Normal Sudanese Spirometeric Values for Police Men

Barakat Mohazab Bakhit (barakatmaster@gmail.com)
Orotta college of medicine and health sciences https://orcid.org/0000-0002-5335-0149
Omer Abd_elaziz Musa
National Ribat University Faculty of Medicine
Mohanad Hassan Malla
University of Bakhtalruda Faculty of Medicine and Health Sciences

Research

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Abstract

Background

Spirometric values for police officers in the police hospital, Khartoum, Sudan were observed to show higher values than predicted.[1] Reference values are important for diagnosis of asthma and chronic bronchitis

Methods

For deriving a new reference value for adult police men, a cross- sectional study was performed on 161 adult male police officers, aged 20–50 years in (June- December 2012) in Khartoum state in different police units. Data were obtained through a questionnaire, pulmonary function testing and taking anthropometric measurements, forced vital capacity (FVC), forced expiratory volume in first second (FEV1) and peak expiratory flow rate (PEFR) were measured using a microplus spirometer and a peak flow meter. Lung function values and anthropometric measurements were correlated and regression equations were derived

Results

Adult police males had a significantly higher FVC, FEV1and PEFR [3.96 ± 0.56 L , 3.61 ± 0.52 L and 564.1 ± 70.4 L/min respectively] than those of normal adult Sudanese males [3.68 ± 0.22 L , 3.35 ± 0.23 L and 505.9 ± 19.1L/min respectively]. A positive correlation was found between lung function and height and a negative correlation with age. Regression equations of normal predicted values were derived for police officer FVC (L) [0.027 X (cm) – 0.039 X A (years) +0.345], FEV1 (L) [0.0264 X (cm) – 0.036 X A (years) +0.0105] and PEFR (L/min) [1.599 X (cm) – 4.207 X A (years) + 329.349.

Conclusions

it seems that the continuous training of police officers produced higher lung volumes and a separate reference values tables should be used for them

1. Background

Reference of normal lung function values are needed for use in diagnosis, follow-up, pre-surgical assessment and research. The earliest attempt to obtain normal Sudanese spirometric values, in 1977, used a small sample and included only two areas of Sudan.[2] The study found that the Sudanese values were lower than the international ones, with differences between inhabitants of different areas. [3]

A pilot study in Gezira (central Sudan) in 1998 gave similar indicators and confirmed the feasibility of performing a large national study to derive the normal spirometric values for Sudanese.[4] The last study to obtain normal spirometric values, in 2002-2005, included data from all areas of Sudan.[1]

Reference values for health measures can be subject-based using baseline values from the same individual obtained when he/she in a defined state of health or population-based using data obtained from a group of well-defined reference individuals. In the case of respiratory parameters, prediction equations obtained from a reference population provide a baseline for evaluating the pulmonary function of a subject, based usually on the person's standing height, age and sex. [5] Lung function in relation to age and height has been studied extensively in Caucasians,[6-9] in whom these indices showed correlations with forced vital capacity (FVC), forced expiratory volume in 1 (first) second (FEV1), FEVI/FVC ratio (FEV,%), and forced expiratory flow (FEF). Ethnic differences in lung function have also been reported by many authors[10-15], FVC and FEV1 have been shown to be lower in African blacks than in whites, while Indians and Chinese have intermediate FVC and FEV1 values. Lung function is greatly influenced by age, gender, anthropometry and ethnicity[16-19]. Lung volumes, especially vital capacity, increased with height and lean body mass, but decreased with obesity. For the same weight and height, spirometric measurements were usually higher in males compared with females. Almost all equations for prediction of lung function in various populations include these parameters. [16, 20, 21] The results of Mälkiä et al showed significant associations between Spirometric values and intensities of physical activity at work and during leisure time in asthmatic men. [19] Although healthier subjects may select more physically demanding activities, it is an equally possible hypothesis that physical activity may improve respiratory function in subjects with and without bronchial asthma. The study showed that swimmers have superior FEV1 independent of stature and age in comparison with both land-based athletes and sedentary controls. [23]Physical activity is associated with a slower decline in pulmonary function and with lower mortality, and thus, middle-aged and older people should be encouraged to enjoy exercise. [24]

Spirometric values for police officers has been observed to be higher than the Sudanese predicted values. The police officers are subjected to extensive training during college and at work. This brings out a question if exercise and training are factors to be considered in deriving prediction equation. Therefore, in this study prediction equation and normal values of police officers were studied and compared with normal Sudanese values.

2. Methods

2-1-Study design

This was cross- sectional study performed over the period June- December 2012 in Khartoum state, Sudan.

2-2-Subjects

A total of 161 adult male police officer aged 20–50 years old were included. The sample size was calculated using a confidence level of 95%, precision level ±8%, P (maximum variability) = 0.5 and estimated population of 9000.

Adult male police subjects were chosen from different police units: Police security, faculty of Police and Police of protection of establishments. Ethical clearance for the study was issued by the National Ribat University.

Adult police male subjects were considered "normal" if they had never smoked tobacco; reported no history of symptoms of respiratory diseases; had normal cardiopulmonary signs on clinical examination; had no history of occupational exposure to dust; and were willing and able to cooperate. [25] Adult police male subjects were excluded if they did not satisfy the inclusion criteria; or if they did not perform the respiratory tests correctly.

2-3-Data collection

The questionnaire was filled by all subjects. The questionnaire included: personal data (age, height and weight); habits (smoking, sports) and personal health condition.

A stadiometer was used to measure the standing height of the adult police male subject in centimeters. A sensitive balance was used to measure the body weight in kilograms. A pocket spirometer (MicroPlus, Micro Medical) was used to measure FVC, FEV1. Peak flow meter was used to measure PEFR. Use of the spirometer was demonstrated to each subject. After maximal inspiration, the subject blew forcibly and continuously into the mouthpiece of the spirometerfor at least six second and the highest measurement of three trials was taken as the most representative of the subject's ability. FVC, FEV1, and PERF were recorded. Subjects were excluded if they failed to inspire before breathing out, failed to exhale due to inability to relax or leaked the air by expiring before holding the mouthpiece or not holding their lips tightly around the mouthpiece.

2-4-Data analysis: - Partial correlation test was used. Student *t*-test and analysis of variance were used to test the significance of differences ($P \leq 0.05$). Multiple regression analysis was used to derive regression equations using *SPSS*, version 14 computer programme

2-5-Ethical considerations: Ethical clearance will be approved from the ethical committee at The National Ribat University -A written consent will be taken from all the participants in the study. Code numbers will be used for the participants that are included in the study.

Pulmonary function tests: The pulmonary function tests were carried out using portable spirometer. The apparatus provides a detailed analysis of predicted and derived values. After taking informed written consent from each subject, a detailed history was recorded to rule out the exclusion criteria.

Anthropometric measurements like height and weight were taken for these subjects.

The pulmonary function tests were repeated three times for each subject each time and the best result was selected for analysis.

Each subject was made to relax for minimum 5 minutes prior to performing the PFT procedure. The following parameters were recorded:

1. FVC: The maximum volume of air expired after a maximum inspiration.
2. FEV1: Forced expiratory volume in first second) the fraction of vital capacity expired during the first second of a forced expiration.
3. PEFR: Peak expiratory flow rate
4. FEV1/FVC ratio.

Recording of PFTs: The relaxed subject, in a standing position, was prepared to grip the sterile mouth piece as demonstrated to her prior to the recording. When the subject was confident and familiar with the procedure, he was asked first to perform maximal inspiration after a deep expiration. The subject was then instructed to expire with maximal effort (maximal expiration). The mouth piece was then removed and the actual, predicted and percentage of predicted values were printed for analysis. Each subject was asked to repeat the maximum forced expiratory effort three times, each time with adequate rest in between, and the best reading of the three was considered for analysis.

3. Results

Descriptive and lung function parameters for policemen are shown in different age groups in**Table1**

The highest values of FVC and FEV1 (4.53± 0.5 L and 3.98 ± 0.50 L respectively) were found in the age group 20–25 years old and the lowest values in the age group 45–50 years (3.62 ± 0.53 L versus 3.15 ± 0.44 L respectively) in Table 1. The highest mean value of PEFR (527.3± 97.7 L/min) was in the age group 30 -35 years old.

3-1- Correlations between lung values and age: -

There was high significant negative correlation in adult police male between age and FVC (r = 0.45), FEV1(r = 0.51), but PEFR (r = 0.03) was none.

3-2-Prediction equations for policemen spirometric lung values: -

FVC, FEV1 and PEFR prediction equations by age and height for policemen were derived using multiple regressions (Table 3).

Control is the lung values from normal population. [1] the recreation of lung values with age is more marked in the normal subjects compared for police men (fig 1, 2, 3).

4. Discussion

While deriving the normal Sudanese spirometric values [1], it has been noticed that athletes and police officers have higher values than predicted. This raised the question if prediction equation for these groups should be separate or not. This study was designed to check this hypothesis in police officer in Khartoum state, Sudan. The police officers perform training in college and on job. It has been difficult to find the needed number in each stratum due to the nature of their jobs, the aging diseases and early pension. This has limited the study between age 20 to 50 years. However, there is no prospective evidence for any association between physical activity and long-term changes in pulmonary function in middle-aged and older individuals [24].

The Normal Sudanese males has highest values of FVC and FEV1 in the age group 21–30 years old[1] while adult police male in the age group 20–25 years. The highest mean value of PEFR was in the age group 20–25 years old in adult police males while Normal Sudanese male highest mean values of PEFR were found in the age group 31–40 years old [1].

There is high significant difference [P < 0.05] between male police FVC and FEV1 and control male Sudanese FVC and FEV1 in age group (20 -25) year.

Even more FVC and FEV1 of Sudanese police officers showed higher values than other training studies. [28,29]

Positive correlation between exercise periods and improvement of FVC and FEV1 values been shown in different studies. [24,28,29]

The aging process itself results in a decline in pulmonary function, [30, 31] loss of lung elastic recoil, increased chest wall compliance and a decrease in the strength of respiratory muscles, which has been proposed to be the most important factors contributing to the decline in pulmonary function with age. [32] It is possible that physical activity could counteract this stiffening tendency in the chest wall. Older endurance athletes have been shown to suffer less aging-related effects on lung elastic recoil and diffusion surface.[33] In previous cross-sectional studies, regular exercise training and good physical fitness have been related to better pulmonary function. [34–39] In one longitudinal study, changes in physical activity positively correlated with the level of FVC between the ages of 13–27 years, [40]Jakes et al found that, those who participated in vigorous activity showed a slower rate of decline in FEV during a 3.7-year follow-up, [41] Policemen elderly had a significantly higher FVC, PEFR and FEV1 than those of normal elderly Sudanese males. This result is similar to the study that compared the lung volumes and pulmonary functions of older endurance-trained athletes with those of healthy sedentary age-matched controls.[42] Older athletes, vital capacity, total lung capacity (TLC), and FEV1 were significantly larger than those of the older sedentary men when normalized for age and height.[42] Which agrees with us in suggesting that exercise may delay the decline in pulmonary function occurring in middle and old age. Policemen showed a slower rate of decline in [FVC, FEV1and PEFR] with age [i.e., negative correlation] as compared with other studies which conducted in different countries in Brazil, Ethiopia and the United States.[26, 27] (fig 1, 2, 3).

In general, the amount of physical activity declines with age.[43] According to surveys conducted in Australia, Canada, Finland, and the United States, one-quarter to one-third of the adult population are sedentary in their leisure time. [44]

Thus, it is possible that more people are expected to preserve moderate pulmonary function into old age.[24]

There is significant correlation between PEFR and maximum expiratory pressure which is a representation of respiratory muscle strength.[45] Exercise training increases the PEFR because of an increase in respiratory muscle strength. Peak flow rate is higher in fitter, healthier population such as Armed forces personnel's and athletes.[46] From all this, the normal prediction equation for trainer policemen and their normal spirometric values are different from the normal spirometric values for the general Sudanese population (table 3,4,5). This implied a very important tract in diagnosing pulmonary disease in trained personnel's: police officer.

5. Conclusion

higher physical activity was related to a slower decline in pulmonary function[23]. Normal spirometric values that conducted in different countries must be reviewed again because it ignored exercise factor that slows the decline in pulmonary function with age .These findings are potentially important from a public health and clinical point of view. Our respiratory exercise could be beneficed in obstructive pulmonary disease patients. Exercise training could be used to delay the deterioration in pulmonary function which a wants future study.

6. Abbreviations

FVC : Force vital capacity

FEV1 : Forced expiratory volume in the first second

PEFR : Peak expiratory flow rate inspiratory muscle

PEFTs: Pulmonary function tests

TLC : Total lung capacity

7. Declarations

Ethics approval and consent to participate:

Ethical considerations: Ethical clearance was approved from the ethical committee at The National Ribat University -A written consent was taken from all the participants in this study. Code numbers was used for the participants that are included in this study.

Pulmonary function tests: The pulmonary function tests were carried out using portable spirometer. The apparatus provides a detailed analysis of predicted and derived values. After taking informed written consent from each subject, a detailed history was recorded to rule out the exclusion criteria.

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Consent for publication

Not applicable

Availability of data and material

The authors declare that data well be available when requested

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Competing interests

The authors declare that they have no competing interests

Authors' contributions

Omer A. Musa participated inConception, Design, Supervision, Funding, Literature Review and Critical Review. Barakat M. Bakhit participated inDesign, Funding, Data Collection, Literature review, Writer and Critical review. Mohand H. Malla Design, Funding, Data Collection, Literature review, Writer, Analysis And Critical review

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Tables

Table-1 Descriptive data and lung function for normal male police officers by age group

Variable	(20-25) Y Means ± SD	(25-30) Y Means ± SD	(30-35) Y Means ± SD	(35-40) Y Means ± SD	(40-45) Y Means ± SD	(45-50) Y Means ± SD
number	30	30	30	27	24	30
Mean age (years)	22.1±1.0	27 ±1.2	32.4 ±1.9	34.8 ± 2.9	42.6 ± 2	48 ± 3.1
Height (cm)	178.3± 8.8	176.1± 6	175.6± 6	178.5 ± 5.5	177.8±7.8	176.4± 6.9
FVC (L)	4.53± 0.5	4.03 ±0.48	3.89±0.49	3.87±0.41	3.74±0.50	3.62± 0.52
FEV1(L)	3.98±0.42	3.83± 0.43	3.55± 0.41	3.55±0.47	3.40±0.55	3.15±0.44
PEFR (L/min)	516.5±95.3	517.7±112)	527.3±97.7	463.9±138.1)	442.6±104.7	453.4±100

SD = standard deviation.

FVC = forced vital capacity; FEV1 = forced expiratory volume in 1 second; PEFR = peak expiratory flow rate

Table-2 Comparison between negative correlation in adults police male and normal adult Sudanese males

	negative correlation (*r*) with age	
	adults police male	normal adult Sudanese males
FVC	0.45 *	0.80 *
FEV1	0.51 *	0.77*
PEFR	0.03	0.56 *

P ≤ 0.05

Table-3 FVC, FEV1 and PEFR prediction equations by age and height for policemen

Adult male police officers (20- and 50-years age) lung function prediction equations: -	
0.027 X (cm) – 0.029 X A (years) +0.207	FVC (L)
0.0268 X (cm) – 0.0298 X A (years) - 0.147	FEV1 (L)
2.465 X (cm) -.940 X A (years) + 160.544	PEFR (L/min)

All values for all ages and heights were significantly higher in police officer compared to normal Sudanese predicted values. ($P \leq 0.05$).

Table-4 Normal spirometric reference values (FVC, FEV1 and PEFR) of policemen

190	185	180	175	170	165	160	Height cm	Age year
4.76	4.62	4.48	4.35	4.21	4.08	3.94	FVC	20
4.35	4.22	4.08	3.95	3.81	3.68	3.55	FEV1	20
610	597	585	573	561	548	536	PEFR	20
4.61	4.48	4.34	4.20	4.07	3.93	3.80	FVC	25
4.20	4.07	3.93	3.80	3.66	3.53	3.40	FEV1	25
605	593	581	568	556	543	531	PEFR	25
4.47	4.33	4.19	4.06	3.93	3.79	3.65	FVC	30
4.05	3.92	3.78	3.65	3.52	3.38	3.25	FEV1	30
600	588	576	564	551	539	526	PEFR	30
4.32	4.18	4.05	3.92	3.78	3.65	3.51	FVC	35
3.90	3.77	3.63	3.50	3.37	3.23	3.10	FEV1	35
596	583	571	559	546	534	522	PEFR	35
4.18	4.04	3.91	3.77	3.64	3.50	3.37	FVC	40
3.75	3.62	3.48	3.35	3.22	3.08	2.95	FEV1	40
591	578	567	554	542	529	517	PEFR	40
4.03	3.90	3.76	3.63	3.49	3.36	3.22	FVC	45
3.60	3.47	3.34	3.20	3.07	2.93	2.80	FEV1	45
586	574	562	550	537	524	512	PEFR	45
3.89	3.75	3.62	3.48	3.35	3.21	3.08	FVC	50
3.46	3.32	3.18	3.05	2.92	2.79	2.65	FEV1	50
581	569	557	545	532	520	507	PEFR	50

Table-5 comparison between predicted normal Sudanese and policemen spirometric values

Height (cm)									
Control	Police	Control	Police	Control	Police	Control	Police		
190	190	180	180	170	170	160	160	Parameter	Age
4.19	4.76	3.99	4.48	3.78	4.21	3.58	3.94	FVC	20
3.88	4.35	3.68	4.08	3.48	3.81	3.28	3.55	FEV1	20
564	610	542	585	521	561	500	536	PEFR	20
4.01	4.61	3.89	4.34	3.69	4.07	3.48	3.80	FVC	25
3.78	4.20	3.58	3.93	3.38	3.66	3.18	3.40	FEV1	25
553	605	532	581	510	556	489	531	PEFR	25
4.00	4.47	3.80	4.19	3.59	3.93	3.39	3.65	FVC	30
3.68	4.05	3.48	3.78	3.28	3.52	3.09	3.25	FEV1	30
542	600	521	576	500	551	478	526	PEFR	30
3.90	4.32	3.70	4.05	3.50	3.78	3.29	3.51	FVC	35
3.58	3.90	3.38	3.63	3.18	3.37	2.99	3.10	FEV1	35
531	596	510	571	489	546	467	522	PEFR	35
3.81	4.18	3.60	3.91	3.40	3.64	3.20	3.37	FVC	40
3.48	3.75	3.28	3.48	3.08	3.22	2.89	2.95	FEV1	40
521	591	499	567	478	542	457	517	PEFR	40
3.71	4.03	3.51	3.76	3.30	3.49	3.10	3.22	FVC	45
3.38	3.60	3.18	3.34	2.98	3.07	2.79	2.80	FEV1	45
510	586	489	562	467	537	446	512	PEFR	45
3.62	3.89	3.41	3.62	3.21	3.35	3.00	3.08	FVC	50
3.28	3.46	3.08	3.18	2.88	2.92	2.69	2.65	FEV1	50
499	581	477	557	456	532	435	507	PEFR	50

Figures

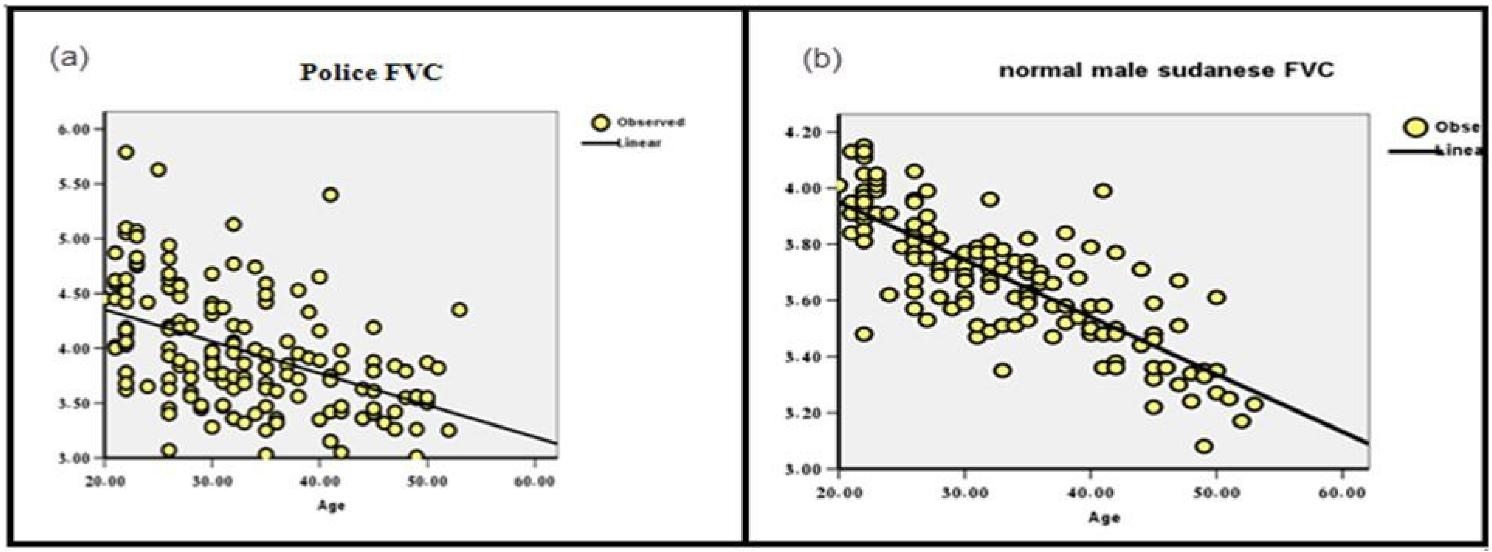

Figure 1

Comparison of regression of FVC in adult policemen (a) and control (b) with age.

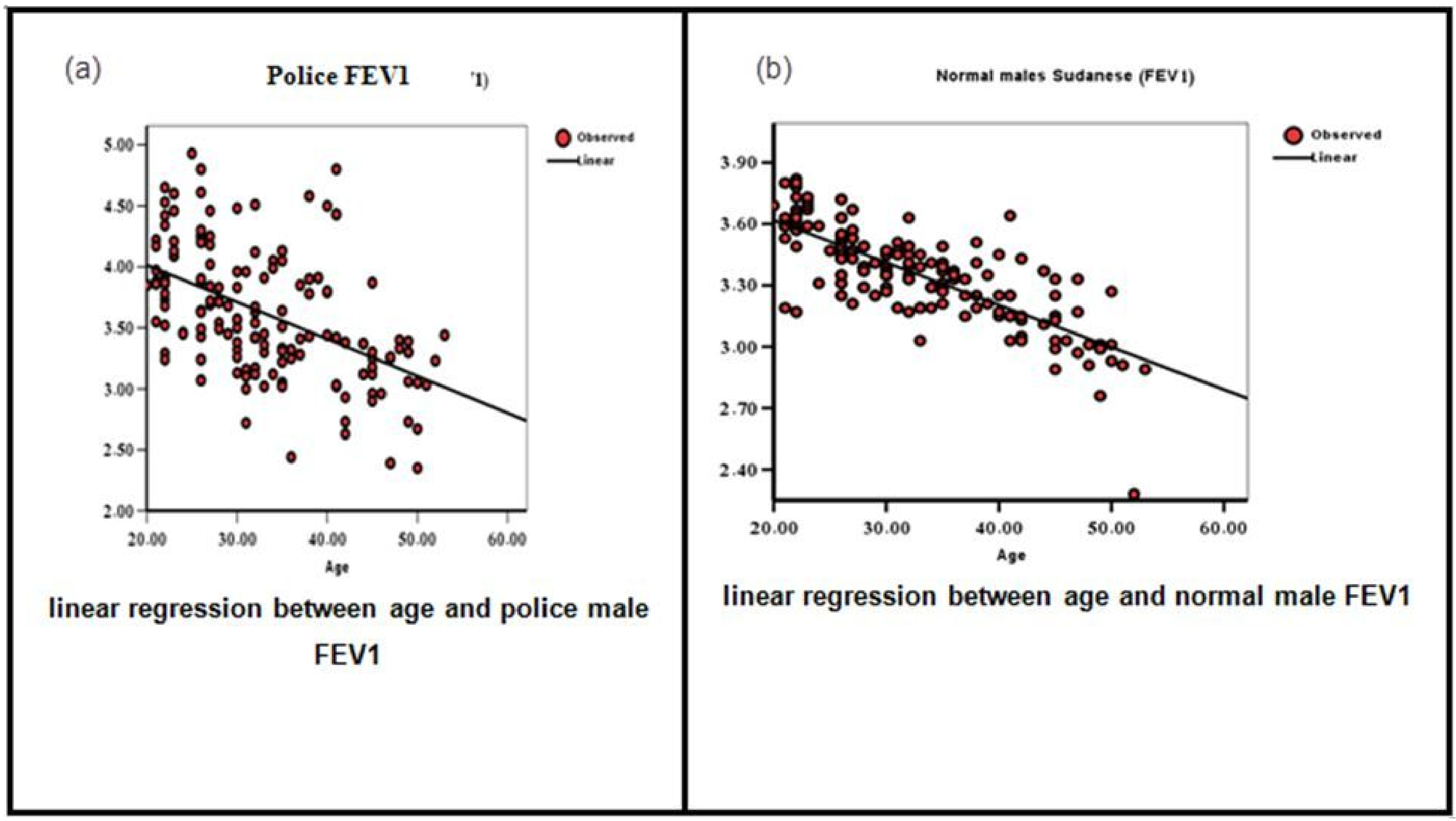

Figure 2

Comparison of regression of FEV1in adult policemen (a) and control (b) with age.

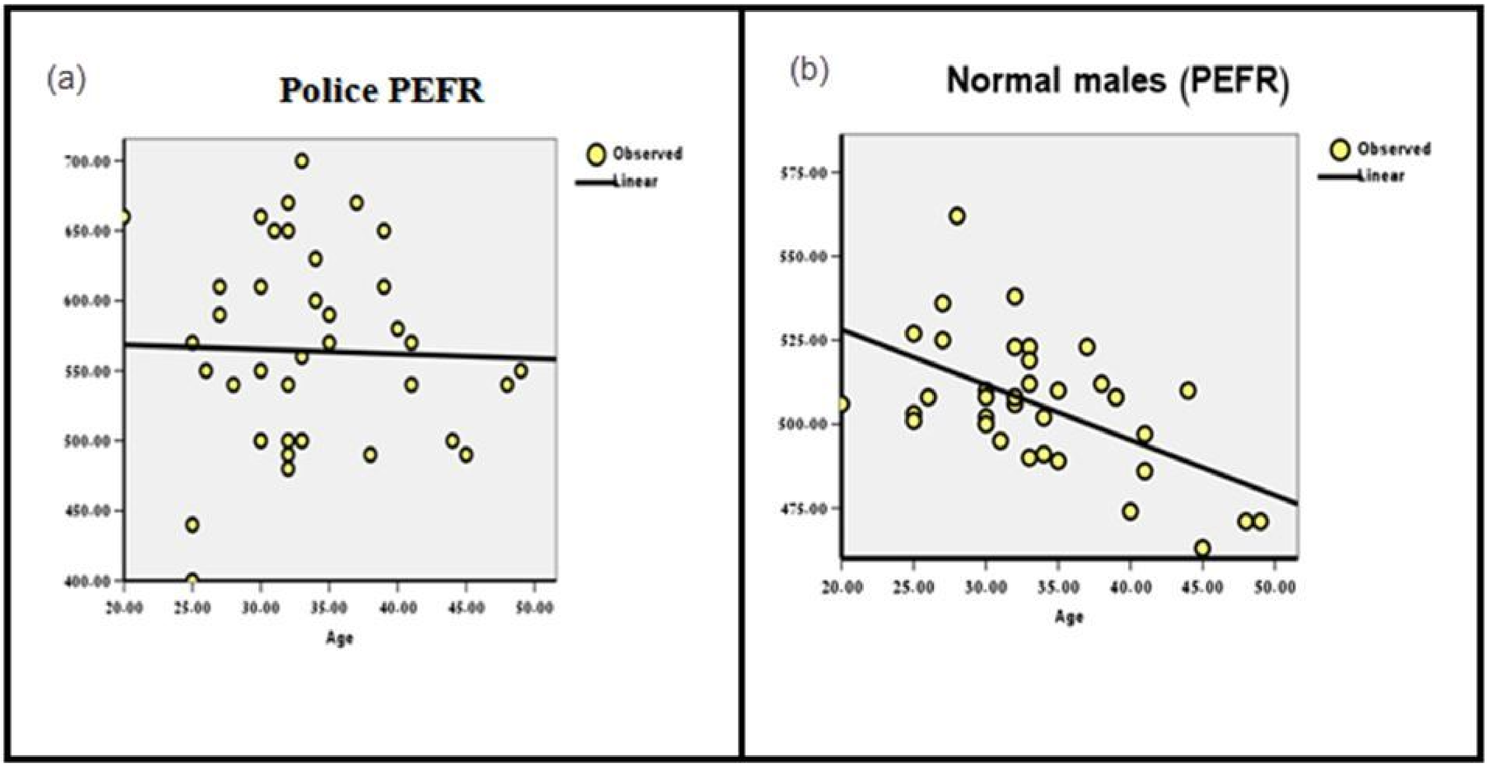

Figure 3

Comparison of regression of PEFR in adult policemen (a) and control (b) with age.