Association of Lifestyle and Cardiovascular Risk Factors with Lung Function in a Sample of the Adult Italian Population: A Cross-Sectional Survey

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Cardiovascolare/Health Examination Survey 2008–2012

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Key Words

Pulmonary function · Cardiovascular risk factors · Lifestyle

Abstract

Background: Some epidemiological studies have identified high values of pulmonary functions as an indicator of good health. At present little is known about the distribution of these characteristics in the general adult population. **Objective:** The aim of this study is to describe pulmonary function in the Italian general population and to evaluate its association with some lifestyle and cardiovascular risk conditions using data of the OEC/HES (Cardiovascular Epidemiology Observatory/Health Examination Survey) Project, a cross-sectional survey based on the examination of random samples of the general population. **Methods:** A total of 9,108 men and women aged 35–79 years were examined between 2008 and 2012. Pulmonary function [forced expiratory volume in 1 s (FEV₁) and forced vital capacity (FVC)] was measured with a spirometer and anthropometric measurements and blood pressure were also recorded, whereas lifestyle (physical activity, smoking habits), health status and drug treatment were assessed by a questionnaire. FEV₁ and FVC % predicted were also calculated. Univariate analysis and a

multiple linear regression were performed in order to assess associations. **Results:** FVC and FEV₁ percent predicted values were 98.0 (95% CI 97.4–98.6) and 107.3 (95% CI 106.6–107.9) for men and 108.7 (95% CI 107.9–109.4) and 113.3 (95% CI 112.6–114.1) for women. A lower mean FEV₁ and FVC % predicted value was found in smokers, individuals physically inactive during their leisure time, diabetics, obese individuals and hypertensive patients. Multivariate linear regression models confirmed the independent association between risk factors and FEV₁ and FVC levels. **Conclusion:** Our data confirm the inverse relationship existing between pulmonary function and cardiovascular risk factors, obesity, dyslipidemias and hypertension, all of which are conditions related to chronic diseases. An early public healthcare intervention on lifestyle could be useful to reduce the decline in pulmonary function.

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Introduction

Pulmonary function is strongly related to physiological and pathological conditions [1]. Epidemiological studies have repeatedly demonstrated the inverse relationship existing among pulmonary function and chronic obstructive pulmonary disease (COPD) [2], lung cancer [3], cardiovascular disease [4] and diabetes [5]. Reduced pulmonary function has been reported to be inversely associated with cigarette smoking [6], obesity [7], metabolic syndrome [8] and conditions linked to an increased cardiovascular risk, such as high blood pressure, high cholesterol, a fast pulse rate and physical inactivity [1, 4].

Some studies have identified high values of pulmonary function as common indicators of health. Having a high vital capacity and being a nonsmoker are the main conditions that predict good health in the long term [9, 10].

Spirometry is the most frequently performed test to assess pulmonary function. The indicators that can be derived by spirometry include forced expiratory volume in 1 s (FEV₁) and forced vital capacity (FVC). These indicators depend on height, weight, age and gender. Pulmonary function declines slowly throughout adult life, even in healthy individuals. This decline may accelerate after the age of 70 years [11]. Mean values of the European adult population are used to determine a normal range of results with expected predicted levels for FEV₁ and FVC.

The purpose of this analysis was to describe the pulmonary function of the Italian adult population by FVC and FEV₁ using data from a cross-sectional survey. A further objective was to assess the association of pulmonary function based on volume indices with some lifestyle and high-risk conditions for cardiovascular diseases.

Methods

We used data from the Cardiovascular Epidemiology Observatory/Health Examination Survey (OEC/HES; see Appendix), a cross-sectional survey conducted between 2008 and 2012 that aimed to describe individual lifestyles (nutrition, physical activity, smoking habit), cardiovascular risk factors (blood pressure, total and high-density lipoprotein (HDL) cholesterol, BMI, high fasting glucose), the prevalence of high-risk conditions (hypertension, dyslipidemia, obesity, diabetes) and cardiovascular diseases within a sample Italian population. A brief description of the survey methods is reported below; further information has already been published [12–14].

Twenty-three centers from all the Italian regions were selected, all having a common protocol. Training was provided to the technicians to guarantee a standardization of the collected data. Each center examined 220 out of every 1.5 million people of both sexes and within the age range of 35–79 years. This population sample

was randomly selected from a list of residents, stratified by age and sex (25 people for each decade of age between 35 and 74 years, and an additional 10 people for the years 75–79). In total 9,107 people were examined, representing a participation rate of 55%. For the purpose of this analysis the following risk factors and lifestyles were considered: height, weight, blood pressure, smoking habit, physical activity at work and during leisure time, total and HDL cholesterol, fasting blood glucose and ongoing treatments for hypertension, dyslipidemia, diabetes, COPD and asthma.

Height was measured in centimeters with a graduated rule fixed to the wall and readings were rounded to the nearest 0 or 5 mm. Weight was measured with a balance beam scale; the measure was reported in kilograms and hectograms, and rounded to the nearest 200 g.

Blood pressure was measured in the right arm with the subject in a sitting position using a Riva-Rocci mercury sphygmomanometer with 2 cuffs (normal and obese), and with a stethoscope bell for auscultation. Three consecutive measurements of blood pressure were recorded at intervals of a few minutes, and the mean of the three measurements was used in the analysis [14]. Fasting blood glucose and total and HDL cholesterol were measured in frozen serum using an enzymatic colorimetric method.

A standardized questionnaire was self-administered to collect personal and clinical information. The question concerning asthma or COPD was based on an awareness of suffering or having suffered from these conditions (with or without a documented diagnosis). Smoking habit was classified into two categories: non-smoking, for those who have never smoked cigarettes or are former smokers, and current smoking, for smokers of one or more cigarette per day.

At work, physical inactivity was defined as generally being sat at a desk or not needing to walk. Inactivity in leisure was considered as time spent reading, watching television or doing other sedentary activities.

Subjects with systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg, or those under treatment were defined as hypertensive. Diabetes mellitus was defined as high fasting glucose levels (≥ 126 mg/dl) or being under treatment. Hypercholesterolemia was defined as a high blood cholesterol level (≥ 240 mg/dl) or being under treatment. Subjects considered to be overweight had a BMI between 25 and 30, whilst obesity was defined as BMI ≥ 30 .

Fatal and nonfatal 10-year cardiovascular risk functions of the CUORE Project were used to classify persons into two classes of risk (<20 and $>20\%$). The individual risk score provides an assessment taking into account certain risk factors, such as age, gender, diabetes, smoking status, systolic blood pressure, and total and HDL cholesterol [15, 16].

Each participant of the study was well informed about the research purposes and was required to provide their signed informed consent before examination. The Ethics Committee of the Italian National Institute of Health approved the documentation related to the protocol of the study (informed consent, information notice for participants and curriculum vitae of the person responsible for the project), and approved all aspects of the study (March 11, 2008 and November 23, 2009).

Spirometry

SpiroPro, a small, portable spirometer that contains stored reference values based on age, sex, height and weight [17], was used. It was necessary to include each subject's full name, iden-

tification number, sex, date of birth, height and weight, and explain to the person how they had to blow into the device (with as much force as possible into the mouthpiece after a deep inspiration with use of a nose clip). Two consecutive measurements were made, and the machine recorded the best one. FVC, the total volume of gas that can be exhaled after a full inspiration, and FEV₁, the volume of exhaled air in the first second, both expressed in liters, were measured, as well as the ratio between the two values. The measurements of the person being tested were compared with their expected values with respect to the reference population of the same age, sex, weight and height. At the end of each day the results were printed out from the spirometer.

The recording program 'Envelope' was used to perform the flow-volume measurement. This program allows several breathing maneuvers to be performed during a test. When the test is completed, the program calculates the envelope from which the final values will be derived. This method leaves the machine with the best choice of spirometry recordings, which are then automatically saved. This method reduces the error associated with the operator in the subjective choice of spirometry results.

Statistical Analyses

Descriptive statistics based on classical cardiovascular risk factors and high-risk conditions were presented, reporting mean and standard deviation for continuous variables and prevalence rates for categorical variables by gender. The observed spirometry parameters (FEV₁, FVC) were adjusted by dividing by height (in centimeters) and are reported as means and standard deviation according to gender and age class, as well as the percent of predicted values (observed parameter/predicted $\times$ 100). The prevalence and 95% confidence intervals (CI) of pulmonary diseases (asthma and COPD) were estimated by gender and age class.

In order to singly assess the association between pulmonary function, lifestyle and high-risk conditions for cardiovascular diseases, the mean levels of FEV₁ and FVC percent predicted value were tested among favorable and unfavorable habits/factors, with the following being considered unfavorable: smoking, overweight/obesity, physical inactivity, diabetes, hypertension, hypercholesterolemia and cardiovascular risk $\geq 20\%$. Age-adjusted multivariate linear regression models were performed using FEV₁ and FVC percent predicted as dependent variables, and lifestyle (smoking habit, physical inactivity during leisure time) and high-risk conditions (presence of asthma, COPD, obesity, diabetes, hypertension or hypercholesterolemia) as independent variables with the aim of evaluating their independent association to FEV₁ and FVC. R² was calculated for each model as an indicator of the degree of variance explained by the models. As a sensitivity analysis, univariate and multivariate analyses were replicated by age class (35–49 and 50–79) and the presence of pulmonary diseases.

The normality of the FEV₁ and FVC distributions was tested graphically and using the Kolmogorov-Smirnov test. Both ANOVA (parametric) and Wilcoxon-Mann-Whitney (nonparametric) tests were performed to compare FEV₁ and FVC distribution among lifestyle and high-risk conditions. A *p* value ≤ 0.05 was considered statistically significant. Statistical analyses were performed using SAS software, release 9.2 (SAS Institute Inc., Cary, N.C., USA).

Results

We excluded men and women without observed and predicted FVC and FEV₁, meaning that analyses were performed on a total of 3,845 men and 3,792 women. The mean BMI was within the overweight class, 22% of men and 19% of women were smokers, physical inactivity was reported by approximately one third of subjects, and hypertension and hypercholesterolemia were frequent conditions (table 1).

The prevalence of asthma and COPD did not significantly differ among men and women, and were measured as 10.2% (9.2–11.1%) and 9.7% (8.8–10.7%), respectively. By age class, the prevalence of asthma decreased and prevalence of COPD significantly increased (fig. 1).

Height-adjusted FVC and FEV₁ were 23.1 (95% CI 23.0–23.3) and 20.3 (95% CI 20.1–20.4) for men, and 18.1 (95% CI 17.9–18.2) and 15.9 (95% CI 15.8–16.0) for women; FVC and FEV₁ percent predicted were 98.0 (95% CI 97.4–98.6) and 107.3 (95% CI 106.6–107.9) for men and 108.7 (95% CI 107.9–109.4) and 113.3 (95% CI 112.6–114.1) for women. Mean FEV₁ and FVC levels significantly decreased by age class, both in men and women (table 2), and the FEV₁ and FVC results displayed a normal graphical distribution.

FVC and FEV₁ percent predicted were significantly lower in smokers, obese, diabetic and hypertensive persons, as well as in those who never do any kind of physical activity during their leisure time, both in men and women, with the exception of FVC in female smokers (tables 3, 4). FVC and FEV₁ percent predicted were also significantly lower in hypercholesterolemic male subjects, as well as those at high cardiovascular risk. Smoking habit and the presence of obesity and diabetes are the most associated factors with FVC and FEV₁, especially in men (difference columns, tables 3, 4).

The significances of FEV₁ and FVC comparisons among lifestyles and high-risk conditions were similar using ANOVA and the Wilcoxon-Mann-Whitney test. Multivariate linear regression models confirmed the independent association between favorable habits/factors and cardiovascular risk condition (nonobese, nonsmoker, nondiabetic, nonhypertensive and physically active) and levels of FEV₁ and FVC, even if adjusted for the presence of pulmonary diseases (data not shown). In women, smoking seems not to be independently associated with FVC. R² values ranged from 0.018 in the female FVC model to 0.085 in the male FEV₁ model. Similar associations among lifestyle, high-risk conditions and pulmonary functions were also shown between age classes and the presence of pulmonary diseases, albeit with a lower statistical power.

Table 1. Risk factors and high-risk conditions for cardiovascular diseases in men and women aged 35–79 years

	Male			Female		
	n	mean	SD	n	mean	SD
Age, years	3,845	56.8	12.5	3,792	56.5	12.3
Systolic blood pressure, mm Hg	3,845	133.8	17.6	3,791	128.9	19.9
Diastolic blood pressure, mm Hg	3,845	83.5	10.2	3,791	78.9	9.7
Total cholesterol, mg/dl	3,810	209.2	44.2	3,762	217.8	43.7
HDL cholesterol, mg/dl	3,810	50.4	12.4	3,762	61.4	14.7
Blood glucose, mg/dl	3,803	102.6	25.0	3,757	95.3	23.9
BMI, kg/m ²	3,843	27.7	4.2	3,791	27.4	5.6
Cardiovascular risk ¹	2,911	7.5	7.8	2,977	2.5	3.3
	n	%		n	%	
Smoking habit	826	21.5		713	18.8	
Obesity ²	971	25.3		1,046	27.6	
Physical inactivity during leisure time	1,187	30.9		1,635	43.2	
Physical activity at work	979	40.7		888	33.7	
Diabetes ³	533	14.0		347	9.2	
Hypertension ⁴	2,129	55.4		1,628	42.9	
Hypercholesterolemia ⁵	1,349	35.4		1,514	40.2	

Data are from the OEC/HES Survey, 2008–2012.

¹ Risk score of the CUORE Project for the Italian risk assessment of 10-year fatal and nonfatal coronary and cerebrovascular diseases in primary prevention for persons aged 35–69 years, based on blood pressure, total and HDL cholesterol, diabetes and smoking habit.

² BMI ≥ 30 .

³ Glycemia ≥ 126 mg/dl, or under specific treatment.

⁴ Systolic blood pressure ≥ 140 or diastolic blood pressure ≥ 90 mm Hg, or under specific treatment.

⁵ Total cholesterol ≥ 240 mg/dl, or under specific treatment.

Fig. 1. Prevalence of asthma and COPD with 95% CI, presented by age class and gender: men (a) and women (b) aged 35–79 years. OEC/HES Survey, 2008–2012.

Table 2. Distribution of FVC and FEV₁ by age class and gender

Age class, n years	FVC, ml/cm			FEV ₁ , ml/cm			FVC, % predicted			FEV ₁ , % predicted		
	mean	SD	p value	mean	SD	p value	mean	SD	p value	mean	SD	p value
<i>Male</i>												
35–49	1,298	26.9	4.7	23.9	3.9		102.2	17.8		110.2	17.2	
50–69	1,785	22.5	4.8	19.7	4.1		98.4	20.4		108.3	20.8	
70–79	762	18.2	4.5	15.5	4.2		89.9	21.9		99.8	26.5	
35–79	3,845	23.1	5.7	20.3	5.1	<0.0001	98.0	20.3	<0.0001	107.3	21.3	<0.0001
<i>Female</i>												
35–49	1,284	21.1	3.8	18.8	3.0		109.3	21.9		113.3	18.0	
50–69	1,769	17.5	3.6	15.4	3.1		109.3	21.6		114.3	22.2	
70–79	739	14.1	3.8	12.0	3.2		106.0	27.9		111.1	29.2	
35–79	3,792	18.1	4.5	15.9	3.9	<0.0001	108.7	23.1	0.0020	113.3	22.5	0.0055

Data are from the OEC/HES Survey, 2008–2012. FVC and FEV₁ were divided by height. p values refer to the age class ANOVA.

Table 3. Association of FEV₁ percent predicted value and high-risk conditions for cardiovascular diseases in men and women aged 35–79 years

	FEV ₁ , % predicted									
	male					female				
	n	mean	SD	p value	difference ¹	n	mean	SD	p value	difference ¹
Nonsmoker	3,018	108.6	21.3			3,078	113.9	23.0		
Current smoker	826	102.2	20.9	<0.0001	–6.5	713	110.9	20.0	0.0004	–3.0
Normal weight	1,016	109.2	21.3			1,479	113.5	20.7		
Overweight ²	1,856	108.5	20.5			1,266	115.3	22.7		
Obese ³	971	102.7	22.3	<0.0001	–6.5	1,046	110.7	24.4	<0.0001	–2.8
Physical activity during leisure time	2,652	108.8	21.3			2,152	114.2	21.8		
Physical inactivity during leisure time	1,187	103.9	21.2	<0.0001	–4.9	1,635	112.2	23.3	0.0067	–2.0
Physical activity at work	1,427	108.5	19.6			1,747	113.3	20.1		
Physical inactivity at work	979	109.5	17.9	0.1895	1.0	888	113.2	20.8	0.9074	–0.1
Nondiabetic	3,269	108.4	20.5			3,411	113.8	22.3		
Diabetic ⁴	533	100.4	23.5	<0.0001	–8.1	347	109.2	24.5	0.0008	–4.6
Nonhypertensive	1,716	109.8	20.1			2,164	114.4	20.4		
Hypertensive ⁵	2,129	105.2	22.1	<0.0001	–4.7	1,628	111.9	24.9	0.0010	–2.5
Nonhypercholesterolemic	2,461	107.9	21.5			2,248	112.9	21.6		
Hypercholesterolemic ⁶	1,349	106.2	20.4	0.0166	–1.7	1,514	114.0	23.7	0.1428	1.1
Cardiovascular risk ⁷ <20.0%	2,684	109.8	18.9			2,964	113.9	20.4		
Cardiovascular risk ⁷ ≥20.0%	227	106.0	19.7	0.0038	–3.8	13	115.7	17.2	0.7571	1.8

Data are from the OEC/HES Survey, 2008–2012. p values refer to ANOVA tests.

¹ Difference to FVC₁ mean level of favorable and unfavorable risk conditions.

² 25 ≤ BMI < 30.

³ BMI ≥30.

⁴ Glycemia ≥126 mg/dl, or under specific treatment.

⁵ Systolic blood pressure ≥140 or diastolic blood pressure ≥90 mm Hg, or under specific treatment.

⁶ Total cholesterol ≥240 mg/dl, or under specific treatment.

⁷ Risk score of the CUORE project for the Italian risk assessment of 10-year fatal and nonfatal coronary and cerebrovascular diseases in primary prevention for patients aged 35–69 years, based on blood pressure, total and HDL cholesterol, diabetes and smoking habit.

Table 4. Association of FVC percent predicted value and high-risk conditions for cardiovascular diseases in men and women aged 35–79 years

	FVC, % predicted									
	men					women				
	n	mean	SD	p value	difference ¹	n	mean	SD	p value	difference ¹
Nonsmoker	3,018	98.7	19.5			3,078	108.8	22.9		
Current smoker	826	95.3	22.8	0.0001	–3.4	713	108.4	23.9	0.6988	–0.4
Normal weight	1,016	100.9	20.3			1,479	109.9	22.7		
Overweight ²	1,856	98.7	19.5			1,266	110.2	22.6		
Obese ³	971	93.7	21.2	<0.0001	–7.2	1,046	105.1	23.9	<0.0001	–4.9
Physical activity during leisure time	2,652	99.2	20.4			2,152	109.7	22.3		
Physical inactivity during leisure time	1,187	95.3	20.0	<0.0001	–3.9	1,635	107.3	24.1	0.0019	–2.4
Physical activity at work	1,427	99.8	18.5			1,747	108.5	21.9		
Physical inactivity at work	979	100.7	18.9	0.2333	0.9	888	109.3	22.4	0.4110	0.7
Nondiabetic	3,269	99.1	19.6			3,411	109.2	22.8		
Diabetic ⁴	533	91.4	22.4	<0.0001	–7.7	347	104.1	26.3	0.0006	–5.1
Nonhypertensive	1,716	101.1	19.6			2,164	110.1	21.8		
Hypertensive ⁵	2,129	95.5	20.6	<0.0001	–5.7	1,628	106.8	24.6	<0.0001	–3.3
Nonhypercholesterolemic	2,461	98.5	20.4			2,248	108.4	23.4		
Hypercholesterolemic ⁶	1,349	97.2	19.9	0.0496	–1.3	1,514	109.2	22.8	0.2516	0.9
Cardiovascular risk ⁷ <20.0%	2,684	100.7	19.1			2,964	109.4	21.7		
Cardiovascular risk ⁷ ≥20.0%	227	95.1	17.1	<0.0001	–5.7	13	108.4	13.7	0.8645	–1.0

Data are from the OEC/HES Survey, 2008–2012. p values refer to ANOVA tests.

¹ Difference to FVC mean level of favorable and unfavorable risk conditions.

² 25 ≤ BMI < 30.

³ BMI ≥30.

⁴ Glycemia ≥126 mg/dl, or under specific treatment.

⁵ SBP ≥140 or DBP ≥90 mm Hg, or under specific treatment.

⁶ Total cholesterol ≥240 mg/dl, or under specific treatment.

⁷ Risk score of the CUORE project for the Italian risk assessment of 10-year fatal and nonfatal coronary and cerebrovascular diseases in primary prevention for patients aged 35–69 years, based on blood pressure, total and HDL cholesterol, diabetes and smoking habit.

Discussion

This study has provided the opportunity to describe pulmonary function in the Italian general adult population and to analyze the relationship between lifestyle, high cardiovascular risk conditions and pulmonary function. Results from the self-administered questionnaire show that the prevalence of COPD increases from the first age class to the last in both men and women, whilst asthma seemed not to significantly change among age classes.

In recent years, some studies have evaluated the impact of different airway obstruction definitions on the estimated prevalence of obstruction in general population samples. Some screening programs have been performed in the population at risk, showing a large variability in COPD prevalence. The prevalence of COPD varied from

4.9% (40–49 years) to 12.3% (60–69 years) in males, and from 1.4% (40–49 years) to 4.5% (60–69 years) in females [18].

To be nonobese, a nonsmoker, nondiabetic, nonhypertensive and nondyslipidemic is a condition positively related to pulmonary function in both genders. In other words, our data confirm that pulmonary function is inversely associated with unfavorable lifestyles and high-risk conditions for cardiovascular disease. To be physically active during work seems not to be related with pulmonary function.

To our knowledge there is a paucity of studies investigating the relation between pulmonary function, lifestyle and cardiovascular risk factors. However, the few studies confirm that reduced pulmonary function is associated with cardiovascular risk factors [1, 19]. Multivariate models have also confirmed the independent association of

cardiovascular lifestyles, high-risk conditions and lower levels of FEV₁ and FVC.

Some methodological issues need to be discussed. Spirometry is the most frequently performed lung function test and is the most sensitive and specific test for detecting airflow limitation. Predicted values play an important role in establishing whether the volumes measured in an individual fall within a range to be expected in a healthy person of the same gender, height and age. Airway obstruction increases airway resistance, which can be measured using a body plethysmograph or a forced oscillator or interrupter. However, these instruments are much more expensive than spirometers, and the results (airway resistance, specific conductance of the airways and total respiratory resistance) are more variable than FEV₁ and FVC, resulting in a higher misclassification rate for airflow limitation [6, 20]. Moreover, they are not applicable for screening of the general population.

The recording program used to perform the flow-volume measurement was 'Envelope', which enables the device to select and automatically save the best choice of spirometry readings (highest sum of FEV₁ + FVC). This allows error to be reduced by eliminating the operator's subjective choice of spirometry results.

Some limitations of the study should be mentioned. First, this is a cross-sectional study; therefore, it does not allow investigation of the cause-effect relationship between cardiovascular risk factors and lung function measured by FEV₁ and FVC. Prospective analyses of longitudinal data would allow for stronger conclusions to be made. Second, the prevalence of asthma and COPD was based on a self-reported questionnaire which could underestimate the real prevalence of diseases in the population; however, to our knowledge, no prevalence data based only on documented diagnoses exists at a national level. Therefore, the data reported here represent a rare opportunity to assess the burden of the main pulmonary diseases at the national level in Italy.

Some strengths of the study are also worth mentioning. First, the huge number of subjects enrolled in the study allowed the reliable assessment of mean levels of FEV₁ and FVC, and analysis of their relation with lifestyle and risk factors in the general adult population. Second, to obtain a complete and useful picture of the whole Italian territory, all Italian regions were included, corresponding proportionally with the resident population. Third, in order to avoid bias due to different numbers within certain age classes or between genders, the design of the study provided a stratified sampling procedure

guaranteeing sufficient subjects in each age and gender class. Finally, lifestyle and risk factors were collected using standardized methods to allow comparison with other studies.

Conclusion

Our results showed an inverse relationship between respiratory function and smoking habit, presence of obesity and diabetes. These risk factors are related to cardiovascular diseases and chronic diseases in general. Contrary to common feeling, pulmonary function depends not only on smoking habit, but also on other lifestyle characteristics and high-risk factors for cardiovascular disease. An early public healthcare lifestyle intervention could be useful to reduce cardiovascular risk factors and the decline in pulmonary function.

Appendix: Research Groups of the OEC/HES

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