanding the connection between muscle capability, including respiratory muscles, and age-related changes is significant for evaluating respiratory wellbeing and tending to possible limits. Interventions and strategies for preserving older adults' respiratory muscle strength and function may emerge from additional research in this field [8].

Therefore, early identification of weak hand grip strength may help to identify changes in respiratory functions with the help of non-invasive, inexpensive method of assessing grip strength [9]. Early detection and recording of those who are very susceptible to compromised respiratory function are crucial from the standpoint of public health. In adults working in a range of industries, a growing corpus of epidemiological studies has shown a connection between handgrip strength and a number of detrimental health effects. This shows that assessing a person's grip strength might be a valuable way to assess their general health and spot possible health problems in different groups.

Prior studies have focused on people in hospital or nursing home settings or with small participant populations to evaluate the connection between handgrip strength and pulmonary function [10,11]. The relationship between handgrip strength and pulmonary function, especially in teachers, is, nevertheless, little understood. In order to fully understand this link in the context of the professional pressures placed on teachers and any potential consequences for their respiratory health, more research is required.

MATERIAL AND METHODS

This correlational study adhered to national ethical guidelines for biomedical and health research, including the Indian Council of Medical Research (2017) & Declaration of Helsinki (2013) guidelines for human subjects. A total of 60 participants residing in Delhi were recruited through convenience sampling and randomly allocated to either group 1 (Teaching) or group 2 (Administrative staff) according to predefined selectionstandards. The research & ethics committee of the institute granted ethical clearance for the study.

The inclusion criteria encompassed participants aged between 20 and 50 years, both males and females, with a normal BMI (Asian), employed as school teachers or administrative staff, working for a minimum of 5 hours per day, and having at least 2 years of experience in their respective roles. On the other hand, individuals with a history of surgeries in specific regions, the use of upper limb orthotic-devices or

prosthesis, any medical conditions or respiratory, neurological, musculoskeletal, or cardiovascular disorders, as well as those with upper limb or chest injuries or fractures, were excluded from the study.
Before participating, written informed consent was obtained from each participant, providing a clear explanation of the study's purpose, relevance, and voluntary nature. Demographic details and baseline assessments were recorded. Pulmonary function tests were conducted using the RMS Helios-401 Model, a handheld apparatus with a turbine transducer connected to a detachable mouthpiece. The pulses produced were seized by a transducer, augmented, and then communicated to a micro-controller for imaging on a connected PC. To facilitate the measurements, additional instruments such as a weighing machine, stadio-meter, and disposable mouthpieces were used for maintaining hygiene. The study involved the assessment of forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and peak expiratory flow (PEFR).
Hand grip-strength was assessedby a dynamometer. Participants' dominance was recorded, and they were instructed to sit restfully on a chair lacking armrests, keeping their gleno-humeral joints in adduction to the side of the body, elbows flexed at a 90-degree angle, and forearms and wrists in a neutral and supinated position. The dynamometer was placed in their hand, and they were asked to squeeze it, ensuring that the squeeze phase did not exceed 6 seconds. Three readings for each hand were recorded, and the mean grip strength value was calculated for each participant.
Data access was accomplished using Microsoft Excel 2010, & statistical analysis was steered using SPSS version 24 software. Descriptive statistics were used to analyze the demographic profile, respiration variables, & hand grip-strength in both group 1 and group 2. The relationshipamid hand grip-strength & respiratory variables was examined using descriptive analysis and the Karl Pearson correlation coefficient.

RESULTS
A total of 60 participants (Males (n=32); females (n=28)) were recruited for the study. Homo-genicity between both groups was maintained (Refer to Table 1). Mean and Standard deviation of all variables are shown in Table 2. In Group-1(Teaching staff) Hand grip strength of right hand shows positive correlation with FVC (p= 0.017), FEV1 (p=0.019) and also with PEFR (p= <0.05) and hand grip strength of left hand shows positive correlation with FVC, FEV1 & PEFR with p- value < 0.05 in all the three variables. In Group- 2, the hand grip strength of right hand does not show significant correlation with FVC (p= o.13), FEV1 (p=0.125), whereas Hand grip strength of right hand shows positive correlation with PEFR (p= < 0.05). Hand Grip Strength of left hand does not show any significant correlation with FVC (p=0.177), FEV1 (p=0.157) & PEFR (p= 0.151) (Refer to Table3).

	Group 1 (Mean±SD)	Group 2 (Mean±SD)
AGE(YEARS)	37.27±7.625	34.17±6.176
HEIGHT(m)	1.62±0.07	1.66±0.008
WEIGHT(kg)	64.84±5.69	64.54±8.26
BMI	24.67±1.83	23.52±2.40

Table 1(Mean and SD of age, height, weight and BMI in both groups)

Variables	Group 1(Mean±SD)	Group 2(Mean±SD)
FVC	2.81±0.58	3.05±0.51
FEV1	2.50±0.69	2.92±0.46
PEFR	4.79±1.51	6.24±1.36
HGS mean (Rt)	22.92±7.24	27.24±8.19
HGS mean (Lt)	21.90±7.56	25.00±8.37

Table 2(Descriptive statistics of variables in Group 1 and Group 2)

		Group1			Group 2		
		FVC	FEV1	PEFR	FVC	FEV1	PEFR
HGS mean (Rt)	Karl Pearson Correlation	0.431*	0.425*	0.396*	0.282	0.287	0.364*
	P value	0.017	0.019	0.030	0.131	0.125	0.048
HGS mean (Lt)	Karl Pearson Correlation	0.393*	0.374*	0.384*	0.253	0.265	0.269
	P value	0.032	0.042	0.036	0.177	0.157	0.151

Table 3 (Correlation between Handgrip and respiratory variables Group 1 and Group 2)

DISCUSSION

This study aimed to investigate the association between respiratory functions (FEV1, FVC, and PEFR) and hand grip strength (HGS) in teaching and non-teaching staff. The results showed that the right hand grip strength exhibited a positive correlation with FVC ($p=0.017$), FEV1 ($p=0.019$), and PEFR ($p<0.05$) in the teaching staff. In the administrative staff, the right hand grip strength showed a significant correlation only with PEFR ($p<0.05$). However, the left hand grip strength did not show a significant correlation with any of the respiratory function parameters in either group. The analysis indicated that HGS could be a significant predictor of respiratory parameters in this population.

As per our data search of the previous studies, no past review has analysed the association amid HGS and respiratory capabilities explicitly in educating and non-educating staff. According to the interpretation of the study's results, HGS can be used to predict lung function indices without relying on anthropometric parameters in settings where resources for spirometry assessment of lung function may be limited.

The significant association observed between lung function parameters and HGS aligns with previous research [11-15], which has highlighted the strong associationamid skeletal muscle power& respiratory muscle power. Lung function measures are thought to explain the relation-shipamid overall muscle power&impermanence. Reduced physical activity and age-related decline in pulmonary muscle strength contribute to decreased mobility and further reductions in respiratory muscle strength [16, 17]. The diagnostic criteria for chronic obstructive pulmonary disease (COPD), such as FVC and FEV1, mirrorlungefficiencyother than respiratory muscle power [14]. One study found a positive association between hand grip strength and larger FEV1 in men but not in women, indicating variations in PEFR among participants [11]. Women with low hand grip strength exhibited reduced PEFR, possibly attributed to increased parenchymal compliance.

However, it is important to note that a study conducted on older males in nursing homes did not find a significant association between hand grip strength (HGS) and lung function [10]. This discrepancy in findings could be attributed to factors such as a smaller sample size, advanced age of the participants, and a predominantly sedentary lifestyle among them. Additionally, the observed moderate to small correlations between HGS and the percentage prediction of lung function measures (such as FEV1 and FVC) may have been influenced by the use of prediction equations for estimating lung function. Further research with larger and more diverse populations, considering factors such as physical activity levels and lifestyle, is warranted to gain a better understanding of the relationship between HGS and lung function in different contexts [15-17].

It is important to acknowledge certain limitations of the study, including the participants' limited experience with spirometry and the small sample size. Factors such as physical activity and ethnicity, known to influence lung function, were not taken into account. Future studies could benefit from larger and more diverse participant groups, encompassing different age ranges, occupations, and variables related to lung function. Examining the relationship between hand grip strength (HGS) and lung function in conjunction with factors like physical activity levels could provide a better understanding of the connection. Despite these limitations, the study's practical implications and benefits outweigh them, offering valuable insights into estimating lung function in educators through a simpler and more objective test like HGS, rather than relying solely on anthropometric measurements. Moreover, enhancing distal muscle strength, particularly hand grip, may have potential benefits for improving respiratory capacities in teachers and vice versa.

CONCLUSION

The present study came to the conclusion that grip strength is a significant indicator of lung function in various occupations. Teaching staff members have a significant correlation between handgrip strength and respiratory functions, whereas non-teaching staff members do not. As a result, the utilization of a simple, inexpensive, and non-invasive HGS test in a low- to middle-income country like India could improve medical practice by serving as an indicator of various populations' lung function status. Likewise, strengthening upper limb muscles, especially hand grasp, may assist with working on the respiratory capabilities as well as the other way around in educators.

Conflict of Interests: NIL.

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