Acta Genet Med Gemellol 33:413-424 (1984)

TWIN RESEARCH 4 - Part C: Clinical Studies
Proceedings of the Fourth International Congress on Twin Studies (London 1983)

Twin Analysis as a Potential Tool for Examining Psychosocial Factors Associated with and Preceeding Smoking Behaviors

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Abstract. Data from the young cohort of the Swedish Twin Registry are being used in an attempt to describe characteristics which distinguish among current, non- and ex- smokers prior to the development of a smoking habit versus those present after establishment of the habit (or lack of one). With twins as a sample of individuals, the psychosocial variables instability, extroversion, leisure activity, relative weight, alcohol, coffee and psychopharmaceutic drug use were examined jointly as predictors of current smoking status in multiple regression analyses. This phase was intended to replicate and expand upon earlier studies characterizing current, non- and ex-smokers. These analyses were then performed on MZ nonsmoking twin individuals who were classified on the basis of their cotwins' smoking status. Pattern of variation in the psychosocial variables across the groups of nonsmokers were similar to the pattern seen for current, ex- and nonsmokers. Characteristics in MZ nonsmokers which are predictive of their cotwins' smoking status may be interpreted as those present prior to development of a smoking habit. Selected results from these analyses will be presented.

Key words: Twin model, Psychosocial behaviors, Smoking

INTRODUCTION

For drug-use traits such as smoking which develop after adolescence, it is difficult to know whether associations with psychosocial traits are present prior to, or develop as a consequence of the smoking habit. Prospective studies provide good measures of the direction of influence for such traits; however, they are costly, time consuming, and relatively rare. The purpose of the following study is to present a design whereby twins can be used retrospectively to assess the importance of various factors for the development vs the establishment of a smoking habit in the absence of truly prospective data.

Supported in part by grant CTR-1367

In a review of the literature on psychosocial influence on cigarette smoking, Kozolowski [8] states that studying the determinants of cigarette smoking is fundamentally a problem for multivariate analysis. However, the majority of articles describing the psychosocial characteristics of smokers vs nonsmokers presents univariate analyses of a wide variety of measures, from socioeconomic status to personality variables, to coffee and alcohol use. Reviews by, among others, Matarazzo and Saslow [9], Smith [14], Dunn [4], and Kozolowski [8] summarize differences between smokers and nonsmokers for about 40 psychosocial characteristics. Differences were found for personality traits such as extroversion, neuroticism, anxiety, locus of control and impulsivity; life style characteristics such as alcohol and coffee use, sports participation, academic performance and marital status; various measures of relative weight; and demographic characteristics such as sex, age, socioeconomic status and urban/rural residence.

Other than the studies by Cherry and Kiernan [3] and Thomas [15], little longitudinal work has been reported elucidating which factors precede, develop concurrent to, or are a consequence of the smoking habit. In a large longitudinal study, Cherry and Kiernan [3], reported that personality scores for neuroticism and extroversion at age 16 were found to have some power in predicting smoking behavior at age 25. A greater variety of variables were included in the study restricted to medical students by Thomas [15]. Coffee, alcohol, systolic blood pressure change, resting heart rate, anxiety and cholesterol measures at age 22 contributed significantly to discriminant functions between non-, current and ex-smokers after the age of 30. Both studies provide valuable information and suggest that large scale, multivariate analyses of a range of psychosocial variables are important for elucidating the relative importance of these measures for establishment and maintenance of the smoking habit.

Studies involving twins and families of twins have contributed significantly to the assessment of the relative proportion of variance for smoking, personality, alcohol and coffee use which can be ascribed to environmental vs genetic factors. Up to 50% of the variation for smoking [11,16] can be ascribed to genetic sources. This is higher than most reports of explained variance for smoking; however, it does not clarify which specific genetic factors contribute to this variance. For instance, a portion of the genetic variation may be shared with genetic variation in other characteristics correlated with the smoking habit such as instability or other psychosocial variables.

The present study will explore the potential of twin study designs for examining the precedents and consequents of smoking without necessitating a longitudinal design. Identical (MZ) twins share all their genes. For traits which have a great degree of genetic influence, one MZ twin's scores can to a great extent predict the cotwin's scores. For smoking, the genetic influence is about equally as strong as the environmental one [16]. Thus, although many MZ pairs are concordant with respect to smoking status, approximately 15% are discordant [10].

A type of threshold effect is probably at work for categorical traits such as smoking status. The genotype of an individual provides a range of reaction, and environmental factors then influence at which level within this range the trait is expressed (phenotype) [7]. Certain individuals become smokers if their genotype is such that environmental factors can influence them to pass a threshold for becoming a smoker. In Fig. 1, the height of the dots represents the underlying probability of becoming a smoker. Genotype A would be a smoker regardless of the environments to which he/she is exposed. Genotype B, on the other hand, would be a non-smoker in environments with less pressure for smoking, but if

exposed to environment with greater pressure would probably pass the threshold and become a smoker. Genotype C would need a greater environmental pressure to become a smoker. Still other genotypes (D) would not surpass the threshold regardless of environmental exposure and remain nonsmokers.

In the case of MZ twins (Fig. 2) both have the same genotype. In pairs where both are smokers (A), the identical genotype is presumably associated with a high probability of being a smoker, and environmental exposures are such that both twins develop a smoking habit. In discordant MZ pairs (B), the genotype may predispose both twins to becoming a smoker; however, one twin does not react to the environmental factors in the same way and does not develop a smoking habit (but may be very close to it). For other discordant pairs (C), the twins may simply not have been exposed to the same environmental factors. Finally, pair D represents a pair genetically concordant for nonsmoking.

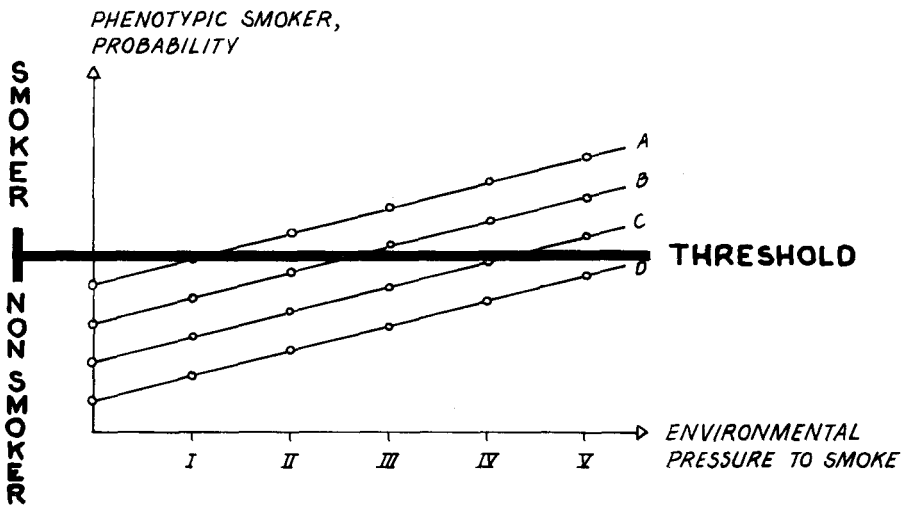

Fig. 1 - Model of threshold effect for individuals.

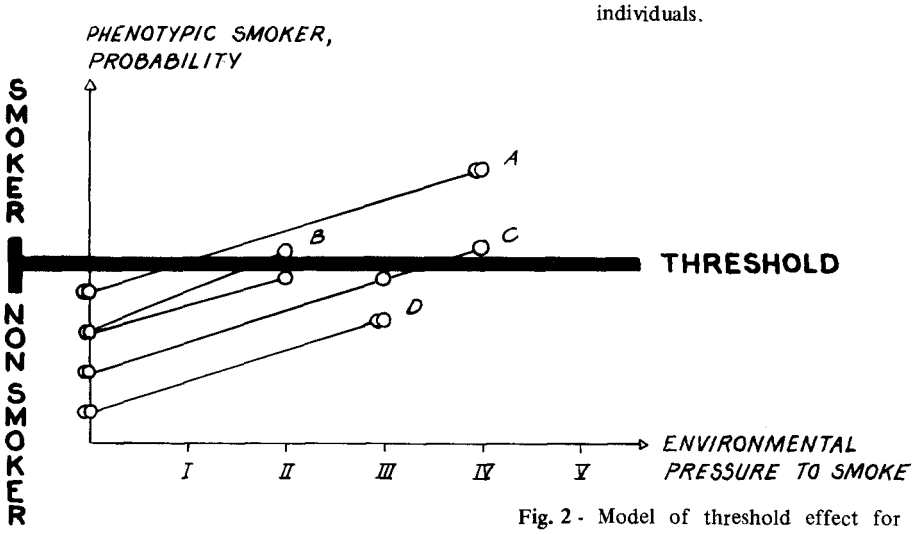

Fig. 2 - Model of threshold effect for twin pairs.

https://doi.org/10.1017/S0001566000005869 Published online by Cambridge University Press

This model may be expanded to include ex-smokers, and other factors, such as psychosocial traits which themselves are results of genetic and environmental influences. In the present study, we will focus primarily upon pairs similar to B, C and D. One can hypothesize that the nonsmoking twin in pairs B and C reflects the smoking cotwin prior to establishing a smoking habit.

The present study employs a cotwin design and comprises several phases. First, using a large sample of twins as individuals (hereafter called A-series analyses), analyses of variance of the psychosocial variables – extraversion, instability, coffee, alcohol and psychopharmaceutic use, relative weight and leisure time activity – by smoking status, sex and age, will permit univariate description of the smoking groups for the variables. For example, whether smokers have higher instability of alcohol scores than non- or ex-smokers, will be addressed by this analysis. On a multivariate level, multiple regression will be used to see to what extent variation in smoking status can be explained by the above named psychological variables and the relative importance of these variables in differentiating among smoking status groups.

In the second phase, which will be called the MZ NET (nonexposed twin) analysis of non smokers, nonsmoking MZ twins are classified on the basis of their cotwin's smoking status. Analysis of variance and multiple regression analyses of the nonsmokers will be employed to characterize groups of nonsmokers categorized by the smoking status of their cotwin. Traits which are of importance in both the A- and MZ-NET series for predicting smoking status (Type I) can be interpreted as those traits present prior to establishing a habit. On the other hand, traits important in distinguishing among smoking groups in the A-series but not in the MZ-NET series nonsmoker analysis (Type II) may be hypothesized to be those which covary with smoking after development of the habit. In similar fashion, measures which may discriminate among nonsmokers in the MZ-NET series analyses, but are not of importance in the A-series (Type III), are probably those which represent differences in nonsmokers after their cotwin has developed a smoking habit or not.

METHODS

Subjects

The New Swedish Twin Registry, compiled in 1973, contains postal questionnaire data from both members of 13,865 pairs [10]. Because twins younger than 18 in 1973 were unlikely to have had sufficient time to develop a smoking habit, only twins born prior to 1956 were included in the analyses. Several types of epidemiological baseline data were collected, including measures of smoking habits, alcohol, coffee and other drug consumption, height, weight, leisure time activity, psychosocial extraversion and instability, diet, measures of living and work situation, and self report information on various health parameters pertaining to the heart and respiratory system. Zygosity was determined by response to an item concerning similarity in childhood. The validity of this method has been tested by Cederlöf et al [2] and reconfirmed by Sarna [12] and others.

Measures

Nonsmokers were those who, during their lifetime, had not smoked more than 10 packages of cigarettes, 75 cigars, 5 packages of pipe tobacco or used 5 boxes of snuff. Ex-smokers were those who previously had been smoking any type of tobacco daily or almost daily but had dropped the habit at the time of the investigation, while current smokers still smoked regularly. Amount smoked per day, age at starting and age at stopping (for ex-smokers) were also ascertained.

Phychosocial extraversion and psychosocial instability scale scores were assessed from responses to 18 items in a short form of the Eysenck Personality Inventory [6]. Coffee was measured as cups per day. Measures of alcohol consumption describing grams of alcohol consumed per month per metabolic body weight ($wt^{\cdot 75}$) could be calculated for beer, wine and spirits use. Total consumption reflects the sum of consumption from all 3 types of beverages. Relative body weight was computed using the formula: $wt = \frac{\text{weight in kg}}{(\text{ht in cm} - 100)\ 0.9}$. A 7-point scale ranging from "hardly any" through "extremely much" was used to assess leisure time activity. Use of psychopharmaceuticals was calculated by summing responses to three point scales ("never/almost never", "now and then", "regularly") for consumption of tranquillizers and sleeping pills. The measures of psychosocial extraversion, psychosocial instability, relative weight, leisure activity and consumption of coffee, alcohol and psychopharmaceutic drugs will hereafter be referred to as the "psychosocial variables".

RESULTS

Univariate Analyses

A-series. In the first stage, analyses of variance were performed with the psychosocial measures as dependent variables and smoking status (non-, ex- and current smoking), sex, and age group (in 6 5-year intervals) as independent variables on the entire sample of twins as individuals (Table 1). All three main effects, ie, smoking status, sex, and age group, were significant for all traits except beer (for which age group was not significant). The two-way interaction of smoking status by sex was significant for leisure activity, relative weight, beer and psychopharmaceutic use. A three-way interaction of smoking status, sex, and age group was significant for leisure activity, relative weight, total alcohol and spirits consumption. These results indicate that there are mean differences for the traits among the smoking status categories, between the two sexes, and among the six age groups. The pattern of mean differences across the smoking groups is different for all traits in men and women, and also differs for the various age groups for activity, relative

Table 1a. ANOVA Summary Table - Psychosocial Variables by Smoking Status, Sex, and Age Group. A-Series Analysis

	df	Instability F	Extroversion F	Leisure Activity F	Relative Weight F	Coffee Consump. F
Main effects	8	199.04***	125.47***	136.64***	676.88***	388.12***
Smoking status	2	275.39***	89.69***	299.26***	43.85***	704.20***
Sex	1	1081.53***	582.94***	588.50***	738.91***	6.92**
Age group	5	29.04***	21.25***	10.90***	915.56***	371.84***
2-way interactions	17	3.61***	2.42***	5.66***	15.12***	1.77*
Smoking-sex	2	6.95***	6.79***	6.11***	6.25***	3.93*
Smoking-age	10	1.54	1.59	3.79***	13.30***	1.45
Sex-age	5	6.59***	2.44*	9.90***	21.63***	1.39
3-way interaction	10	1.73	1.15	2.91***	4.14***	0.73
N		24,448	24,410	24,387	24,202	24,102

* $P \leqslant 0.05$; ** $P \leqslant 0.01$; *** $P \leqslant 0.001$.

https://doi.org/10.1017/S0001566000005869 Published online by Cambridge University Press

Table 1b. ANOVA Summary Table, Continued - Psychosocial Variables by Smoking Status, Sex and Age Group. A-Series Analysis.

	df	Use of psychopharm. F	Total alcohol F	Beer F	Wine F	Spirits F
Main effects	8	75.80***	484.10***	338.63***	82.69***	458.21***
Smoking status	2	89.93***	833.03***	381.60***	281.62***	621.03***
Sex	1	257.88***	1549.31***	1535.25***	14.48***	1813.04***
Age group	5	47.85***	5.31***	2.10	12.41***	3.55***
2-way interactions	17	5.39***	9.29***	10.33***	1.85*	14.08***
Smoking-sex	2	13.47***	67.54***	72.97***	5.02**	96.00***
Smoking-age	10	4.31***	0.71	1.96*	1.31	1.62
Sex-age	5	6.32***	2.55*	.50	1.17	4.59***
3-way interaction	10	0.62	2.34**	1.29	1.66	2.64***
N		22,888	22,301	23,111	22,207	21,960

* $P \leqslant 0.05$; ** $P \leqslant 0.01$; *** $P \leqslant 0.001$.

Table 2 - Multiple Classification Analysis of Means for Psychosocial Variables by Smoking Status, Sex and Age Group. A-Series Analysis

	Insta-bility	Extro-version	Leisure act.	Rel. weight	Coffee	Psycho-pharmac.	Total alcohol	Beer	Wine	Spirits
Grand mean	2.82	4.76	3.65	1.02	3.97	2.18	8.35	1.95	2.13	4.33
Deviations[a]:										
Smoking										
Nonsm.	−.40	−.21	.24	.01	−.67	−.06	−3.55	−.74	−.83	−2.01
Ex- sm.	.07	−.01	.11	.00	−.16	−.00	−.03	.16	.43	−.55
Current sm.	.35	.20	−.26	−.01	.67	.06	3.33	.65	.64	2.06
Sex										
Men	−.52	.36	.25	.02	.05	−.07	3.18	.96	−.12	2.37
Women	.46	−.32	−.22	−.02	−.04	.06	2.97	−.87	.11	−2.22
Age group										
43-47	−.14	.02	−.08	.09	.84	.09	−.38	−.08	−.21	−.15
38-42	−.11	−.21	−.04	.06	.77	.09	−.17	−.10	−.04	−.06
33-37	−.14	−.15	−.04	.02	.55	.02	−.34	−.06	−.01	−.30
28-32	−.11	−.07	−.05	−.01	.13	−.01	.29	.12	.24	.00
23-27	.05	.08	.05	−.03	−.49	−.04	.63	.00	.25	.41
18-22	.34	.23	.12	−.07	−1.14	−.09	−.34	.04	−.35	−.06
Multiple R^2	.061	.039	.043	.181	.114	.026	.147	.104	.029	.142

[a]Adjusted for other independant variables.

https://doi.org/10.1017/S0001566000005869 Published online by Cambridge University Press

Table 3a. ANOVA Summary Table - Psychosocial Variables by Partner's Smoking Status, Sex and Age Group. MZ NET-Series

	df	Instability F	Extroversion F	Leisure Activity F	Relative Weight F	Coffee Consump. F
Main effects	8	17.95***	11.52***	12.20***	69.41***	40.05***
Smoking status	2	12.60***	4.73**	2.71	3.67*	0.60
Sex	1	114.12***	66.73***	76.60***	39.23***	2.19
Age group	5	2.49*	2.42*	2.37*	102.47***	61.39***
2-way interactions	17	1.86*	1.23	2.28**	1.81*	1.17
Smoking-sex	2	4.80**	1.53	0.58	2.40	0.33
Smoking-age	10	0.87	1.00	1.84*	1.54	1.06
Sex-age	5	3.03**	1.59	3.83**	2.15	1.71
3-way interaction	10	0.68	0.49	0.66	0.50	1.01
N		2314	2313	2307	2293	2288

* $P \leqslant 0.05$; ** $P \leqslant 0.01$; *** $P \leqslant 0.001$.

Table 3b. ANOVA Summary Table, Continued - Psychosocial Variables by Smoking Status, Sex, and Age Group. MZ NET-Series

	df	Psycho-pharm. F	Total alcohol F	Beer F	Wine F	Spirits F
Main effects	8	5.05***	33.28***	23.38***	9.97***	32.00***
Smoking status	2	2.97*	39.52***	17.30***	31.89***	17.95***
Sex	1	17.68***	169.01***	133.69***	0.41	206.68***
Age group	5	2.86**	1.11	2.20*	2.18	0.70
2-way interactions	17	0.87	1.91**	1.61	1.07	2.20***
Smoking-sex	2	2.80	2.94	2.68	0.06	4.45**
Smoking-age	10	0.64	1.52	1.20	1.13	1.79
Sex-age	5	0.80	1.89	1.66	1.26	1.73
3-way interaction	10	1.15	2.21	2.00*	1.14	2.72**
N		2205	2121	2188	2080	2087

* $P \leqslant 0.05$; ** $P \leqslant 0.01$; *** $P \leqslant 0.001$.

https://doi.org/10.1017/S0001566000005869 Published online by Cambridge University Press

weight, beer and psychopharmaceutic use.

For all variables but activity and relative weight, nonsmokers had the lowest scores followed by ex-smokers and then current smokers (Table 2). For leisure activity, nonsmokers were most active followed by ex-smokers and current smokers. Nonsmokers had a higher relative weight followed by ex- and current smokers, respectively.

The two-way interactions with age can be described as differences in degree, ie, the slope of the line plotting scores with age is slightly different in the three smoking groups. The pattern of means, however, is the same among the smoking groups.

MZ NET-series. Nonsmoking partners of MZ twins in each of the three smoking groups were compared in an analysis of variance (Table 3). There is a significant main effect (1) of partner's smoking status for all traits but leisure activity and coffee, (2) of sex for all except coffee and wine consumption, and (3) of age group for all but total alcohol, wine and spirits use. Instability and spirits use showed significant interactions of smoking status and sex, and leisure activity had a significant interaction of smoking status and age. Three-way interactions were significant for beer and spirits consumption. The smoking status main effect for the MZ nonsmoking partners (Table 4) is in the same direction as for the A-series for all variables but relative weight. MZ nonsmokers with partners who are nonsmokers have lower scores on instability, extroversion, relative weight, coffee consumption, psychopharmaceutic use, and the 4 alcohol measures than nonsmokers with ex-smokers and current smoker partners, respectively. As in the A-series analyses, the pattern for leisure activity is reversed.

Table 4 - Multiple Classification Analysis of Means for Psychosocial Variables by Partner's Smoking Status, Sex and Age Group. MZ NET-series

	Instability	Extroversion	Leisure act.	Rel. weight	Coffee	Psychopharmac.	Total alcohol	Beer	Wine	Spirits
Grand mean	2.48	4.59	3.89	1.02	3.27	2.13	4.70	1.19	1.48	2.09
Deviations[a]:										
Smoking										
Nonsm.	−.16	−.08	.04	−.00	−.03	−.02	−.92	−.18	−.33	−.41
Ex-sm.	−.27	−.01	−.02	−.00	.05	.01	.93	.20	.31	.37
Current sm.	.37	.28	−.13	.01	.08	.05	2.60	.51	.94	1.20
Sex										
Men	−.61	.48	.34	.02	−.08	−.05	2.56	.69	−.05	1.89
Women	.39	−.30	−.21	−.01	.05	.03	−1.69	−.45	.03	−1.26
Age group										
43-47	−.18	−.03	−.10	.10	.88	.04	.05	.08	−.10	.07
38-42	−.04	−.31	−.12	.05	.79	.06	−.51	−.01	−.11	−.41
33-37	−.08	.01	−.07	.02	.48	.00	.11	−.05	.18	−.04
28-32	−.06	−.05	−.00	−.01	.12	.00	.42	.27	.22	−.04
23-27	−.05	−.05	−.03	−.03	−.57	−.02	.36	−.10	.18	.27
18-22	.31	.24	.18	−.08	−1.16	−.06	−.48	−.20	−.34	.08
Multiple R^2	.058	.038	.040	.195	.123	.018	.111	.078	.037	.108

[a] Adjusted for other independent variables.

https://doi.org/10.1017/S0001566000005869 Published online by Cambridge University Press

Multivariate Analyses

Multiple regression was employed as a multivariate method to describe the relative importance of several traits for differentiating pairs of smoking status groups. Smoking classification as a series of dichotomies was used as the dependent variable. When such dichotomies are used, sampling distributions make it impossible to compare R^2 across equations, as the magnitude of R^2 is limited by the distribution of the dependent variable and does not reflect the actual amount of variance explained. The regression equations are valuable, though, for model building, examining the rank order in which independent variables are included and, within equations, the relative influence each traits has on the dependent variable expressed by the beta coefficient. Multiple logistic analysis could have been applied; however, given the model building nature of this study, we doubt whether the conclusions drawn here would differ. Thus, multiple regression equations evaluated each of the following comparisons as the dependent variable: nonsmoker vs ex-smoker, ex-smoker vs current smoker, nonsmoker vs current smoker, never smoker vs ever smoker (both ex- and current smokers).

Because of the significant effects of sex and age group on the psychosocial traits, these factors were forced into the regression equation first. The variables instability, extroversion, leisure activity, relative weight, psychopharmaceutic use, total alcohol and coffee consumption were then entered via a forward inclusion method. In this manner, the effects of age group and sex removed from the relationships between the dependent and independent variables. Each set of equations was derived for the A-series and MZ NET- series of nonsmoking partners. The rank order and beta values (standardized partial regression coefficients) for each of the variables which met inclusion criteria and were entered into the equations are reported in Table 5.

A-series. The order of inclusion of independent variables into the equation for the never-ever distinction was as follows: alcohol consumption > coffee consumption > instability > leisure activity = extroversion > relative weight > psychopharmaceutic use. This rank ordering reflects the influence of each of the traits towards distinguishing whether an individual is a nonsmoker or has at some time taken up the smoking habit. A similar rank order can be seen for the nonsmoker vs ex-smoker dichotomy (alcohol > coffee > > instability > extroversion = leisure activity > psychopharmaceutic use). For the ex-smoker vs current smoker equation, coffee has the strongest influence, followed by alcohol, leisure activity, the 3 variables extroversion, relative weight and instability with nearly equal betas, and psychopharmaceutic use. Finally, the order for the nonsmoker vs current smoker equation is alcohol > coffee > leisure activity = extroversion > instability > relative weight > psychopharmaceutic use. Alcohol consumption has the greatest influence in distinguishing among smoking status groups in these analyses, followed by coffee, leisure activity and instability. After alcohol and coffee consumption, leisure activity has the next greatest influence in distinguishing current smokers from ex-smokers, and current smokers from nonsmokers, whereas instability has the third greatest influence in distinguishing nonsmokers from ex-smokers, and never smokers from ever smokers.

MZ NET-series. Alcohol, instability, extroversion, relative weight and leisure activity, in that order, distinguish nonsmoking twins whose partners are nonsmokers and those whose partners became smokers. The same variables, in the same order, are also of importance for the non/current distinction in this series. Alcohol and instability influence the non-

Table 5 - Multiple Regression of Smoking Status by Sex, Age Group, Psychosocial Variables. Variables in the Equation[a], Rank Order, Beta.

Variables in the equation	Smoking status groups compared			
	Never-ever	Non-ex	Ex-current	Non-current
	Rank (Beta)			
A-series	N = 21,035	N = 11,626	N = 12,057	N = 18,121
Sex (1 = M, 2 = W)	(−0.14)	(−0.08)	(−0.04)	(−0.15)
Age group (1-6, old-young)	(.06)	(−.02)	(.10)	(.08)
Instability	3 (.11)	3 (.07)	6 (.05)	5 (.10)
Extroversion	5 (.10)	4 (.04)	5 (.05)	4 (.12)
Leisure activity	4 (−.10)	5 (−.04)	3 (−.08)	3 (−.12)
Relative weight	6 (−.06)		4 (−.05)	6 (−.07)
Coffee consumption	2 (.21)	2 (.11)	1 (.12)	2 (.24)
Alcohol consumption	1 (.26)	1 (.20)	2 (.11)	1 (.29)
Psychopharmac. use	7 (0.03)	6 (.02)	7 (.02)	7 (.04)
Multiple R^2	0.16	0.06	0.05	0.20
MZ NET-series	N = 2,025	N = 1,628	N = 621	N = 1,801
Sex (1 = M, 2 = W)	(−0.02)	(0.01)	(−0.05)	(−0.04)
Age group (1-6, old-young)	(−.08)	(−.09)	(.07)	(−.05)
Instability	2 (.08)	2 (.06)		2 (.08)
Extroversion	3 (.07)			3 (.08)
Leisure activity	5 (−.04)			5 (−.05)
Relative weight	4 (.05)			4 (.07)
Coffee consumption				
Alcohol consumption	1 (.19)	1 (.10)	1 (.09)	1 (.21)
Psychopharmac. use				
Multiple R^2	0.05	0.02	0.01	0.06

[a]Sex and age group were forced into the equation first. Other variables entered by forward inclusion method. Variables reaching significance are presented.

vs ex-smoker dichotomy and only alcohol was entered into the equation for ex- vs current smoking partners.

The general rank order of the variables in these analyses was not the same as in the A-series. Coffee, which was ranked as having a primary influence in the A-series, was not even present in the "MZ NET-series". Instability was consistently ranked before activity in the latter analyses, whereas their relative order was often reversed in the A-series.

DISCUSSION

The univariate results generally confirm previous findings of differences among current, non- and ex-smokers for psycho-social variables [1,4,5,9,14]. Because of the large sample, even small differences were significant. Between 3%-18% of the variance in the 10 variables was explained by smoking status, sex and age.

At the multivariate level, seven of the psychosocial variables were used to predict smoking status dichotomies. The rank order of the measures (alcohol and coffee consumption, followed by instability and activity, extroversion, relative weight and psy-

chopharmaceutic use) is quite similar to the stepwise inclusion of similar variables into 3 pairwise discriminant functions by Thomas [15]. The low ranking of psychopharmaceutic use as compared to alcohol and coffee consumption is perhaps a function of their relatively infrequent use in this population.

In an attempt to assess the relative importance of smoking consumption measures for distinguishing current and ex-cigarette smokers, the regression equation was expanded to allow for inclusion of age at start of smoking and total cigarettes smoked per day. Although ex-smokers smoked significantly fewer cigarettes per day ($P < 0.001$) (but did not start at a significantly different age), neither of these measures met criteria for inclusion in the regression equation.

The univariate results for the MZ NET-series show that the psychosocial scores within the nonsmoking group vary depending upon the smoking status of the cotwin for all measures except leisure activity and coffee consumption. The variation seen is very similar to, although less pronounced than, the variation in the 3 smoking status group of the A-series. This suggests that the nonsmoker groups included in the MZ NET-series consist of subjects at different distances from the threshold of smoking, none having passed the boarder (Fig. 2).

A multiple regression function for these nonsmoker groups could thus reveal factors of importance for the function theoretically depicted in Fig. 2. The results would then be uninfluenced by possible effects of smoking as is the case in the A-series analysis.

As shown in Table 5, there are 5 factors of significance in the MZ NET-series multiple regression equation for never/ever smokers, the most important being alcohol consumption followed by instability, extroversion, relative weight and leisure activity. These factors, being Type I findings, may then be referred to as factors predisposing (or reflecting predisposing factors) for becoming a smoker. Alcohol consumption has been primarily thought of as developing concurrently to smoking. The present findings suggest that it may covary with a variety of predisposing factors. By and large, this analysis is consistent with the prospective findings by Thomas [15].

Two differences were found between the results for the A-series and the MZ NET-series regression. In the A-series, smokers had the lowest relative weight, whereas in the B-series, nonsmokers with smoking partners had the highest relative weight. This change in direction of the association may reflect compensation mechanisms. As Selye [13] stated, the question is not "whether to smoke or not, but whether to smoke, or to overeat, to drink, to drive fast or merely to fret and bite the fingernails".

Coffee represents a clear Type II finding, that is, it was a factor of importance in the A-series but *not* of importance in the MZ NET-series. These results suggest that coffee drinking is not a predisposing factor for development of the smoking habit (but covaries independently of such development).

None of the factors included were significant only in the MZ NET-series (Type III). Factors differing for the nonsmoker groups without being repeated in A-series analyses, ie, without being smoking dependent, may of course exist if specific variables are chosen, such as differing parental treatment.

It may be concluded that the present results demonstrate the potential of using MZ twins as a retrospective indicator of characteristics important in developing a habit in the absence of truly prospective data.

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