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Phil. Trans. R. Soc. Lond. B 1973 **266**, 113-119
doi: 10.1098/rstb.1973.0040

Phil. Trans. R. Soc. Lond. B. **266**, 113–119 (1973) [113]
Printed in Great Britain

IV. Spirometric studies of Yemenite and Kurdish Jews in Israel

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(*Communicated by A. E. Mourant, F.R.S.* – *Received* 30 *March* 1972 –
Revised 7 *March* 1973)

Measurements have been made of forced expiratory volume (f.e.v.) and forced vital capacity (f.v.c.) in two groups of rural Israeli Jews aged 20 to 30, born in the Yemen and in Kurdistan.

The Jews from Kurdistan had a significantly higher f.e.v. and f.v.c. than the Jews from the Yemen, but there was no difference in the f.e.v. % ratio.

These differences were not accounted for by differences between the groups in age, nor entirely by morphological differences. The pattern of correlations with anthropometric variables suggested that in the Jews from the Yemen the lung function values were related to linearity rather than to body bulk, while in the Jews from Kurdistan they were better correlated with overall size and mass of the body.

f.e.v. and f.v.c. were elevated in smokers compared to non-smokers, possibly owing to an increased respiratory effort to cope with a reduction in the f.e.v. % ratio.

Introduction

Measurements have been made of forced expiratory volume (f.e.v.) and forced vital capacity (f.v.c.) of the Yemenite and Kurdish Jews whose anthropometric characteristics show significant differences (Lourie 1973). The male Kurdish Jews were taller and heavier than the male Yemenite Jews. There was no significant difference in height between the women in the two communities, but the female Kurdish Jews were heavier than the female Yemenite Jews.

Differences in ventilatory capacity between ethnic groups have been noted in many investigations (Cotes & Malhotra 1964; Damon 1966). These variations are not accounted for by differences in body size, although f.e.v. and f.v.c. have been shown to be positively correlated with height (Cotes 1965).

No population study of ventilatory function has previously been made in Israel, where communities of varied origin live under good conditions of nutrition and public health.

Subjects and methods

The subjects comprised 149 Israeli Jews of both sexes from the Yemen (Yemenite Jews) and from Kurdistan (Kurdish Jews). They were all in the age range 20 to 30 years and the age distribution was similar for both communities and both sexes.

All tests were carried out by the same observer in the late afternoon or evening during January and February 1969, with the subject standing. The instrument used was the battery-operated McDermott dry spirometer (McDermott, McDermott & Collins 1968; Garw Electronic Instruments Ltd, Pontyrhyl, Glamorgan) which has a capacity of 9 l. This was calibrated periodically in the course of the study.

The subjects were instructed to breathe in as deeply as possible and then to exhale as *hard* and *fast* as possible into the mouthpiece of the instrument. They were allowed two practice

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attempts to familiarize themselves with the procedure, followed by five 'blows' during which the forced expiratory volume in 1 s ($f.e.v._{1.0}$) was measured. The last three of these 'blows' were continued to maximal expiration, with much verbal exhortation from the tester, for the measurement of forced vital capacity (f.v.c.). All volumes were corrected to b.t.p.s. (body temperature 37 °C, standard pressure 760 mmHg, saturated with water vapour). For each subject the average of the three best technically satisfactory attempts for $f.e.v._{1.0}$ and of the two best for f.v.c. were taken as the values of these indices in the analysis.

At the time the measurements were made, an assessment of each subject's cooperation was noted as 'good' or 'poor' according to their understanding of the manoeuvre required of them. Only the results from subjects whose performance was satisfactory (88.6 % of the total) were included in the analysis. Subjects with a history of cardio-respiratory illness, female subjects more than 6 months pregnant, and one female subject who had been delivered 8 days previously, were also excluded.

Current smoking status was recorded as: none (category 0); less than 20 cigarettes per day (category 1) or 20 or more cigarettes per day (category 2). There were no cigar or pipe smokers.

Results

The means and standard deviations of f.e.v. and f.v.c. and of the ratio $100 \times$ f.e.v./f.v.c. (f.e.v. % ratio) are given in table 1.

Table 1. Means and standard deviations of age, height, mass, forced expiratory volume ($f.e.v._{1.0}$), and f.e.v. %

		Kurdish Jews (males)	Yemenite Jews (males)	Kurdish Jews (females)	Yemenite Jews (females)
number		51	31	26	23
age/years	mean	25.2	24.9	25.7	23.8
	s.d.	2.87	2.97	3.33	3.08
height/cm	mean	168.0	162.8	153.1	153.5
	s.d.	5.56	5.02	4.72	5.93
mass/kg	mean	66.4	61.6	58.2	52.2
	s.d.	10.01	9.46	14.21	9.77
$f.e.v._{1.0}$/l (b.t.p.s.)	mean	3.831	3.427	2.760	2.526
	s.d.	0.561	0.492	0.316	0.308
f.v.c./l (b.t.p.s.)	mean	4.800	4.294	3.416	3.079
	s.d.	0.657	0.585	0.481	0.296
f.e.v. % ratio	mean	79.94	79.91	81.22	81.76
	s.d.	6.42	5.08	5.50	6.97

Values for both f.e.v. and f.v.c. were significantly higher ($P < 0.01$) in the Kurdish than in the Yemenite Jews in both sexes. Within each ethnic group males had higher values of both indices than females, this difference in every case being highly significant ($P < 0.001$). There was no significant difference in the f.e.v. % ratio either within each sex between the ethnic groups or between the sexes in either ethnic group, or between the ethnic groups when results from the two sexes were combined.

Correlation coefficients of f.e.v., f.v.c. and f.e.v. % ratio with some anthropometric variables are given in table 2.

TABLE 2. CORRELATIONS OF LUNG FUNCTION VALUES WITH ANTHROPOMETRIC VARIABLES

For each correlation the value of r, the correlation coefficient, is given, followed by a figure in parenthesis indicating the degrees of freedom and the level of significance denoted by: n.s. (not significant), $P > 0.05$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

		Kurdish Jews		Yemenite Jews	
		males	females	males	females
height	f.e.v.	+0.57 (49) ***	+0.62 (24) ***	+0.55 (29) **	+0.27 (20) n.s.
	f.v.c.	+0.67 (49) ***	+0.68 (24) ***	+0.62 (29) ***	+0.17 (19) n.s.
mass	f.e.v.	+0.43 (49) **	+0.31 (24) n.s.	+0.04 (29) n.s.	−0.10 (21) n.s.
	f.v.c.	+0.47 (49) ***	+0.44 (24) *	+0.09 (29) n.s.	+0.02 (20) n.s.
surface area	f.e.v.	+0.54 (49) ***	+0.41 (24) *	+0.19 (29) n.s.	−0.01 (18) n.s.
	f.v.c.	+0.60 (49) ***	+0.56 (24) **	+0.26 (29) n.s.	−0.04 (18) n.s.
transverse chest	f.e.v.	+0.31 (47) *	+0.35 (22) n.s.	+0.02 (28) n.s.	+0.23 (15) n.s.
	f.v.c.	+0.36 (47) *	+0.40 (22) *	+0.07 (28) n.s.	+0.61 (15) n.s.
anterior-posterior chest	f.e.v.	+0.30 (47) *	+0.41 (24) *	+0.03 (28) n.s.	−0.01 (19) n.s.
	f.v.c.	+0.24 (47) n.s.	+0.45 (24) *	+0.09 (28) n.s.	+0.01 (19) n.s.
chest circumference†	f.e.v.	+0.33 (46) *	—	−0.10 (28) n.s.	—
	f.v.c.	+0.33 (46) *	—	−0.10 (28) n.s.	—

† Not measured in females.

There was no significant correlation with age except f.e.v. % ratio in the female Yemenite Jews (r −0.50, $P < 0.05$); however, the age range was narrow. Highly significant ($P < 0.01$ or $P < 0.001$) positive correlations of f.e.v. and f.v.c. with height were obtained in all groups except the female Yemenite Jews, in whom the value of r was positive but low. F.e.v. and f.v.c. were positively correlated with mass in all groups, with the exception of f.e.v. in the female Yemenite Jews; the levels of significance reached varied between the groups. Other measures of body size tended to give higher correlations with the lung function indices in the Kurdish than in the Yemenite Jews. Regression equations of f.e.v. and f.v.c. on height were calculated (table 3), hence the following values for a standardized height of 165 cm were obtained:

	f.e.v. (1)	f.v.c. (1)
male Kurdish Jews	3.67	4.57
male Yemenite Jews	3.41	4.45
female Kurdish Jews	3.24	4.25
female Yemenite Jews	2.56	3.17

TABLE 3. REGRESSIONS OF f.e.v.$_{1.0}$ AND f.v.c. (l b.t.p.s.) ON HEIGHT H (cm)

Standard errors of the regression coefficients are given in parentheses.

	equation	residual standard deviation
Kurdish Jews, male	f.e.v. = $0.0564H$ (± 0.0118) − 5.648	0.468
	f.v.c. = $0.0783H$ (± 0.0125) − 8.348	0.494
Yemenite Jews, male	f.e.v. = $0.0535H$ (± 0.0152) − 5.287	0.419
	f.v.c. = $0.0719H$ (± 0.0170) − 7.414	0.468
Kurdish Jews, female	f.e.v. = $0.0417H$ (± 0.0107) − 3.620	0.252
	f.v.c. = $0.0696H$ (± 0.0152) − 7.326	0.359
Yemenite Jews, female	f.e.v. = $0.0145H$ (± 0.0124) + 0.267	0.329
	f.v.c. = $0.0077H$ (± 0.0117) + 1.902	0.310

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Differences between the ethnic groups remain and are significant for the women but not for the men.

About half the male Kurdish Jews were smokers, the majority of these being heavy smokers (more than 20 cigarettes per day). In the other groups only 10 to 20 % of subjects smoked, most of whom consumed less than 20 cigarettes per day.

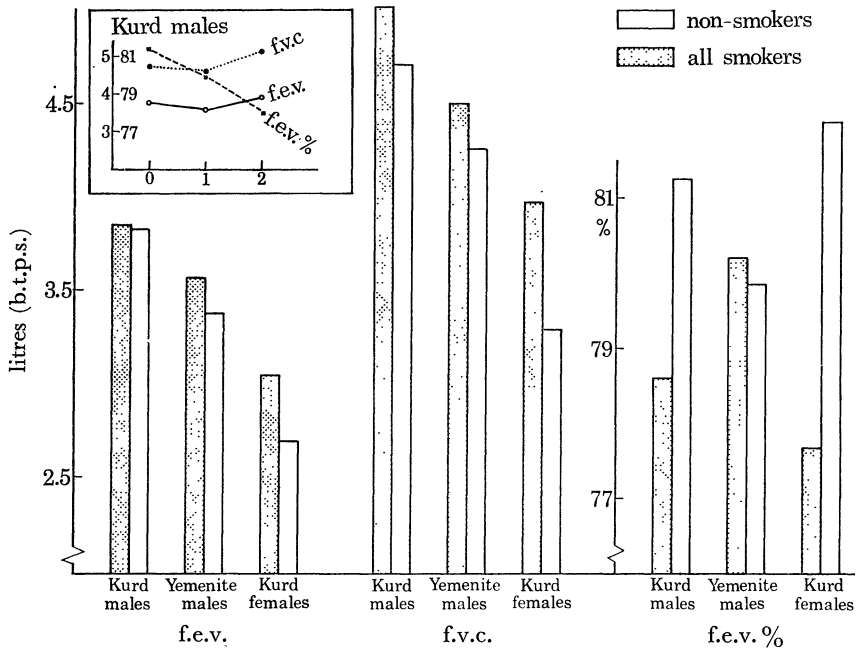

FIGURE 1. Smoking and lung function. (Inset: the scale units on the ordinate are litres (b.t.p.s.) on the left of the axis (for f.e.v. and f.v.c.), and percentages on the right (for f.e.v. %). Abscissa units represent daily cigarette consumption of 0, less than 20 (1), and 20 or more (2).)

In figure 1 the mean values of the three lung function indices are compared in smokers and non-smokers. The number of smokers among the female Yemenite Jews was insufficient for inclusion in this analysis. In each group, both f.e.v. and f.v.c. were higher in the smokers than in the non-smokers. Among the Kurdish Jews f.e.v. % was lower in smokers, and in the male Yemenite Jews this index was only marginally higher in the smokers. The trends of these indices with increasing tobacco consumption are shown in the inset to figure 1; the number of subjects in the two smoking categories was only sufficient to warrant this analysis in the case of the male Kurdish Jews. These trends were towards a progressive decrease in the f.e.v. % ratio, while f.e.v. and f.v.c. were slightly lower in the light smokers than in the non-smokers, but higher in the heavy smokers.

DISCUSSION

The main finding is that there is a significant difference between the Kurdish and Yemenite Jews in both forced expiratory volume and forced vital capacity. The ethnic difference is particularly marked between the women in the two communities. It has been shown that sex, age and height together account for about 60 % of the total variability in f.e.v. and f.v.c. (Cotes 1965). In certain populations other anthropometric variables and factors such as climate, physical activity in adolescence, smoking and respiratory disease can also account for

part of the variation (Ferris, Anderson & Zickmantel 1965; Damon 1966; Cotes & Ward 1966; Frisancho 1969).

The highly significant sex differences in f.e.v. and f.v.c. in both Kurdish and Yemenite Jews are similar to those observed in all other studies. The differences between the two communities were not due to age, as the age range (20 to 30) and age distribution were similar. There were significant differences in height between the men in the two communities and after standardization for height the differences in f.e.v. and f.v.c. were reduced and were no longer significant. There was no significant difference between the women of the two communities as regards height, hence after standardization there was still a significant difference between the Kurdish women and Yemenite women. Body mass was correlated with the pulmonary function indices in the Kurdish Jews; after standardization for height and mass there was still a significant difference between the women in the two communities.

The small (and non-significant) differences in f.e.v. % between the sexes and between the ethnic groups are similar to the findings in other studies (Cotes & Malhotra 1964; Damon 1966). Influences on this ratio appear to be environmental (e.g. smoking, air pollution, chest disease) rather than genetic, and the significant sex or ethnic group differences observed in some studies (Abramowitz, Leiner, Lewis & Small 1965; Huizinga & Glanville 1968) may be ascribed to one or more of these causes.

The expected influence of cigarette smoking is to decrease lung function indices (Hensler & Giron 1963; Cotes 1965; Blackburn *et al.* 1965; Lundman 1966; Huhti 1967; Royal College of Physicians 1971). No decrease was observed in this study in f.e.v. or f.v.c.; instead these were larger among the smokers although there were no significant differences between smokers and non-smokers. Stanescu, Gavrilescu & Teculescu (1968) also observed increased f.e.v. and f.v.c. in young smokers; Peters & Ferris (1967) found a higher f.v.c. (but not f.e.v.) in light smokers but heavy smokers had reduced values. Seltzer (1963, 1968) has suggested that morphological differences exist between smokers and non-smokers. In the present study, smokers were on average taller than non-smokers but the differences were not significant. Although there were more smokers amongst the Kurdish Jews than the Yemenite Jews, this only accounted for a trivial part of the differences in f.e.v. and f.v.c.

Climatic factors were identical for the two groups, all of whom had lived in Israel for 18 years. None of the subjects had signs or symptoms of cardiorespiratory disease, so these influences could not have contributed to the ethnic difference. It is therefore concluded that in the case of the women a significant difference existed between the Kurdish and Yemenite Jews and this difference could be due to genetic factors. There are a number of studies showing that differences in vital capacity exist between ethnic groups (Cotes & Malhotra 1964; Abramowitz *et al.* 1965; Damon 1966). In figure 2 the values for f.e.v. and f.v.c. in the Israeli groups are compared with those in American white (Ferris, Anderson & Zickmantel 1965) and negro (Abramowitz *et al.* 1965) samples, and in the Kurumba, a West African population (Huizinga & Glanville 1968). All values have been standardized to an age of 25 years and a height of 165 cm according to the regression equations derived for each of these populations.

Among the males, vital capacity is greater in both Israeli groups than in the U.S. whites (although f.e.v. in the Yemenite Jews is lower than in the whites). Both American samples consisted predominantly of town-dwellers with sedentary occupations, exposed to urban air-pollution, which may contribute to this difference; the Kurdish and Yemenite Jews were living in the country and were engaged in physical work during much of the day. The Kurumba,

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however, were primarily farmers and herdsmen and were not entirely dissimilar to the subjects of this study in their way of life in a hot, dry climate. They were less well-nourished than the Israelis, and lived under inadequate conditions of hygiene and medical care, but to account for the striking contrast in lung function between these populations it would be necessary to postulate some environmental factor, or combination of factors, of considerable magnitude in the absence of a genetic basis for the difference.

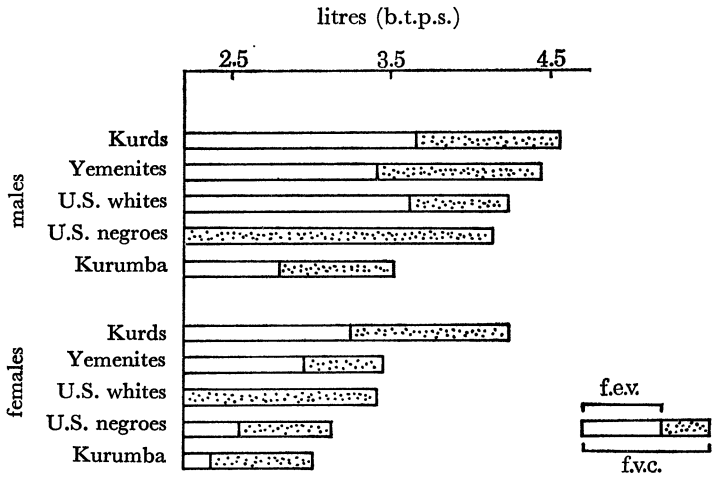

FIGURE 2. F.e.v. and f.v.c. in different ethnic groups, standardized to age 25 years and height 165 cm.

The very high values found in the female Kurdish Jews is difficult to explain; if this is not an artefact produced by the small sample size, it suggests that they may have a vital capacity at least as large as that of any other low-altitude population yet described.

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