RESEARCH ARTICLE

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Co-Relation of Grip Strength and Inspiratory Pressure in Preterm School Going Children

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Abstract

Objective: To determine the correlation of grip strength and inspiratory pressure in preterm school-going children using a Jamar dynamometer and a U tube manometer. **Relevance:** Inspiratory pressure is a negative pressure that is generated during inhalation. Gripstrength measurement is easier to check in children, faster, requires minimal equipment. The correlation of maximum inspiratory pressure and gripstrength was already found to be correlated in middle aged individual's for critically ill patients and who were difficult to wean off. Hence to function as a source of information for further studies on the preterm population the study is aimed to find a relationship between inspiratory pressure and gripstrength in preterm school going children. **Method:** A cross sectional observational study done in 52 children, were recruited by probability sampling and were included by inclusion and exclusion criteria. A U-tube manometer was used to measure each person's maximum inspiratory pressure and a Jamar dynamometer to assess the grip strength. **Analysis:** To evaluate the mean and standard deviation of the corresponding groups, descriptive statistics were performed. Spearman's rank correlation coefficient was used to find out the correlation between the variables. **Results:** It shows a strong correlation between chronological age and Gripstrength using the Spearman's rank correlation coefficient. There is significant correlation between inspiratory pressure and grip strength by Spearman's rank correlation coefficient (p=0.0021).

Major Findings: The results showed significant correlation between grip strength and inspiratory pressure of preterm school going children.

Keywords: Gripstrength, Maximum Inspiratory Pressure, Preterm

1. Introduction

Inspiratory pressure is a negative pressure that is generated during inhalation. Inspiratory pressure suggests the muscle strength of the inspiratory muscles and ventilatory reserve.

Maximum inspiratory pressure is one of the common ways to evaluate the strength of the muscles of inhalation and it is also used to know the combined force generation capacity of inspiration muscles.

Inspiratory pressure is also considered as equal to the strength of the peripheral muscles[1]. As inspiratory muscle strength is measured it also tells the ability of the patients to reverse *atelectas* is and to cough effectively which is also correlated with maximum inspiratory pressure[2-4]. Inspiratory pressure has been used to measure inspiratory muscle strength in various clinical settings[5].According to medical research council there was correlation of the inspiratory pressure and the following muscles which are shoulder abductors, elbow flexors, wrist extensors, hip flexors, knee extensors and ankle dorsiflexors[6]. Maximum inspiratory pressure could be underestimated with a underlying upper respiratory pathology and later can cause inconveniences[6]. Inspiratory muscle strength is correlated with the strength of the peripheral muscles and also grip strength and has been established in adults[7]. Grip strength measurement is easier to be check in children and faster and requires minimal equipment and can be done in a single trial. That is, it can be done in one step rather the inspiratory pressure measurement requires to

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be done for three trials which may not be possible in all the clinical settings or in an intensive care unit.

Grip strength is a helpful measurement that can be utilized as a general indication of overall strength and health out comes in adults[8].

The maximum inspiratory pressure and grip strength was found to be correlated in middle aged individuals who were critically ill and were difficult to wean off, the correlation stems from age-related changes in muscle strength, physiological factors, the interdependence of peripheral and respiratory muscles, and individual health status[6].

There is a larger population of preterm children in early childhood and adult hood having impairment in spirometry and an increased risk of respiratory infection. They have reduced lung function which has not been much researched in later life[9-10]. Although lung functions are reduced in preterm children there is a lack of knowledge of their lung functions in laterlife[9].

Premature birth can lead to long-term lung problems in later childhood, including reduced lung function, chronic respiratory conditions, and an increased risk of asthma. Even those born late preterm (33-36 weeks) may experience breathing difficulties later in life, but there are very few studies.

The previous studies state that, there has been correlation of grip strength and inspiratory pressure in normal children, but preterm population being a large population and it has been not proven in them.

Hence to serve as reference research for the future studies for the preterm population the study is aimed to find a correlation between inspiratory pressure and grip strength in preterm school going children.

2. Methodology

A cross sectional observational study was conducted in schools of Belagavi city.Ethical clearance was obtained from institutional ethical committee. The study has been approved by the KLE Institute of Physiotherapy Institutional Ethical Committee Sr.no.793 and the study has been registered under the Clinical Trial Registry of India(CTRI). The CTRI number for the trial is CTRI/2023/04/051332-[Registeredon:23/10/2023]. List of schools in Belagavi city was obtained from DDPI and computerized randomization was done. To conduct the study permission was taken from school higher authorities.

Survey was done by providing slips to collect information about the child's birth history, gestational history, demographic details, and any medical history. School principal and teachers were explained about the procedure, on the scheduled day the researcher will collect the slips and children will be either included or excluded from the study based on the inclusion and exclusion criteria.

The parents of the participants were then explained about the nature of the study. An informed written consent was obtained from all parents who allowed their child to participate in the study and an informed oral assent from the child, then children were made to perform the tests.

A total of 52 participants were screened from schools by providing them screening slips which included the gestational age and was asked to be filled by their parents once the preterm children were screened. The children were included in the study if their gestational age was <37 weeks, if the age was 8-12 years, if they were hospitalized after birth, preterm school going children whose parents gave consent for participation. The children were excluded from the study if they had hearing and visual impairment, medically diagnosed neurological conditions. Such as cerebral palsy, physical disabilities, or any deteriorating conditions, musculoskeletal problems like fractures, any surgeries, pain, or trauma in the past 3 months, any congenital deformities, diagnosed cardiorespiratory conditions. The children were recruited in the study by the purposive sampling method.

3. Procedure for Testing

3.1 Gripstrength Using Jamar Dynamometer

The participants sit upright where their feet should be supported. The arm which is supposed to be tested was on the table, the shoulder in slight abduction and neutral rotation. The elbow is flexed at ninety degree and wrist resting on the table. The participants are asked to maintain this position. Each participant is asked to grip the dynamometer three times, firstly with the dominant hand and then with the non-dominant hand. Give rest of 30s after each trail. They were given a command of pressing the dynamometer for 2-3 sec verbally telling them to "squeeze as hard as you can."

3.2 Maximum Inspiratory Pressure Using a U tube Manometer

The participants will be asked to sit upright with their feet supported. The manometer will be kept on a stable surface and will be given one end of the tube with a mouth piece and ask the subject to exhale completely and then inhale as deep as they can and with one minute of break they will be asked to repeat the same for 2 time and the best out of the three will be taken. It will be seen that there is no fatigue while performing the test.

Statistical Analysis done by the software SPSS26.0 (SPSSInc., Chicago,IL) where the level of significance was pre-set to p<0.05. Descriptive statistics was performed to assess the mean and standard deviation of the respective groups. To check if the data was Normally distributed Kolmogorov Smirnov test was done. Spear man's rank correlation coefficient test help to find out the correlation between the variables.

4. Results

The descriptive analysis showed that, Out of 52 participants 34 were boys and 18 were girls, there were 65.38% of male participants in the study with the mean chronological age of 9.94 years with +1.13SD, there were 34.62% female participants participated in the study. The mean chronological age is 9.83years+1.04SD (Table 1). The mean height of males was 131.17cm+7.20 SD and mean height for females is 130.21cm+9.27SD. The mean weight of males was 27.44kg+4.13 SD and mean weight for females is 26.30cm+4.93SD. (Table 2). There is no significant correlation between the gender with the gestational age, Grip Strength and Inspiratory Pressure.

It shows strong correlation between Chronological age(p=0.006) and Grip Strength but there is no statistically significance seen in the correlation of grip strength with the Gestational Ageand BMI (Table 3). There is no significant correlation between Gestational age, Chronological Age and BMI with inspiratory pressure. There is significant correlation between Inspiratory Pressure and Grip Strength by (p=0.0021) (Table 4).

Table1. Distribution of patients according to gender

Gender	No of Patients	% of Patients
Male	18	34.62
Female	34	65.38
Total	52	100.00

Table 2. Comparison of male and female with mean age, gestational age and BMI by independent t test

Variables	Male		Female		t-value	p-value
	Mean	SD	Mean	SD		
Chronological Age	9.94	1.13	9.83	1.04	0.3594	0.7208
Height (cm)	131.17	7.20	130.21	9.27	0.3823	0.7038
Weight (kg)	27.44	4.13	26.30	4.93	0.8395	0.4052
BMI	15.93	2.43	15.44	2.23	0.7257	0.4714

Table 3. Correlation between age, gestational age and BMI with grip strength (in kgs) by Spearman's rank correlation coefficient

Variables	Correlation between Grip Strength (in kgs) with			
	N	Spearman R	t-value	p-value
Chronological age	52	0.3763	2.8721	0.0060*
Gestational age	52	0.0262	0.1852	0.8538
BMI	52	0.0909	0.6455	0.5216

*p<0.05

Table 4. Correlation between inspiratory pressure (In cmH_2O) and grip strength (in kgs) by Spearman's rank correlation coefficient

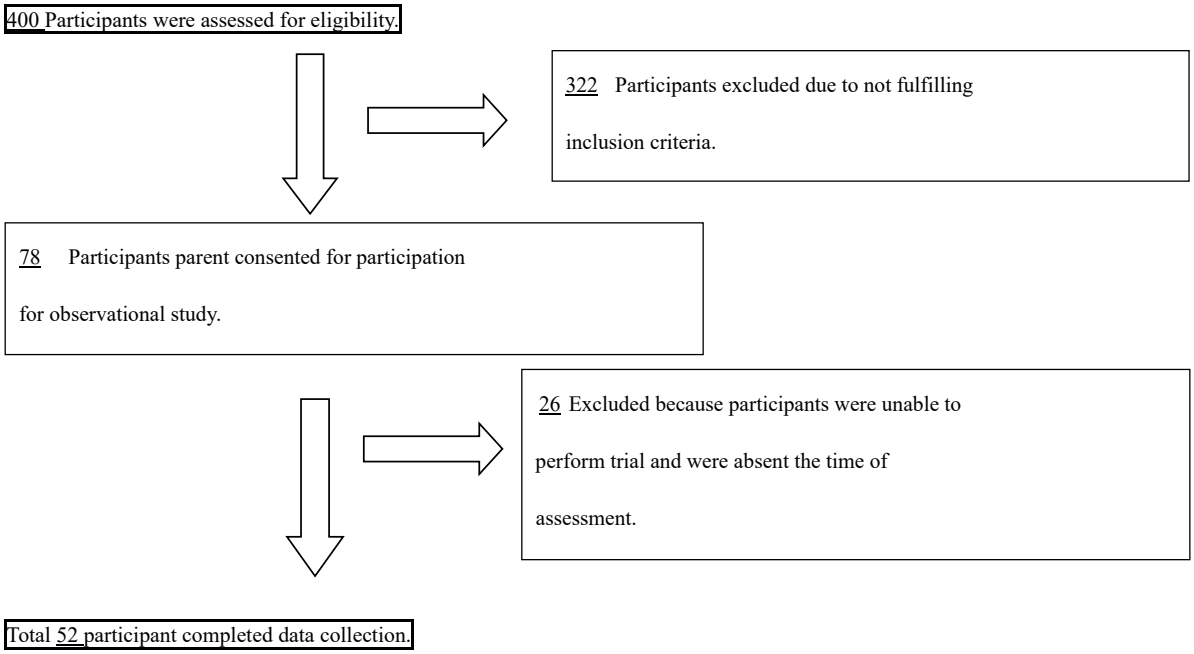
Variables	Correlation between Inspiratory Pressure (in cmH2O) with			
	N	Spearman R	t-value	p-value
Grip strength (in kgs)	52	-0.4172	-3.2459	0.0021*

*p<0.05

5. Discussion

The results of the research can be summed up as firstly these was significant correlation between Inspiratory Pressure and Grip Strength of preterm school going children, the value of Inspiratory pressure can be predicted by the Grip Strength. As there is significant correlation between the two the Inspiratory pressure can be assessed by the assessment of Grip strength. The Grip strength can be predicted by Chronological age of the child. Grip strength is a simple tool to measure strength of the breathing muscles among the participants in the study as well as used in projecting the Inspiratory Pressure. Given the strong association between the previously mentioned prediction grip Strength and Inspiratory pressure, where Chronological age has an important contribution to this

Flow Chart



correlation, which increases the likelihood of the age and the body structure, affecting the functioning of the lungs.

This similar relationship was also seen in a previous study done where there was strong correlation of the sex, BMI and Gripstrength[7].

The association of the grip strength with the musculature was also seen in a study done in previous research demonstrating a strong correlation (corresponding r values of 0.75 and 0.68) between grip strength and the quadriceps muscle, peripheral muscles and diaphragm function introduced the relationship between the peripheral muscles and the respiratory muscles[11]. A study found that the strength of the grip can be evaluated in COPD in patients whose condition is progressing and are older participants but two other studies found that checking of the grip strength is a useful, tool in evaluating ICU patients respiratory muscle strength[12].

Assessing hand grip strength is the first force indicator in an ICU patient, where a patient must perform after coming out of sedation. It gives us immediate information regarding the patient's physical and mental state and is a very simple, quick, and affordable to use. Usually in cases of neuromuscular disorders, respiratory pressure is a helpful indicator for monitoring the development of the respiratory system. However, measuring respiratory pressure requires cooperation from the patient or the child and can be difficult at times.

Our study contains a few limitations that is there is lack of generalizability of our results because the sample size was smaller which would be unrepresentative. Also, if to generalize these finding in the patients or children in ICU setting may not be possible, we also see that grip strength can offered at a for assessing the respiratory system in patients in the intensive care unit. Although the findings in this study are promising but more research on ICU patients is required to determine the prediction correlation of the Inspiratory pressure and grip strength in preterm children.

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