ELSEVIER

Spouse Selection and Environmental Effects on Spouse Correlation in Lung Function Measures

MATTHEW W. KNUIMAN, PhD, MARK L. DIVITINI, BAppSc, AND
HELEN C. BARTHOLOMEW, GradDipComp

PURPOSE: Concordance between spouses may be due to partner selection factors and/or the effects of marriage/environment. The extent to which partner selection factors contribute to spouse concordance has important implications for heritability studies. The aim of this study was to examine the magnitude of spouse correlation in lung function measures and its relationship to duration of marriage.
METHODS: Cross-sectional and longitudinal data collected over the period 1969 to 1995 for 2615 couples from the Busselton Health Study have been analyzed using the program FISHER.
RESULTS: Unadjusted correlations were around 0.45 for forced expiratory volume in 1 second (FEV1) and 0.25 for FEV1/FVC (forced vital capacity) and were reduced to 0.05 and 0.10, respectively, after adjustment for age, height, and smoking. No trend with marriage duration was apparent in both cross-sectional and longitudinal analyses but there was a significant downward trend in the correlations with age at marriage.
CONCLUSIONS: The findings indicate that observed correlations in lung function measures are mostly due to partner selection factors and that partner selection factors have greater influence for couples that marry at younger ages. Family studies that aim to identify and separate genetic from other influences on lung function measures should not regard the mother–father correlation as due to common environment effects.
Ann Epidemiol 2005;15:39–43. © 2004 Elsevier Inc. All rights reserved.

KEY WORDS: Cross-sectional Analysis, Forced Expiratory Volume, Longitudinal Studies, Marriage Duration, Regression Analysis, Spouse Concordance.

INTRODUCTION

There is considerable interest in identifying genetic, lifestyle, and environmental factors contributing to disease development and family studies involving non-genetically related parents are often used to segregate genetic from other effects (1–3). In most families the parents are a married couple who have shared lifestyle choices and household and neighborhood influences. It is generally assumed that marriage/lifestyle/environment factors, if relevant to the trait under study, induce positive concordance and concordance should increase with marriage duration (4, 5). However, any concordance between spouses may be due to partner selection factors ("assortative mating") as well as the effects of marriage/lifestyle/environment (5, 6). The extent to which partner selection factors contribute to spouse concordance has important implications for heritability studies (7).

Cross-sectional studies of married couples allow investigation of spouse concordance with marriage duration but are subject to sampling bias if, for example, marriages of couples who were less similar at marriage are more likely to terminate prematurely due to divorce or death of one partner (5). Cohort or longitudinal studies are less susceptible to bias.

Spirometric lung function measures are commonly used indicators for underlying lung diseases and have also been shown to be risk factors for cardiovascular diseases and total mortality (8, 9). The heritability of spirometric indices, chronic obstructive airway disease, and asthma are of considerable interest (1, 3).

Here we use regression modeling to investigate spouse correlations in measures of lung function using both cross-sectional and longitudinal data on general population samples of spouse pairs to ascertain the influences of partner selection and environmental factors.

METHODS

Population and Subjects

Busselton is a town in Western Australia and its residents have been the subject of several health surveys over the period 1966 to 1995. Cross-sectional surveys of all adults in Busselton were conducted in 1966, 1969, 1972, 1975, 1978, and 1981, and a follow-up survey was conducted in 1994/1995. Lung function was measured in all surveys except for women in 1966.

From the School of Population Health, University of Western Australia, Perth, Western Australia.
Address correspondence to: Dr. M.W. Knuiman, School of Population Health (M431), University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia. Tel.: +61-08-6488-1250; Fax: +61-8-6488-1188. E-mail: matthew@sph.uwa.edu.au
Received November 17, 2003; accepted April 19, 2004.

1047-2797/05/$–see front matter
doi:10.1016/j.annepidem.2004.04.005

AEP Vol. 15, No. 1
January 2005: 39–43

Selected Abbreviations and Acronyms

FEV1 = forced expiratory volume in 1 second
FVC = forced vital capacity
SD = standard deviation
SE = standard error

A total of 2615 husband–wife pairs attended at least one survey together (and provided data on lung function and key determinants) since 1969. The cross-sectional analysis used lung function data for pairs taken from the survey when marriage duration was least to get the maximum data possible on the early years of marriage.

A total of 464 husband–wife pairs attended both the 1969 and 1981 surveys (12 years apart) and a total of 624 husband–wife pairs attended both the 1981 and 1994/1995 surveys (13 years apart). Longitudinal analyses were conducted for these two groups.

Measurements

Lung function was measured by spirometry (1). The measures of lung function that have been analyzed are forced expiratory volume in 1 second (FEV1) and the ratio of FEV1 and forced vital capacity (FVC). The ratio FEV1/FVC is a measure of airway narrowing and has been converted to percent for analysis (i.e., multiplied by 100). Gender, age, height, and smoking are known to be key determinants of lung function in adults (10). Gender, age, and smoking were assessed by questionnaire and height was measured by stadiometer.

Statistical Methods

FISHER is a Fortran program that fits multivariate normal models to familial data and longitudinal data using maximum likelihood estimation (11, 12). It allows flexible modeling of both the mean and variance/correlation structures and has been used for both the cross-sectional and longitudinal models for lung function in spouse pairs.

The models that have been used for the mean are:

$$[\text{M1}] \quad \text{Mean} = \beta_1 + \beta_2 \text{ sex}$$

$$[\text{M2}] \quad \text{Mean} = [\text{M1}] + \beta_3 \text{ age} + \beta_4 \text{ sex.age} + \beta_5 \text{ age}^2 + \beta_6 \text{ sex.age}^2$$

$$[\text{M3}] \quad \text{Mean} = [\text{M2}] + \beta_7 \text{ height} + \beta_8 \text{ sex.height}$$

$$[\text{M4}] \quad \text{Mean} = [\text{M3}] + \beta_9 \text{ (if former smoker)} + \beta_{10} \text{ (if current smoker)} + \beta_{11} \text{ sex.(if former smoker)} + \beta_{12} \text{ sex.(if current smoker)}$$

In all situations the variance has been assumed constant, i.e., variance $= \sigma^2$. A model that allowed the variance to vary with age was considered but found not to be needed.

The models used for the husband–wife correlation in lung function in the cross-sectional analysis were:

$$\text{Correlation} = \rho$$

$$\text{Correlation} = \rho_k \text{ if in marriage duration group } k\ (0-4, 5-9, \ldots 25-29, 30+ \text{ years})$$

$$\text{Correlation} = \rho + \lambda \text{ marriage duration}$$

$$\text{Correlation} = \rho + \lambda_1 \text{ marriage duration} + \lambda_2 \text{ age at marriage}$$

The correlation model used in the longitudinal analyses allowed a separate correlation for each pair within the class (husband time 1, husband time 2, wife time 1, wife time 2). Only the estimated husband–wife correlations for time 1 and time 2 are reported.

RESULTS

Cross-sectional Analysis

Table 1 shows the characteristics of the 2615 couples used in the cross-sectional analysis of spouse correlation in lung function. The crude (i.e., unadjusted) correlation between husband and wife is 0.572 for FEV1 and 0.288 for FEV1/FVC. Note also that the spouse correlation is very high for age at marriage and age at measurement and moderate for height (0.269) and smoking (0.266). There is a good range of age at marriage and marriage duration. Figure 1 shows the distribution of marriage duration.

Table 2 shows the estimated residual variance and correlation by extent of adjustment in mean (i.e., M1–M4) for the constant correlation model ρ in the cross-sectional

TABLE 1. Characteristics of 2615 married couples in cross-sectional analysis who were participants in Busselton health surveys, Western Australia, 1969–1995

Characteristic*	Husbands	Wives	Correlation
Age (yrs)	46.7 ± 15.4	43.2 ± 15.1	0.955
Marriage duration (yrs)	17.2 ± 12.3	17.2 ± 12.3	1.000
Age at marriage (yrs)	29.5 ± 9.1	26.0 ± 8.3	0.865
Height (meters)	1.74 ± 0.07	1.61 ± 0.06	0.269
Smoking			
1 never (%)	31	65	
2 former (%)	29	15	0.266
3 current (%)	40	20	
FEV1 (L)	3.49 ± 0.95	2.57 ± 0.67	**0.572**
FEV1/FVC (%)	74.2 ± 10.6	77.3 ± 9.2	**0.288**

*Values are mean ± SD or percent.