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The effect of ethnic origin on pulmonary prediction equations in a Jewish immigrant population

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Summary
Background: Ethnic origin affects spirometric prediction values. Our aims were to investigate the effect of ethnic origin on prediction equations in an immigrant-based society, identify possible deviations from commonly used prediction equations and analyze the effect of miscalculation in a large cohort of apparently healthy individuals.
Methods: Healthy never-smokers participants from a large Israeli survey underwent lung function testing and were divided into two major ethnic groups: Ashkenazi Jews (AJ) and Sephardic Jews (SJ). Data were analyzed by multiple linear regressions. Forced vital capacity (FVC), forced expiratory volume in 1 s (FEV_1) and the FEV_1/FVC ratio were measured according to ERS-ATS guidelines.
Results: The study population comprised 3150 individuals (AJ = 1817; SJ = 1333). AJ tended to be older and taller than SJ (all $p<0.005$). Ethnicity entered as a significant regression variable for FVC for both genders and for FEV_1 for females only. The final regression model for both FVC and FEV_1 had $R^2 = 0.71$ and the standard error of the estimate (SEE) for FVC and FEV_1 were 0.54 and 0.43 L, respectively. The regression model for the FEV_1/FVC ratio has less statistical strength ($R^2 = 0.06$, SEE = 6.15%). We found statistically significant underestimates of predicted lung volumes from the commonly used prediction equation for each ethnic group.
Conclusions: Ashkenazi and Sephardic Jews have different ranges of normal pulmonary function values. Lung function prediction equations in an immigrant-based society should be based on local and not previously reported regional equations and adjusted for ethnic attributed variance.

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Introduction

Ethnic-attributed pulmonary function test variance has been previously shown in the medical literature,[1–6] and official recommendations have been made.[7,8] In spite of this, many countries use pulmonary function prediction equations, which are not ethnically tailored. For example, until the publication of the NHANES III pulmonary prediction equations in 1999,[3] most pulmonary function laboratories in the United States used prediction equations for normal values based predominantly on measurements from subjects of European descent.[9] The default prediction equations used in our pulmonary laboratory that are widely used in Israel are also based on European prediction equations, being mainly the European Coal and Steel Community (ECSC) prediction equations.[10,11] In an immigrant-based society such as Israel, ethnic origin may have a role to play in determining normal pulmonary function values. Regionally based pulmonary prediction equations previously presented, such as Middle Eastern[12] or Mediterranean,[13,14] may also be inappropriate for the Israeli Jewish population.

This study utilizes the fact that Israel is an immigrant-based society. Approximately one-third of Israeli Jews today are foreign-born, and the majority of the remaining two-thirds are first generation native-born in the country.[15] Jews arrived in Israel from some 150 countries of origin in Asia, Africa, Eastern and Western Europe, North and South America and Oceania. Often, Israel's immigrants and their native-born descendants are dichotomously differentiated by origin: Jews of Middle Eastern or North African descent (SJ—Sephardic Jews) and Jews of European descent (AJ—Ashkenazi Jews). Hence, each of these two groups encompasses subjects from multiple nationalities who nevertheless share similar physical characteristics.[16]

The present study aims to investigate the differences in normal lung function values between two major ethnic groups, to compare them to the currently used prediction equation in Israel and to widely used prediction equations worldwide and to analyze the possible effect of miscalculation by the use of non-tailored pulmonary prediction equations.

Methods

Population and ethnicity analysis

We analyzed the data collected as part of the Tel Aviv Medical Center Inflammation Survey (TAMCIS),[17–19] a registered data bank of the Israeli Ministry of Justice. All individuals enrolled were recruited during their routine annual health check-up and gave their written consent in accordance with the guidelines of the institutional ethics committee. A total of 10,851 subjects gave their informed consent. A systematic examination ruled out enrollment bias due to sociodemographic or biomedical variables.

Two thousand one hundred and fifty-seven subjects were initially excluded from the current analysis due to a history of any malignancy, immunosuppressive therapy, chronic lung disease, pregnancy, systemic steroidal or non-steroidal treatment (except for aspirin at a dose of $\leqslant$325 mg/day), bronchodilator, antihistamine or inhaled steroid use and subjects with an acute infection or who had undergone an invasive procedure (surgery, catheterization, etc.) in the previous 6 months. Excluded in addition, were 3627 individuals with a past or current history of smoking and 825 individuals who did not perform pulmonary function tests or in whom the test was not satisfactory.

We then divided the study population into ethnic groups utilizing a strict criterion whereby each participant's ethnic group was defined by both parents having the same country of birth. Applying this criterion, participants were found to originate from some 40 different backgrounds with group sizes ranging from a handful of cases to samples as large as a few hundred cases. Such a distribution of the major explanatory variable requires the merger of individual groups into wider categories of origin. We thus reconstructed two major ethnic groups of Middle Eastern–North African (SJ) and European (AJ) descent, according to the known Jewish immigration patterns throughout the centuries.[16] All other ethnic origin groups, as well as individuals whose parents originated from different ethnic groups were further excluded from the analysis.

Table 1 Pulmonary function relevant baseline characteristics of subjects according to gender and ethnic group.

	Ashkenazi Jews						Sephardic Jews						*p*-Value*
	Males ($N = 1154$)			Females ($N = 663$)			Males ($N = 786$)			Females ($N = 547$)			
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	
Age (years)	45	11	21–79	47	10	20–74	43	10	21–84	43	9	20–69	<0.001
Height (cm)	176	7	150–197	163	6	147–181	174	7	150–195	161	6	142–185	<0.001
Exercise intensity (hours/week)	2.4	2.6	0–25	2.0	2.5	0–20	2.1	2.7	0–28	1.7	2.4	0–18	0.004
FVC (l)	4.7	0.8	2.0–7.5	3.3	0.6	1.7–5.3	4.6	0.8	1.8–7.5	3.2	0.6	1.6–5.1	<0.001
FEV_1 (l)	3.8	0.6	1.7–6.2	2.7	0.5	1.4–4.5	3.8	0.7	1.5–6.0	2.7	0.5	1.4–4.1	<0.001
FEV_1/FVC (%)	80.9	6.3	56–105	82.8	6.5	60–100	82.5	6.0	54–99	82.9	6.4	59–102	0.001

*p-Value between ethnic groups, adjusted for gender and age (besides age comparison).