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Association between Anthropometry, Physical Activities and Pulmonary Function of the Teenagers

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ABSTRACT: *A cross-sectional, correlation study was conducted to eighty-three students from No. (1), Basic Education High School, Lammadaw Township, Yangon Region to examine the relationship between demographic characteristic, anthropometry and physical activities and pulmonary function among the teenagers. This study was assessed by using the research instruments such as physical activity questionnaire for older children (PAQ–C) and spirometer (Vitalograph) for measuring of pulmonary function parameters. Among 83 students, (50.6%) of students were male and (49.4%) of students were female. This study found that the pulmonary function was statistically significant with gender, BMI and physical activity (p<0.0.5) except age (p>0.05). FVC and FEV1 except ratio of FEV1/FVC was higher associated with gender (p <0.05). BMI was positively correlated with FVC (r = 0.320, p < 0.01) and FEV1 (r = 0.177, p < 0.05). FEV1 was positively correlated and statistically significant with overall physical activities (r = 0.227, p = < 0.01). This study found that more active students have higher pulmonary function parameters among the students. Therefore, the evidence from this study could be used to more upgrade the physical activity for the pulmonary function among teenager students at their school.*

KEYWORDS: *Anthropometry, Physical activities, Pulmonary functions, Teenagers*

I. Introduction

Healthy children enjoy and engage in physical activities. And physical activities, plays and exercises are one essential for their growth and development. Fitness in terms of stamina favors children, adolescents and teenagers to sustain in physical, intellectual and social performance. Fostering physical exercises and functional capacity of children and teens are crucial concerns in promoting and maintaining health and fitness of nation. Furthermore, the important of physical activity is to improve pulmonary function as well as to maintain normal body weight.

Anthropometry provides the single most portable, universally applicable, inexpensive and non-invasive technique for assessing the size, proportions and composition of the human body [1]. According to Kivastik, 2000, the age and height variables are considered good predictors of pulmonary function [2]. Woodruff and Duffield (2002) suggested that the association of anthropometric indices for Body Mass Index (BMI) with age and height are required to assess in adolescents in less-developed countries. The height of normal children and teenagers are expected to increases with age and corresponding development of pulmonary function [3]. Mohammed, Maiwada and Sumaila (2015) stated that anthropometric measurements are an important, widely applicable, noninvasive, and inexpensive technique for assessing body mass index (BMI) [4]. Woodruff and Duffield (2002) stated that Anthropometric indices in normally nourished adolescents are changing with age and sexual development [3]. Thus, the use of anthropometry may be more challenging to assess growth and development of adolescents than in other age groups.

Pulmonary function is governed by genetic, environment and nutritional factors. A child with low birth weight may further affect growth and development of a child including functional capacity of the lungs [5]. Another one of the major health issues around the world is obesity. The two main factors of affecting respiratory function in healthy teenagers are obesity and physical inactivity [6]. Furthermore, the factors that age, gender, height, weight, race or ethnicity, and possibly obesity are usually affected to the values of pulmonary function tests [7]. Physical exercise during growth is essential in developing a greater endurance in respiratory muscle [5].

Therefore, all of the teenagers need to do regular physical activities in their daily life to improve lung function as well as their health.

School Health Division is an essential part of Department of Public Health as well as school health nurse is a critical part of community health nurse. Teenagers group is part of the target in the Youth Health and Development Programme which strengthen linkages with other strategic plans such as reproductive health, food and nutrition, drug and substance abuse control, and HIV/STIs and so on [8]. These health promotion activities are focused to promote students' health. In addition, the education sector plays ownership role and the other sector provides support in nutrition promotion and food safety, and sports and physical activities [9]. Navcoya (2014) stated that "school health programme can be one of the most cost-effective investments [10] and WHO promotes it as a strategic means to prevent important health risks among youths."

Priority actions had been developed in National Health Plan (2011-2016) to prevent, control and reduce disease, disability and premature deaths from chronic non-communicable diseases and conditions. In Myanmar, according to the priority of leading cause of morbidity and mortality in 2011, the priority reveals an acute upper respiratory infection at 8th [8]. According to Yangon General Hospital annual report, the majority of infection of the respiratory system with patients were admitted between 2015 and 2016: the numbers of patients with ARI were 59 cases, the numbers of patients with asthma were 131 cases, and the numbers of patients with COPD were 545 in 2015 respectively. The numbers of patients with ARI were 262 cases, the numbers of patients with asthma were 187 cases, and the numbers of patients with COPD were 831 in 2016 respectively [11]. By reviewing of annual statistical report, the numbers of patients with respiratory tract diseases have dramatically increased in Myanmar annually.

One of the major NCDs includes chronic respiratory disorders. Among NCDs, it is stress related asthma that prevails among the teenagers in developed countries whereas asthma becomes a common disease worldwide. Prevalence of asthma was higher among children than adult between 2008 and 2010. Asthma prevalence increased (8.4%, 2.57 million) in 2010 compared to 7.3% in 2001 [12]. Chronic Obstructive Pulmonary Disease (COPD) is the third leading causes of death in the US [13]. Clinical diagnosis was based on a characteristic pattern of symptoms. Diagnosis of asthma ought to rely on a careful history followed by spirometry in practice [2]. In this study would be a trail to find out the relationship between the pulmonary function and BMI groups, and pulmonary functions results and physical activities of the teenagers. And then, the findings from this study could be used to build effective intervention efforts to improve pulmonary function for the Union Republic of Myanmar population and reduce disparities in lung function among teenagers. Furthermore, the purpose of this study aimed to describe the association between anthropometry, physical activities and pulmonary function of the teenagers. It is also hoped that the finding of this study will have to apply in further study by using basic data of respiratory function variables.

II. Methodology

2.1. Study Design. A cross-sectional, correlation study design was used to study the association between anthropometry, physical activities and pulmonary function of the teenagers.

2.2. Study Area. This study was conducted at the No. (1), Basic Education High School, Lammadaw Township, Yangon Region.

2.3. Sample Size. The formula of Daniel (1999) was used to obtain the sample size [14]. The study population was all of the teenager students between the 12 years and 15 years of age including both genders. For Inclusion Criteria, the teenager students were with the permission of their parents to participate in this study. For Exclusion Criteria, the students, who had history of respiratory symptoms within two weeks such as cough or sore throat, etc., were excluded in this study.

The required numbers of sample population 83 students were selected from the total students (214) by using simple random sampling method such as lottery method. There were total teenagers' students (214) who are attending at grade eight, nine, and ten of No. (1), Basic Education High School (B.E.H.S), Lammadaw, Yangon region. As (214) students are eligible, informed consent forms were sent to their parents via each student. Only (153) informed consent were obtained. 83 students were selected among the (153) students. Students who were absent on the day of data collection were deleted.

2.4. Data Collection Method and Procedure. Face to face interview was done by investigator by using questionnaires of physical activities for older children (PAQ-C). Then, weight and height were measured by the

investigator. Standing height was measured and recorded to the nearest 0.1 cm using a calibrated stadiometer of each student. Weight was measured and recorded to the nearest 0.1 kg in school clothing without footwear. BMI of each teenager was calculated. BMI of the teenagers were categorized into underweight (≤18.5 Kg/m^2), normal weight (18.5–24.9 Kg/m^2), overweight (25–29.9 Kg/m^2) and obesity (≥30 Kg/m^2) based on WHO classification (WHO, 2017). The research was conducted from February to September, 2017.

It was conducted in the morning in Assembly Hall of this school by using spirometer (Vitalograph) comprised 3-Liter Precision Syringe (Air Syringe) and In2itive device and PC, MODEL 2040, Ireland.. Pulmonary function measurements included: forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), and the ratio of FEV1 and FVC, in addition to the automatic evaluation done by the software device. Johnson and Theurer (2014) were defined that FVC, FEV1 and ratio of FEV1/FVC % predicted value for children from 5 to 18 years old were described as normal value of FVC and FEV1 % predicted value were more than 80 % predicted and normal value of ratio of FEV1/FVC % predicted value was more than 85 [15]. In this study, the % predicted value of FVC, FEV1 and ratio of FEV1/FVC were divided into three categories: equal and less than 97 % predicted value, 80 to 120 % predicted value, and equal and more than 121 % predicted value.

Each student was asked to involve in the test until three satisfactory measurements in reference to result illustrated on computer screen. According to ATS guidelines, three acceptable tests were obtained, recorded the best value by the spirometric software. All lung function values were sent to and reviewed by a respirologist (chest physician) for acceptability of the test. 40 students were tested for second round after reviewed by the chest physician. PFTs take approximately 15 minutes for adults, 15 to 30 minutes for children according to Johnson and Theurer (2014) and it was considered in pulmonary function test of the students. Students under the study took 10 to 30 minutes for successful measurement [15].

To ensure reliability and validity of the Questionnaires (PQA-C) and spirometer were tested among the 20 students in the grade eight of No. (4), Basic Education High School, AhLone Township, Yangon region. In this study, content validity of the questionnaire was 0.99 and reliability test was acceptable for both genders. Male was 0.80 and female was 0.83.

2.5. Data Analysis. Data entry and statistical analysis was done by using the Statistical Package for Social Sciences Software, SPSS version 16.0. For continuous data, mean and standard deviation were calculated and frequency and percentages were identified for categorical data. The association between demographic characteristic (age and gender) and pulmonary function of the teenagers was calculated by using Fisher's Exact test and Chi-Square test. The relationships between BMI and pulmonary function of the teenagers, and the relationships between physical activity and pulmonary function of the teenagers by Spearman's r were calculated. Burns and Grove (2009) were defined as the strength of the correlation such as $r < 0.3$ is considered as weak linear relationship, 0.3 to 0.5 is considered as moderate linear relationship $r > 0.5$ is considered as strong linear relationship. Significance was accepted for values of $p < 0.05$ in all tests [16].

III. Results

3.1. Demographic Characteristics of the Teenagers. A total of 83 teenagers under study including both genders as well as their age with youngest was 12 years old and the oldest was 15 years old. The commonest age of the respondents was 12 years that accounted for 45.78% (n=38), the lowest age of the respondents was 15 years that accounted for 3.61% (n=3), and medium age was thirteen years that accounted for 19.28% (n=16) and fourteenth years group accounted for 31.33% (n=26). Among them, 42 (50.60%) respondents were males and 41 (49.4%) respondents were female. Teenagers in this study comprised the students from grade eight (48.19%, n=40), from grade nine (13.25%, n=11), and from grade ten (38.56%, n=32) as shown in Table 1.

3.2. Anthropometry of the Teenagers. Body mass index (BMI) of the teenagers under study was varied as they varied in weight and height was described that the maximum height was 173 cm and the minimum height was 131 cm among the study population. Mean height was 153.72 and SD was 9.986. Additionally, the weight (Kg) of the respondents among study population varied from the lowest 26 Kg to the highest 97 Kg. Mean and SD were 45.40 and 13.765 respectively. Body mass index (BMI) of the respondents revealed that 43 students (51.81%) were found as underweight (≤18.5 Kg/m^2), 34 students (40.96%) were found as normal weight (18.5–24.9 Kg/m^2), 4 students (4.82%) were found to be overweight (25–29.9 Kg/m^2), and 2 students (2.41%) were found as obesity (≥30 Kg/m^2). The minimum BMI was 12.38 Kg/m^2 and maximum BMI was 33.22 Kg/m^2 in reference to the World Health Organization cutoff value indicated in Table 2.

		No of Students	Percentage (%)
Age	12 years	38	45.78
	13 years	16	19.28
	14 years	26	31.33
	15 years	3	3.61
Gender	Male	42	50.60
	Female	41	49.40
Grade	Eight	40	48.19
	Nine	11	13.25
	Ten	32	38.56

TABLE 1: Demographic Characteristics of the Teenagers (n=83)

TABLE 2: Height and Weight, and Body mass index (BMI) distribution of the Teenagers (n=83)

	Mean	**Standard Deviation**	**Minimum**	**Maximum**
Height (cm)	153.72	9.986	131	173
Weight (Kg)	45.40	13.765	26	97
Body mass index (BMI) of the Teenagers				
	No of Students	**Percentage (%)**		
Underweight (≤18.5)	43	51.81		
Normal weight (18.5–24.9)	34	40.96		
Overweight (25–29.9)	4	4.82		
obesity (≥30)	2	2.41		

3.3. Pulmonary Function of the Teenagers. Pulmonary function of the teenagers in terms of spirometric parameters (FVC, FEV1, and ratio of FEV1/FVC % predicted value) was described as Mean, SD, Minimum and Maximum. FVC revealed that 8 students (9.64 %) were found to be equal and less than 79; 68 students (81.93%) were found to be between 80 and 120; and 7 students (8.43%) were found to be equal and more than 121 among the respondents respectively. FEV1 revealed that (32.53%, 27 students) was found to be equal and less than 79 and equal and more than 121, and (60.24 %, 50 students) was found to be between 80 and 120 among respondents respectively. The ratio of levels FEV1/FVC of the respondents revealed that 4 students (4.82%) were found to be equal and less than 79, 79 students (95.18%) were found to be between 80 and 120, and no student was found to be equal and more than 121 among respondents.

Spirometric parameters among eighty-three respondents revealed that the highest % predicted value of FVC was one hundred and thirty-seven, and the lowest % predicted value of FVC was sixty-five. Mean and SD of FVC was 93.25 and 13.779. In addition, the maximum of FEV1 was one hundred and twenty-eight, the minimum of FEV1 was fifty-four, its' mean was 86. 23 and SD was 15. 422. And, the highest % predicted value of FEV1/ FVC ratio was one hundred and five, the lowest was seventy, mean was 92.52 and SD was 6.938 as summarized Table 3.

The levels of FVC of the respondents revealed that 8 students (9.64 %) was found to be equal and less than 79, 68 students (81.93 %) was found to be between 80 and 120, and 7 students (8.43%) was found to be equal and more than 121. In addition, levels of FEV1 showed that 27 students (32.53 %) were found to be equal and less than 79, 50 students (60.24 %) were found to be between 80 and 120, and 6 students (7.23 %) were found to be equal and more than 121 of FEV1. Furthermore, the levels of the ratio of FEV1/FVC of the respondents indicated that 4 students (4.82 %) were found in equal and less than 79, 79 students (95.18 %) were found between 80 and 120. However, no student was found to have equal and more than 121 of ratio of FEV1/FVC among respondents as summarized Table 4.

TABLE 3: Level of Pulmonary Function parameters among the Teenager (n=83)

	Levels of % predicted value		
	≤ 79	**80 - 120**	**≥ 121**
FVC	8 (9.64%)	68 (81.93%)	7 (8.43%)
FEV1	27(32.53%)	50(60.24%)	27(32.53%)
FEV1/FVC	4 (4.8%)	79 (95.18%)	-
Levels of the Pulmonary Function parameters			

	% Predicted Value			
	Mean	**SD**	**Minimum**	**Maximum**
FVC	93.25	13.779	65	137
FEV1	86.23	15.422	54	128
FEV1/ FVC ratio	92.52	6.938	70	105

TABLE 4: Levels of Force Vital Capacity (FVC), Forced Expiratory Volume at the 1st second (FEV1), and, FEV1/FVC ratio of the Teenagers (n=83)

Levels of % predicted value	**No of Students**	**Percentage (%)**
Levels of Force Vital Capacity (FVC)		
Equal and less than 79	8	9.64
Between 80 and 120	68	81.93
Equal and more than 121	7	8.43
Levels of Forced Expiratory Volume at the 1st second (FEV1)		
Equal and less than 79	27	32.53
Between 80 and 120	50	60.24
Equal and more than 121	6	7.23
Levels of FEV1/FVC ratio		
Equal and less than 79	4	4.82
Between 80 and 120	79	95.18
Equal and more than 121	-	-

3.4. Physical Activities of the teenagers. During the past seven days, the respondents had leisure time for physical activity: skipping, swimming, walking for exercises, bicycling, jogging or running, aerobics, dancing, football, badminton, volleyball, and basketball. Almost one in five students did skipping last week. 13 students (15.66%) skipped 1-2 times, 3 students (3.61%) skipped 7 or more times and 1 student (1.20%) did skipping 3-4 times last week. 66 students (80.5%) did not skipping at all. Swimming was found 1-2 times among 3 students (3.61%), 3-4 times among another 3 students (3.61%), 7 or more times in 2 students (2.41%) and 75 students (90.0%) did not swim at all last week.

The respondents had walking for exercises of 1-2 times by 14 students (16.87%), 3-4 times by 14 students (16.87%), 5-6 times by 12 students (14.46%), and 7 times or more by 23 students (27.71%). 20 students accounted for 24% among respondents who did not do for it. Nearly more than one fourth of the students were done walking for exercises 7 times or more. For bicycling of 1-2 times by 6 students (7.23%), 3-4 times by 7 students (8.43%), 5-6 times by 1 student (1.20%), and 7 times or more by 8 students (9.64%). 61 students accounted for (73.2%) was not bicycling among respondents. Jog or run 1-2 times by 21 students (25.30%), jog or run 3-4 times by 19 students (22.89%), jog or run 5-6 times by 3 students (3.61%), and jog or run 7 times or more by 4 students (4.82%). One fourth of the respondents were done jogging or running of 1-2 times. 36 students (43.2%) did not Jog or run among respondents.

Physical activity for aerobics of 1-2 times by 4 students (4.82%), 3-4 times by 2 students (2.41%), and 5-6 times were 1 student (1.20%). 76 students (91.2%) did not account for it as well as aerobic of 7 times or more was not done among study respondents. Dance 1-2 times by 21 students (25.30%), dance 3-4 times by 5 students (6.02%), dance 5-6 times by 3 students (3.61%), and dance 7 times or more by 6 students (7.23%). 48 students (57.6%) did not dance among respondents. On the other hand, one fourth of the respondents did dancing 1-2

times. For football of 1-2 times by 11 students (13.25%), 3-4 times by 9 students (10.84%), 5-6 times by 9 students (10.84%), and 7 times or more by 10 students (12.05%). Football was not done by 44 students that accounted for 52.8% among students.

For badminton of 1-2 times were 5(6.02%), 3-4 times were 4(4.82%), 5-6 times were 2(2.41%), and 7 times or more were 1(1.20%). 71 students (85.2%) did not play badminton among students. 82 students accounted for 98.4% of volleyball did not play. There were no students played for 1-2 times, 3-4 times, and 5-6 times among 83 students. On the other hand, one student (1.20%) played to volleyball for 7 or more time. 81 students accounted for 97.2% who did not play basketball as well as did not play for 5-6 times, and 7 or more time among 83 students. However, basketball was played for 1-2 times by one student (1.20%). and another 3-4 times were played by one student (1.20%). Finally, this table shows the physical activity for other sports was not done among study respondents totally as summarized Table 5.

TABLE 5: Teenagers' Levels of Engagement in Leisure Time Activities (n=83)

Types of Sports	1-2 times		3-4 times		5-6 times		7 times or more	
	n	%	n	%	n	%	n	%
Skipping	13	15.66	1	1.20	-	-	3	3.61
Swimming	3	3.61	3	3.61	-	-	2	2.41
Walking for exercise	14	16.86	14	16.87	12	14.46	23	27.71
Bicycling	6	7.23	7	8.43	1	1.20	8	9.64
Jogging or running	21	25.30	19	22.89	3	3.61	4	4.82
Aerobics	4	4.82	2	2.41	1	1.20	-	-
Dance	21	25.30	5	6.02	3	3.61	6	7.23
Football	11	13.25	9	10.84	9	10.84	10	12.05
Badminton	5	6.02	4	4.82	2	2.41	1	1.20
Volleyball	-	-	-	-	-	-	1	1.20
Basketball	1	1.20	1	1.20	-	-	-	-
Others	-	-	-	-	-	-	-	-

3.5. Association between Demographic characteristics (age and gender) and pulmonary functions of the teenagers. Fisher's Exact Test was carried out to analyze the association between ages and pulmonary function (FVC, FEV1, and ratio of FVC and FEV1 % predicted value) of the teenagers. the level of FVC for ages categories of respondents indicated that among 12 years old students, 3 students (3.61 %) were found in equal and less than 79 of FVC, 33 students (39.76 %) were found in 80 to 120 of FVC, 2 students (2.41 %) were found in equal and more than 121 of FVC. Moreover, it was found that among 13 years old students, 3 students (3.61 %) were found in equal and less than 79 of FVC, 13 students (15.66 %) were found in 80 to 120 of FVC. However, there were no students found in equal and more than 121 of FVC among 13 years old students. Furthermore, it was found that among 14 years old students, 2 students (2.41%) were found in equal and less than 79 of FVC, 20 students (24.10 %) were found in 80 to 120 of FVC, 4 students (4.82 %) were found in equal and more than 121of FVC. In addition, it was showed that among 15 years old students, 1 student (1.2 %) was found in equal and less than 79 of FVC, 2 students (2.41%) were found in 80 to 120 of FVC, 1 student (1.2 %) was found in equal and more than 121 of FVC. Among 12, 13, 14 and, 15 years old students, 9 students (10.84 %) had equal and less than 79 of FVC. There was, however, no statistically significant association between ages and FVC with p =0.248.

The level of FEV1 for ages categories of respondents indicated that among 12 years old students, 12 students (14.46%) were found in equal and less than 79 of FEV1, 24 students (28.91%) were found in 80 to 120 of FEV1, 1 student (1.2 %) was found in equal and more than 121of FVC. Moreover, it was found that among 13 years old students, 9 students (10.84 %) were found in equal and less than 79 of FEV1, 7 students (8.43%) were found in 80 to 120 of FEV1. However, there were no students found in equal and more than 121of FEV1 by 13 years. Furthermore, it was found that among 14 years old students, 6 students (7.23 %) were found in equal and less than 79 of FEV1, 16 students (19.23 %) were found in 80 to 120 of FVC, 4 students (4.82 %) was found in equal and more than 121of FEV1. In addition, it was found that among 15 years old students, 2 students (2.41%) were found in 80 to 120 of FEV1, 1 student (1.2 %) was found in equal and more than 121 of FEV1. There was no student showed equal and less than 79 of FEV1 among 15 years old students whereas 27 students (32.53 %)

had equal and less than 79 of FEV1 among 12, 13, and 4 years old students. There was, however, no statistically significant association between ages and FVC with p = 0.085.

The level of the ratio of FEV1/FVC for ages categories of respondents indicated that among 12 years old students, 1 student (14.46%) was found in equal and less than 79 of the ratio of FEV1/FVC, 37 students (44.58 %) were found in 80 to 120 of the ratio of FEV1/FVC, Moreover, it was found that among 13 years old students, 2 students (2.41 %) were found in equal and less than 79 of the ratio of FEV1/FVC, 14 students (16.87 %) were found in 80 to 120 of the ratio of FEV1/FVC. Furthermore, it was found that among 14 years old students, 1 student (1.2 %) was found in equal and less than 79 of ratio of FEV1/FVC, 25 students (30.12 %) were found in 80 to 120 of ratio of FEV1/FVC. In addition, it was found that among 15 years old students, only 3 students (3.61%) were found in 80 to 120 of FEV1. Present study was found that from 12 to 14 years, 4 students (4.82 %) were found in equal and less than 79 of ratio of FEV1/FVC. On the other hand, there were no students showed equal and less than 79 of ratio of FEV1/FVC by 15 years. There was, however, no statistically significant association between ages and the ratio of FEV1/FVC with p = 0.416 are summarized in Table 6.

Chi-Square test was carried out to analyze the association between gender and FVC, FEV1, and ratio of FEV1/FVC % predicted value of the teenagers. The level of FVC for gender categories of respondents indicate that one male student (1.20 %) was found in equal and less than 79 of FVC, 36 male students (43.37 %) were found in 80 to 120 of FVC, 3 male students (3.61 %) were found in equal and more than 121 of FVC. Furthermore, it was found that 7 female students (8.43 %) were found in equal and less than 79 of FVC, 32 female students (38.55 %) were found in 80 to 120 of FVC, 2 female students (2.41 %) were found in equal and more than 121 of FVC. Present study was found that both male and female had an equal and less than 79 of FVC. However, female had equal and less than 79 of FVC than male. There was statistically significant association between gender and FVC with p = 0.041.

The level of FEV1 for gender categories of respondents indicate that 9 male students (10.84 %) were found in equal and less than 79 of FVC, 29 male students (34.93 %) were found in 80 to 120 of FEV1, 4 male students (4.82 %) were found in equal and more than 121 of FEV1. Furthermore, it was found that 18 female students (21.69 %) were found in equal and less than 79 of FEV1, 20 female students (24.10 %) were found in 80 to 120 of FEV1, 2 female students (2.41 %) were found in equal and more than 121 of FEV1. Present study was showed that both male and female had equal and less than 79 of FEV1. However, female had equal and less than 79 of FEV1 than male. There was statistically significant association between gender and FEV1 with p = 0.041.

The level of the ratio of FEV1/FVC for ages categories of respondents indicate that 42 male students (50.60 %) were found in 80 to 120 of ratio of FEV1/FVC. However, there was no male students showed equal and less than 79 of ratio of FEV1/FVC. In addition, it showed that 4 female students (4.82%) were found in equal and less than 79 of ratio of FEV1/FVC, 37 female students (44.58 %) were found in 80 to 120 of ratio of FEV1/FVC. There was however no statistically significant association between gender and the ratio of FEV1/FVC with p = 0.069 are summarized in Table 7.

TABLE 6: Association between Ages and Pulmonary Functions (FVC, FEV1 and FEV1/FVC % predicted value) of the Teenagers (n=83)

	FVC % predicted value								
	≤ 79		**80 to 120**		**≥ 121**		**Total**		
Ages	**N**	**percent**	**N**	**percent**	**N**	**percent**	**N**	**Percent**	***p* value**
12 years	3	3.61	33	39.76	2	2.41	38	45.78	0.248
13 years	3	3.61	13	15.66	-	-	16	19.28	
14 years	2	2.41	20	24.10	4	4.82	26	31.32	
15 years	1	1.2	2	2.41	1	1.2	3	3.61	
	FEV1 % predicted value								
	≤ 79		**80 to 120**		**≥ 121**		**Total**		
Ages	**N**	**percent**	**N**	**percent**	**N**	**percent**	**N**	**Percent**	***p* value**
12 years	12	14.46	24	28.91	1	1.2	38	45.78	0.085
13 years	9	10.84	7	8.43	-	-	16	19.28	
14 years	6	7.23	16	19.23	4	4.82	26	31.32	

15 years	-	-	2	2.41	1	1.2	3	3.61	
	ratio of FEV1/FVC % predicted value								
	≤ 79		**80 to 120**		**≥ 121**		**Total**		
Ages	**N**	**percent**	**N**	**percent**	**N**	**percent**	**N**	**Percent**	***p* value**
12 years	1	1.2	37	44.58	-	-	38	45.78	0.416
13 years	2	2.41	14	16.87	-	-	16	19.28	
14 years	1	1.2	25	30.12	-	-	26	31.32	
15 years	-	-	3	3.62	-	-	3	3.61	

Fisher's Exact Test

TABLE 7: Association between Gender and Pulmonary Functions (FVC, FEV1 and FEV1/FVC % predicted value) of the Teenagers (n=83)

	FVC % predicted value								
	≤ 79		**80 to 120**		**≥ 121**		**Total**		
Gender	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	***p* value**
Male	1	1.20	36	43.37	3	3.61	42	50.60	0.041
Female	7	8.43	32	38.55	2	2.41	41	49.40	
	FEV1 % predicted value								
	≤ 79		**80 to 120**		**≥ 121**		**Total**		
Gender	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	***p* value**
Male	9	10.84	29	34.93	4	4.82	42	50.60	0.041
Female	18	21.69	20	24.10	2	2.41	41	49.40	
	ratio of FEV1/FVC % predicted value								
	≤ 79		**80 to 120**		**≥ 121**		**Total**		
Gender	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	**N**	**Percent**	***p* value**
Male	-	-	42	50.60	-	-	42	50.60	0.069
Female	4	4.82	37	44.58	-	-	41	49.40	

Chi-Square

3.6. Relationship between BMI, Physical Activities and Pulmonary Functions (FVC, FEV1 and FEV1/FVC % predicted value) of the teenagers. The correlation of BMI with pulmonary function parameter (FVC, FEV1, and the ratio of FEV1/FVC % % predicted value) indicated that the BMI of respondents had independent variables and FVC, FEV1, and the ratio of FEV1/FVC had dependent variables. Present study showed that FVC and FEV1 were positively significant correlation with BMI ($r = 0.320$, $p < 0.01$) and ($r = 0.177$, $p < 0.05$). Present study showed that the ratio of FEV1/FVC was negatively correlated with BMI There was, however, no statistically significant ($r = -0.030$, $p = 0.235$) as shown in Table 8.

The correlation of physical activities with pulmonary function parameters (FVC, FEV1 and FEV1/FVC % predicted value) of the respondents. The physical activities of the respondents were independent variables and pulmonary function parameters were dependent variables. Present study showed that FVC was positively correlated with scoring of leisure time physical activities. However, there was no statistically significant between scoring of leisure time physical activities and FVC ($r = 0.166$, $p > 0.05$). Furthermore, FEV1 was positively correlated with scoring of leisure time physical activities. However, there was no statistically significant between scoring of leisure time physical activities and FEV1 ($r = 0.174$, $p > 0.05$). The ratio of FEV1/FVC was positively correlated with scoring of leisure time physical activities. However, there was no statistically significant between scoring of leisure time physical activities and the ratio of FEV1/FVC ($r = 0.147$, $p > 0.05$).

Present study showed that FVC was positively significant correlation with very active and frequent ($r = 0.226$, $p = < 0.01$). In addition, FEV1 was positively significant correlation with very active and frequent ($r = 0.270$, $p = < 0.01$). However, the ratio of FEV1/FEVC was not significantly correlation with very active and

frequent (r = 0.159, p = > 0.05). Regarding FVC, there was no significant correlation with daily physical activities. (r = 0.064, p = > 0.05). FEV1 was no significant correlation with daily physical activities. (r = 0.066, p = > 0.05). The ratio of FEV1/FVC was not significantly correlation with daily physical activities (r = 0.015, p = > 0.05). Furthermore, it showed that FEV1 was positively significant correlated with overall physical activity (r = 0.227, p = < 0.01). However, the correlation of FVC and the ratio of FEV1/FVC with overall physical activity were not statistically significant (r = 0.214, p < 0.05) and (r = 0.102, p < 0.05) as shown in Table 8.

TABLE 8: Relationship between BMI, Physical Activities and Pulmonary Functions (FVC, FEV1 and FEV1/FVC % predicted value) of the teenagers. (n=83)

Pulmonary function parameters	**BMI**	***p* value**
FVC	.320**	0.003
FEV1	.218*	0.0.47
FEV1/FVC ratio	-0.030	0.786
	Pulmonary function parameters	
Physical Activities	**FVC**	**FEV1**	**FEV1/FVC ratio**
Leisure times physical activities	.166	.174	.147
Very active and Frequent	.226*	.270*	.159
Daily	.064	.066	.015
Overall Physical activity	.214	.227*	.102

(*Spearman's r*) ** = *0.01 level*, * = *0.05 level*

IV. Discussion

A cross-sectional, correlation study design was carried out to study the association between anthropometry, physical activities and pulmonary function of the teenagers. Data was collected by physical activity questionnaire for older children (PAQ – C) and Body mass index (BMI) was computed as the participants' weight (kg) divided by the square of their height (m) was determined based on WHO BMI classification [1] and pulmonary function parameters were measured by using spirometer (vitalograph).

According to the findings, the age of the teenagers was varied from 12 years to 15 years and from grade eight from grade nine, and from grade ten. Almost equal numbers of male and female were involved. According to the findings, the minimum height was 131 cm and the maximum height was 173 cm. The minimum weight (Kg) was 26 Kg and the maximum weight (Kg) was 97 Kg.

According to the analyzed data that the first most physical activity respondents had done was walking for exercise, second most physical activity they had done was jogging or running and dancing, and the third most physical activity they had done was skipping. Besides, the least had done physical activity was volleyball. It seems that most of the respondents did physical activity for easily accessible sports owing to time limitation in day to day life activity.

According to the finding, Pulmonary function expressed in percent predicted value of FVC, FEV1 and FEV1/FVC ratio of the teenagers. Mean and SD of FVC was (93.25±13.779). Mean and SD of FEV1 was (86.23±15. 422). And, Mean and SD of FEV1/ FVC was (92.52±6.938). It showed that levels of % predicted value of force vital capacity (FVC) revealed that (n=8, 9.6 %) students were found in equal and less than 79, (n=68, 81.9 %) students were found to be between 80 and 120 and (n=7, 8.4 %) students were found in equal and more than 121 among the respondents. Levels of % predicted value of expiratory volume at the 1st second (FEV1) revealed that (32.5 %, 27) students was found to be equal and less than 79, (60.24 %, 50) students was found to be between 80 and 120, and (7.2 %, 6) students was found to be equal and more than 121 among eighty three respondents. Levels of % predicted value of the ratio of FEV1/FVC of the respondents revealed that (4, 4.8 %) students were found to be equal and less than 79, (79, 95.2 %) students were found to be between 80 and 120, and no students were equal and more than 121 among eighty-three respondents.

The current study showed that association between ages and pulmonary function (FVC, FEV1 and ratio of FEV1/ FVC % predicted value) was not statistically significant (p values: 0.248, 0.085 and 0.416). It is similar with the study of Nasr, et al (2014) which reported that none of the parameters showed significant correlation with age [17]. Finding of the current study revealed that associations between gender and pulmonary function parameters (FVC and FEV1 % predicted value) were statistically significant (p values: 0.041 and 0.041).

Current study revealed that mean and SD of FVC was (93.25±13.779). Mean and SD of FEV1 was (86.23±15. 422). It was similar to the study of da Silva, Wehrmeister, et al (2016) which found that boys had higher mean value of FVC, FEV1 than girls with regard to overall pulmonary function parameters [18].

In present study, the correlation of BMI with pulmonary function parameters (FVC and FEV1 % predicted value) were positively significant correlation ($r = 0.320$, $p < 0.01$) and ($r = 0.218$, $p < 0.05$). The similar finding of Mohammed, Maiwada and Sumaila (2015) in which all the anthropometric variables had significant relationship with pulmonary function parameters (FEV1 and FVC) among primary school children [4]. In this study was also different from the finding of Koraddi, Bagali and Aithala (2015). It showed negative correlation of BMI with FVC and FEV1 which were not statistically significant [19].

Finding on this study showed that more students were underweight (≤ 18.5 Kg) as well as pulmonary function (FVC and FEV1) were equal and less than 79 % predicted value. Spirometeric opinion also showed that seven of the students had restrictive pulmonary function. Study of Koraddi, Bagali and Aithala (2015) was also found the similar results [19]. On the other hand, this finding is in agreement with that of Pellegrino, et al (2005), pointed out to the presence of a restrictive ventilatory defect may be suspected when VC is reduced and the FEV_1/VC is increased (> 85 – 90%). A reduced VC by itself does not prove a restrictive ventilatory defect. It was evidence that there was no result of FEV1/FVC ratio for equal and less than 79 from the spirometer come out [20]. The possible reason in this study, they could not forcefully blow out into the spirometer after taking a deep breath or it may be restricted to capacity of lung to expand and hold normal amount of air. The ratio of FEV1/FVC % predicted value was negatively correlated with BMI and it was not statistically significant ($r = -0.030$, $p = 0.193$). Banerjee, et al (2014) mentioned that BMI in non-obese subjects is not significantly associated with pulmonary function parameters (FVC, FEV1, and ratio of FEV1/ FVC % predicted value) [21].

The results of the present study revealed that FVC, FEV1 and the ratio of FEV1/FVC were no significant correlation with leisure time physical activities ($r = 0.166$, $p > 0.05$), ($r = 0.174$, $p > 0.05$) and ($r = 0.147$, $p > 0.05$). Difference from a recent study, cross sectional survey of children and adolescents between the age group 6 and 17 years in the Korean reported that physical fitness tests were significantly correlated with FVC and FEV1 [22]. Therefore, leisure time physical activities need to be more an encouraged to improve school students' pulmonary function.

Based on the observations, da Silva, et al (2016) suggested that regular physical activity has positive effects on lung development during growth period [18]. It is desirable to promote physical fitness and health as very basic of the physical activities like games and sports [23]. Moreover, regular physical activity can positively change to lung health. And a prospective cohort study of Nechuta, et al (2015) have shown that exercise participation in adolescence appeared to be more strongly associated with reduced risk of cancer mortality among all participants [24]. Furthermore, Fatima, Rehman, Saifullah, and Khan, (2013) stated that an improving in the pulmonary function parameters have showed to effect of physical exercise [25].

The results of the current study revealed that FVC was positive correlated and statistically significant ($r = 0.226$, $p < 0.05$) with scoring of very active and frequent physical activities engaged. Similar results were also found in a cross-sectional study of Khashaba (2015). It was reported that pulmonary function measurements differed significantly according to students' physical activity levels, highest values among students with high physical activity levels and least values among students with low physical activity levels [26]. Physical activity in teen years may contribute to the development of healthy adult lifestyles [27].

Another similar result was also found that physical activity was significantly associated with lung function development among Chinese girls aged 9–11 years [28]. Therefore, physical activity in teenager requires addressing a number of sports or games. On contrary to another study in Tunisia among the children aged 6 -6 years no association was found between physical activity and absolute values of FEV1 [29]. Menezes, et al (2012) had stated that many variables are more likely to influence girls' than boys' lung function [30].

Furthermore, Bae, et al (2015) also suggested that aerobic exercise and an exercise program to increase muscle strength and power is needed in order to improve the pulmonary function of children and adolescents [22]. According to finding of Irandoust (2015), FVC and FEV1 were significantly improved in aerobic exercise of high school obese adolescence [6]. Therefore, it is possible that the higher pulmonary function parameters of the teenagers indicate that physical activity like sports may have a positive impact on pulmonary functions.

The findings the present study revealed that none of the pulmonary function parameters (FVC, FEV1, and FEV1/FVC % predicted value) was not statistically significant with scoring of daily physical activities even

though it was positively correlated with scoring of daily physical activities. Likewise, da Silva, Ripka, Ulbricht (2016) reported that there was no significant association between pulmonary function test and time physical activity in either gender [31]. Present study proved that of daily physical activity during the last week could not improve pulmonary function parameters obviously.

Other possible mechanism may an affect on pulmonary function. Furthermore, previous studies among middle-aged and older Chinese assessing the relationship between regular physical activity and mortality from all causes and circulatory diseases have reported significantly associations [32]. One study proved that pulmonary function can be improved by doing regular long-term physical exercise which is likely due to improved respiratory muscles power [33]. Hallal, et al (2006) stated that teenager physical activity provides a long-term protective effect on bone health other than teenage physical activity provides a short-term benefit refers to bone and mental health [27]. Hence, appropriate interventions, such as prescribed physical activity programs, may prevent lung function deterioration in these teenager respondents.

Chaitra, et al (2012) reported that the significant positive relationship between after 16 weeks of aerobics training and pulmonary function (FVC and FEV1) increased in healthy young men [34]. In previous studies, a cross sectional analytical observational assessment of normal school children between the age group 12 and 14 years in the India reported spirometric parameters for boys were higher than girls and boys except for the FEV1 % [35]. Furthermore, previous studies reported that spirometric variables increased after acute exercise and the values were higher in boys than in girls. Among spirometric variables, the values of FVC and FEV1 increased after acute exercise in both males and females [36]. Ji, Wang, Liu and He (2013) has however reported that physically active girls had significantly higher FVC than in active girls [28]. On contrary with Ana, et al (2012) reported to forced expiratory volume in 1 second was not associated with physical activity whereas FEV1 was reduced among girls who were inactive [37].

The finding of the present study revealed that total scoring of physical activity was statistically significant and positively correlated with pulmonary function parameter (FEV1 % predicted value) as well as weak linear relationship between total scoring of physical activity and FEV1 ($r = 0.066$, $p = > 0.05$). In previous studies, Menezes et al (2012) stated that as compared with total physical activity, leisure-time physical activity was generally more strongly associated with lung function parameters. It was found that more physical activity in teenagers is related to improved pulmonary function [30]. The current study proved that very active and frequent physical activities had better pulmonary function parameters (FVC, FEV1, and FEV1/FVC % predicted value) than that of overall physical activities.

The findings of this study are also consistent with the results of a study by da Silva et al (2016) have reported that total, and vigorous-intensity physical activity was significantly associated with pulmonary function (PF) gain. Some recommended physical activity to change pulmonary function [18]. A study in Brazil had stated that both physical activity and lung function are related to non-communicable diseases, which represent the largest share of the burden of disease in the world [38]. Therefore, physical activity promotion strategies are needed to improve pulmonary function and general health.

V. Conclusion

This is the study on association between anthropometry, physical activities and pulmonary function of the teenagers in No (1), B.E.H.S, Lanmadaw Township, Yangon region. In this study, description of anthropometry, physical activities and pulmonary function parameters are included. Among the students, most of the participants were 12 years old students and male are the commonest in this study. This study demonstrated that less the number of students was found to have mild restriction of pulmonary function due to lack of the respiratory muscle performance enhancement. Furthermore, it was found that more physical activity can help better pulmonary function than least physical activity among teenagers. Therefore, further study has to be conducted in a large sample size to validate these preliminary findings.

Limitation of the Study

Findings of the study could not be representative of all teenagers rather than the teenagers from No (1) BEHS, Lammadaw Township. Self- reported tool for physical activity in term of physical activity questionnaires for older children based on recall of the last 7 days physical activity was used instead of direct measurement of physical exertion which might be influenced by recall bias. Body mass index (BMI) was obtained based on height and weight measurement rather than defining percentages of body fat and lean mass. A larger population may allow the detection of significant association among teenagers because limitation in sample size affected on outcomes of the results.

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