

Comparison of Lung Functions Among Asthmatic Children in Malaysia

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ABSTRAK

Satu kajian perbandingan telah dijalankan ke atas 163 kanak-kanak asma di Kuala Lumpur (tercemar) dan 38 orang di Terengganu (kurang tercemar) telah dipilih dalam kajian. Objektif kajian adalah untuk membandingkan fungsi paru-paru kanak-kanak asma mengikut jantina dan kawasan kajian. Borang soal selidik dan kad diari digunakan untuk mengumpul maklumat latar belakang dan kekerapan serangan asma di kalangan responden. Alat "spirometer" digunakan untuk mengukur fungsi paru-paru. Hasil kajian mendapati perbezaan yang signifikan bagi nilai FEV_1 % jangkaan ($p=0.002$), FEV_1/FVC % jangkaan ($p=0.001$) dan $\%FEV_1/FVC$ ($p=0.002$) antara kanak-kanak lelaki di kedua-dua kawasan. Walau bagaimanapun, perbezaan yang signifikan hanya terdapat antara FEV_1 % jangkaan di kalangan kanak-kanak perempuan di kedua-dua kawasan. Korelasi yang signifikan juga didapati antara kekerapan serangan asma dengan FEV_1 % jangkaan ($p=0.008$) FEV_1/FVC % jangkaan ($p=0.001$) dan $\%FEV_1/FVC$ ($p=0.001$) di kalangan kanak-kanak asma di Kuala Lumpur tetapi tiada korelasi yang signifikan didapati di kalangan kanak-kanak asma di Terengganu.

ABSTRACT

A comparative study was conducted on 163 asthmatic children from Kuala Lumpur (polluted area) and 38 asthmatic children from Terengganu (less polluted area). The objective of this study was to compare the lung functions of the asthmatic children between the 2 sexes and study areas. Questionnaires and diary cards were used to obtain background information and frequency of asthma attacks. A spirometer was used to measure lung functions of the asthmatic children. Findings showed that there was a significant difference in the FEV_1 % predicted ($p=0.002$), FEV_1/FVC % predicted ($p=0.001$) and the $\%FEV_1/FVC$ ($p=0.002$) between male children in the two areas. However, only the FEV_1 % predicted ($p=0.011$) was significantly different between the female children in the two areas. Significant correlation was also found between the frequency of asthma attacks with FEV_1 % predicted ($p=0.008$), FEV_1/FVC % predicted ($p=0.001$) and $\%FEV_1/FVC$ ($p=0.001$) among the asthmatic children Kuala Lumpur but no significant correlation was found among the asthmatic children in Terengganu.

Keywords: Asthmatic children, lung functions, asthmatic attacks

INTRODUCTION

A study on asthmatic school children was conducted in Kuala Lumpur and Terengganu. Lung function measurements such as the Forced Vital Capacity (FVC), Forced Expiratory Volume in One Second (FEV_1) and $\%FEV_1/FVC$ are essential indicators for identifying the obstructive problems in the respiratory system due to diseases such as asthma, bronchitis or emphysema. If the FEV_1 is less than 80% of the expected percent, then the patient is categorized as having obstructive effects. The FEV_1/FVC % predicted is the most important index in evaluating the severity of asthma among patients (Murray 1979). If the FEV_1/FVC % predicted is less than 75%, then the patients have serious asthma problems and need attention (Miller 1978). The objective of this study was to assess and compare lung function measurements of asthmatic children in K. Lumpur and Terengganu.

METHODOLOGY

Four primary schools in Kuala Lumpur and 2 schools in Terengganu were selected. The schools in K. Lumpur are located in the city center on a main road where the traffic is busy. The schools in Kemaman and Setiu in Terengganu are located away from the main road.

Due to the fact that the prevalence of asthmatic cases in Terengganu is lower, only 38 children were selected while in Kuala Lumpur, a total of 163 asthmatic children were selected. Information on the socio-economics, history and severity of asthma attacks, type of medicine used, hospital visits and treatment were obtained through questionnaire interviews on the children and their guardians.

Lung functions of the children were carried out to determine their lung volume and flow (volume per unit of time). A "Pony Cosmed Spirometer" which met the American Thoracic Society (1987) specifications was used in this study. The spirometer was calibrated each day before measurements. The procedure was explained and demonstrated to each child in which he or she was asked to inhale deeply in the standing position and blow rapidly and completely into a calibrated spirometer. Three acceptable and at least two reproducible curves were obtained in each subject. The highest values of forced vital capacity (FVC) and forced expiratory volume in the 1st second (FEV_1) were selected. Age was recorded to the nearest year, height was measured to the nearest 0.5 cm (with the subject standing without shoes), and weight was recorded to the nearest 0.5 kg. All readings were recorded at ambient temperature and pressure saturated (ATPS). FVC and FEV_1 measurements were adjusted to body temperature and pressure saturated (BTPS).

For comparative purposes, only the Malay respondents from the K. Lumpur school were studied because the asthmatic children selected in the Terengganu schools were made up of only ethnic Malays. At the same time, the prediction equations were based on sex and racial ethnicity. Therefore, other ethnic groups had to be excluded.

RESULTS AND DISCUSSIONS

Respondents' Background Information

The background and socioeconomic information of the asthmatic children are shown in Tables 1, 2 and 3. The mean age between the 2 groups of asthmatic children were about the same. The 163 children in Kuala Lumpur, were made up of 143 Malays, 10 Chinese and 10 Indians. There were 98 male children and 103 female children in both areas and the numbers were almost equal.

The household income in Table 2 shows that the children in K. Lumpur (RM1170.40) were in the lower middle class socioeconomic group while the children in Terengganu (RM586.80) were in the lower class socioeconomic group. About half of the families in K. Lumpur had household incomes of more than RM1000 while in Terengganu, all of the families have household incomes of less than RM1000. The difference in their total incomes was statistically significant (Table 3). In K. Lumpur, the fathers were mostly businessmen (34.4%), officers or office assistants (8.3%) and technicians (8.3%). In Terengganu, the majority of the fathers work as drivers (18.4%), businessmen (13.2%), labourers (13.2%) and fishermen (13.2%). The mothers in K. Lumpur (47.2%) and in Terengganu (81.6%) are mostly housewives.

TABLE 1
Respondents' background information

Location	Total (n)	Sex		Mean age	Race	(n)
		Boys	Girls			
K. Lumpur	163	81	82	10 yrs 2 mth	Malay	143
					Chinese	10
					Indian	10
Terengganu	38	17	21	10 yrs 1 mth	Malay	38

TABLE 2
Comparison of respondents' socioeconomic background in the study areas

	Kuala Lumpur (mean±s.d)	Terengganu (mean±s.d)	p-value (t-test)
Household income(RM)	1170.37 ± 755.44	586.84 ± 194.41	0.001
Length of residency (mth)	98.34 ± 33.94	103.89 ± 32.93	0.356
Length of stay in school (mth)	48.36 ± 10.20	50.52 ± 11.31	0.282

s.d = standard deviation
mth =month

TABLE 3
Household income of respondents in the study areas

Household income	Kuala Lumpur ^a Total (%)	Terengganu ^b Total (%)
< RM500	6 (3.7)	12 (31.6)
RM500 - RM1000	84 (51.5)	26 (68.4)
RM1001 - RM1500	37 (22.6)	-
RM1501 - RM2000	23 (14.1)	-
> RM2000	13 (8.1)	-

a: n=163

b: n=38

The children in K. Lumpur have resided in the area for an average length of 98.34 months (~8.16 years) and have been attending the school for an average period of 48.36 months (~4.03 years). The children in Terengganu have resided and attended the school for an average period slightly longer than the children in K. Lumpur (Table 2).

Only about half of the K. Lumpur (49.1%) and Terengganu (44.7%) children have a family history of asthma (Table 4). They inherited the disease from their parents, grandparents or siblings. However, the other half of these children must have contracted the disease by other means. This type of asthma is called extrinsic asthma. It can be caused by several factors such as food, emotional stress, cigarette smoke, dust, medicine and physical exhaustion (Rahmat 1992). According to Azizi (1994), environmental pollutants in the atmosphere can trigger asthmatic attacks.

The asthmatic children in K. Lumpur usually get treatment from hospitals and clinics (73.6%). Their asthmatic conditions are probably more severe than the Terengganu children because they were prescribed with Becotide® and Ventoline® (33.2%) which are bronchodilator medications (Table 4). Asthmatic attacks are a great concern for parents in K. Lumpur due to the frequency and severity of the attacks on the children. The percentage who seek treatment at clinics or hospitals is also higher in K. Lumpur (73.6%) than in Terengganu (5.8%). Table 4 also shows how parents perceive their children's asthmatic attacks. It seems that the attacks among the K. Lumpur children are more severe than those among Terengganu children.

The Lung Functions

Figs. 1 to 4 show the distribution of FEV₁% predicted and %FEV₁/FVC among the asthmatic children in both areas according to their sex. The classification was based on Miller *et al.* (1978). The mean FEV₁% predicted among the asthmatic children in Kuala Lumpur (87.66) was lower than the asthmatic children in Terengganu (100.01).

TABLE 4
Comparisons of medical history, medication and severity of asthma attacks of children in the study areas

	Total (%)		p-value (Chi-square)
	K. Lumpur ^a	Terengganu ^b	
Family history of asthma	81 (49.7)	17 (44.7)	0.778
Medication (Becotide® (Glaxo) & Ventoline® (Glaxo))	54 (33.2)	-	-
Percentage who seek clinic or hospital treatment	120 (73.6)	2 (5.79)	0.001
Severity of asthma attacks			
-Very severe	5 (3.1)	-	0.597
-Severe	14 (8.6)	-	
-Moderate	102 (62.6)	29 (76.3)	
-Mild	42 (25.8)	9 (23.7)	

a: n=163

b: n=38

Table 5 shows the difference in the means of FEV₁% predicted between the 2 groups with regard to sex. The mean FEV₁% predicted value for the males (75.19) and females (83.03) in K. Lumpur was lower than the males (91.73) and females (100.24) in Terengganu. Statistics showed that there was a significant difference in the mean FEV₁% predicted value between both groups. Asthmatic children in Terengganu have better expiratory air flow from the lungs compared to the K. Lumpur children.

The measurements of %FEV₁/FVC, were also carried out according to sex as shown in Table 6. The mean %FEV₁/FVC for the males (75.70) and females (84.81) in K. Lumpur was lower than that of the males (94.91) and females (92.21) in Terengganu. However, the difference was only significant for the males (p = 0.002).

As for the mean FEV₁/FVC% predicted, the mean for male children (82.76) and female (91.41) in K. Lumpur was also lower than the Terengganu male (102.67) and female (100.39) respectively (Table 6). However, similar to the %FEV₁/FVC, a significant difference in FEV₁/FVC% predicted was found only among the male children. This implies that the lung obstructiveness in the male K. Lumpur children was more severe than that of Terengganu.

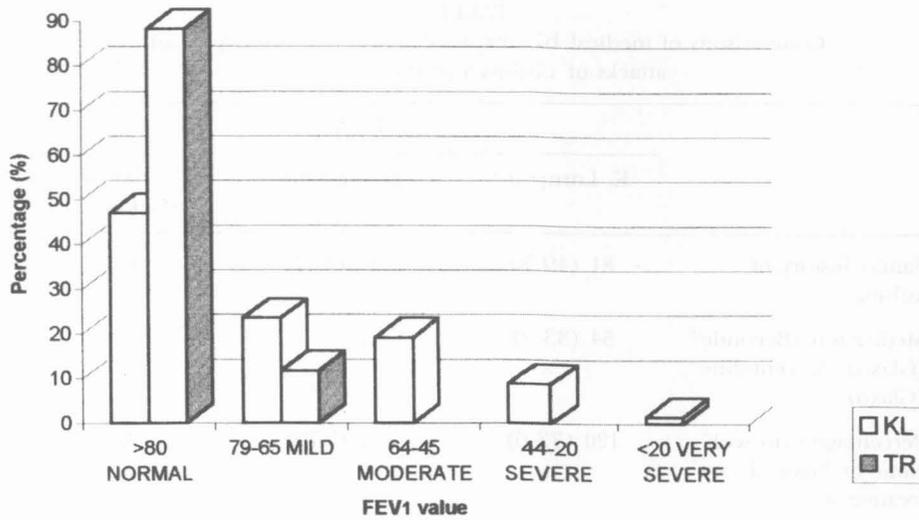


Fig. 1: Distribution of FEV₁% predicted among asthmatic boys in the study areas

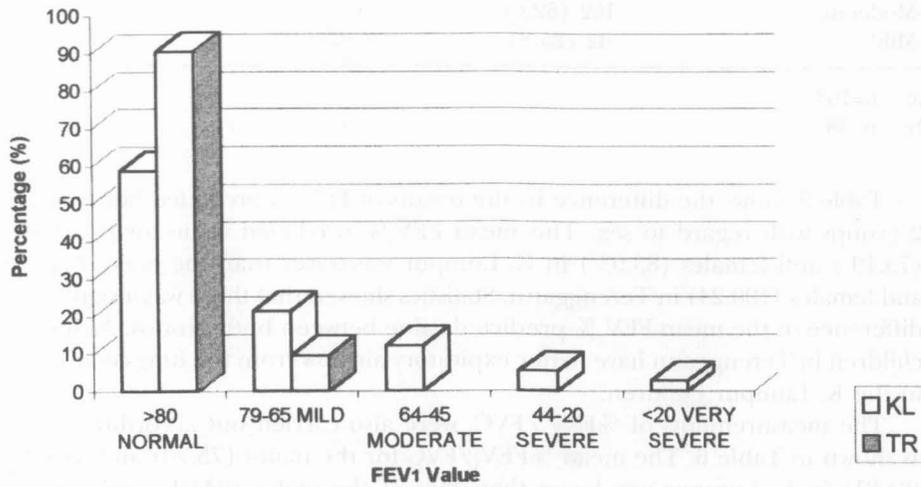


Fig. 2: Distribution of FEV₁% predicted among asthmatic girls in the study areas

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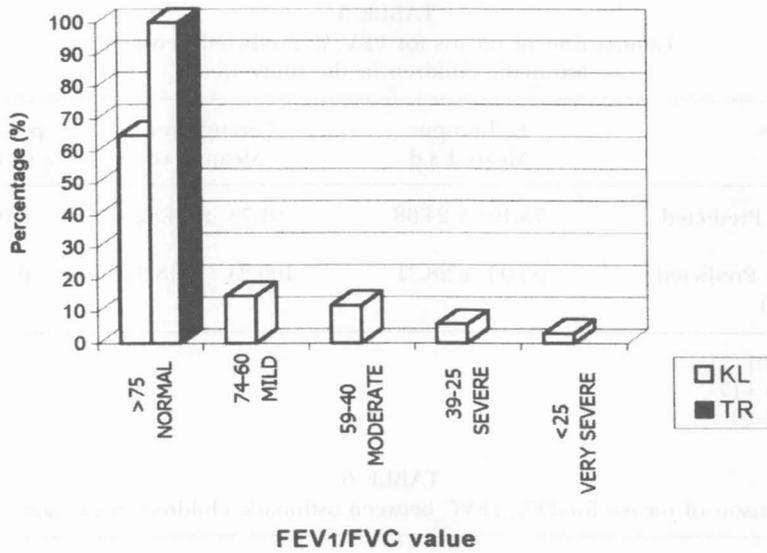


Fig. 3: Distribution of FEV₁/FVC% predicted among asthmatic boys in the study areas

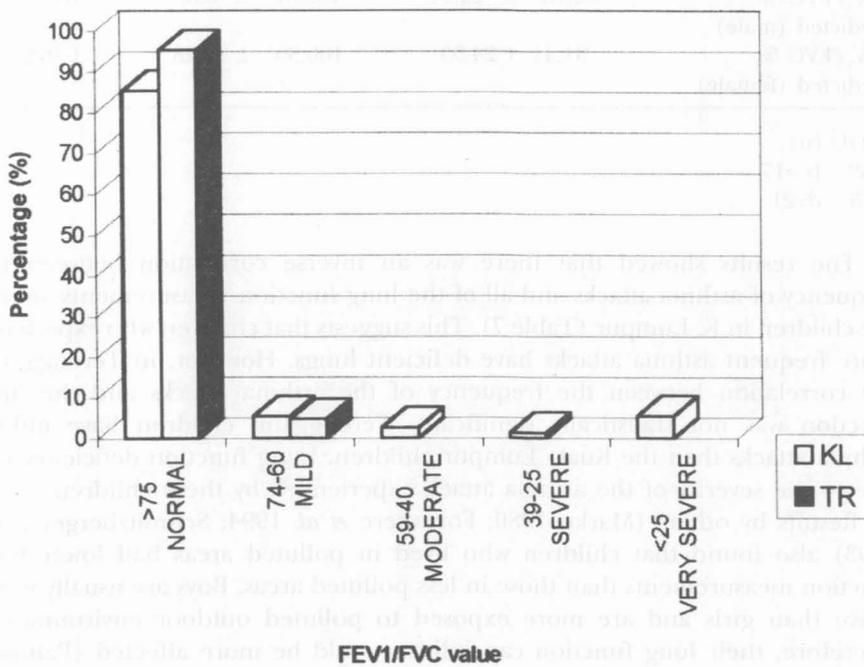


Fig. 4: Distribution of FEV₁/FVC% predicted among asthmatic girls in the study areas

TABLE 5
Comparison of means for FEV₁ % predicted between
asthmatic children in the study areas

Variables	K. Lumpur Mean \pm s.d	Terengganu Mean \pm s.d	p value (t- test)
FEV ₁ % Predicted (Male)	75.19 ^a \pm 24.38	91.73 ^b \pm 14.82	0.002
FEV ₁ % Predicted (Female)	83.03 ^c \pm 28.31	100.24 ^d \pm 18.34	0.011
Total (n)			
a=68 b =17			
c=75 d=21			

TABLE 6
Comparison of means for FEV₁/FVC between asthmatic children in the study areas

Variables	K.L Mean \pm s.d	TR Mean \pm s.d	p (t-test)
%FEV ₁ /FVC (male)	75.70 ^a \pm 23.27	94.91 ^b \pm 7.19	0.002
%FEV ₁ /FVC (female)	84.81 ^c \pm 22.50	92.21 ^d \pm 5.51	0.126
FEV ₁ /FVC % Predicted (male)	82.76 ^a \pm 23.97	102.67 ^b \pm 8.05	0.001
FEV ₁ /FVC % Predicted (female)	91.41 ^c \pm 24.55	100.39 ^d \pm 10.28	0.092

Total (n)
a=68 b =17
c=75 d=21

The results showed that there was an inverse correlation between the frequency of asthma attacks and all of the lung function measurements among the children in K. Lumpur (Table 7). This suggests that children who experience more frequent asthma attacks have deficient lungs. However, in Terengganu, the correlation between the frequency of the asthma attacks and the lung function was not statistically significant. Terengganu children have milder asthma attacks than the Kuala Lumpur children. Lung function deficiency was due to the severity of the asthma attack experienced by these children.

Results by others (Marko 1980; Forestiere *et al.* 1994; Schmitzberger *et al.* 1993) also found that children who lived in polluted areas had lower lung function measurements than those in less polluted areas. Boys are usually more active than girls and are more exposed to polluted outdoor environments. Therefore, their lung function capabilities would be more affected (Paumels 1986).

The Multiple Regression "enter" method conducted on the individual asthmatic attacks for all the children have a statistically significant relationship

TABLE 7
Correlation between individual asthma attacks with lung functions in the study areas

	Kuala Lumpur (n=163)		Terengganu (n=38)	
	r value	p value	r value	p value
FEV ₁ % predicted	-0.206	0.008	0.048	0.775
FEV ₁ /FVC % predicted	-0.317	0.001	0.139	0.405
% FEV ₁ /FVC	-0.343	0.001	-0.246	0.136

with only %FEV₁/FVC when all other confounding factors are controlled (Table 8), even though the R² value is only 12.4%. Atmospheric pollutants such as respirable particulate (PM10) and gases are foreign materials that can promote or increase the overall bronchiole hyperactivity, thus obstructing or restricting bronchioles repetitively by causing mucosal edema. This can cause abnormal air flow in the lungs and as a result, cause lung function inefficiency.

TABLE 8
Relationship between individual asthma attacks with selected variables

Independent variable	Regression Coefficient	t value	p value
Constant	3.856	0.969	0.334
Sex	1.902	1.693	0.092
Food tabulation	1.541	1.396	0.164
FEV ₁ % Predicted	4.191E-0.2	1.463	0.145
FEV ₁ /FVC % Predicted	4.146E-0.2	0.704	0.482
% FEV/FVC	-0.193	-2.728	0.007

'Multiple Regression' for 'enter' method

F statistics = 5.698

p value = 0.01

R value = 0.387

adjusted R² value = 0.124

CONCLUSIONS

On the whole, the results of FEV₁% predicted showed that the asthmatic children in Terengganu have better lung function capacity compared to their counterparts in Kuala Lumpur. Statistical results showed that the difference in the obstructiveness as indicated by the FEV₁ values was significant between both the males and females in both study areas. The degree of severity of the asthma attacks as shown by the %FEV₁/FVC also differ significantly among the male children in both areas. The K. Lumpur asthmatic children have poorer lung

capacity and functions and experience more severe asthma attacks than Terengganu children as indicated by the %FEV₁/FVC.

Atmospheric pollutants influence the lung function efficiency of these children. Even though the medical facilities are better in Kuala Lumpur, the children are more exposed to these pollutants. The children in Kuala Lumpur are experiencing more serious asthmatic problems than in Terengganu due to the high industrial and traffic activities in these urban areas which contribute to air pollution.

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