

Supplementary material

Residential greenspace and lung function decline over 20 years in a prospective cohort: The ECRHS study

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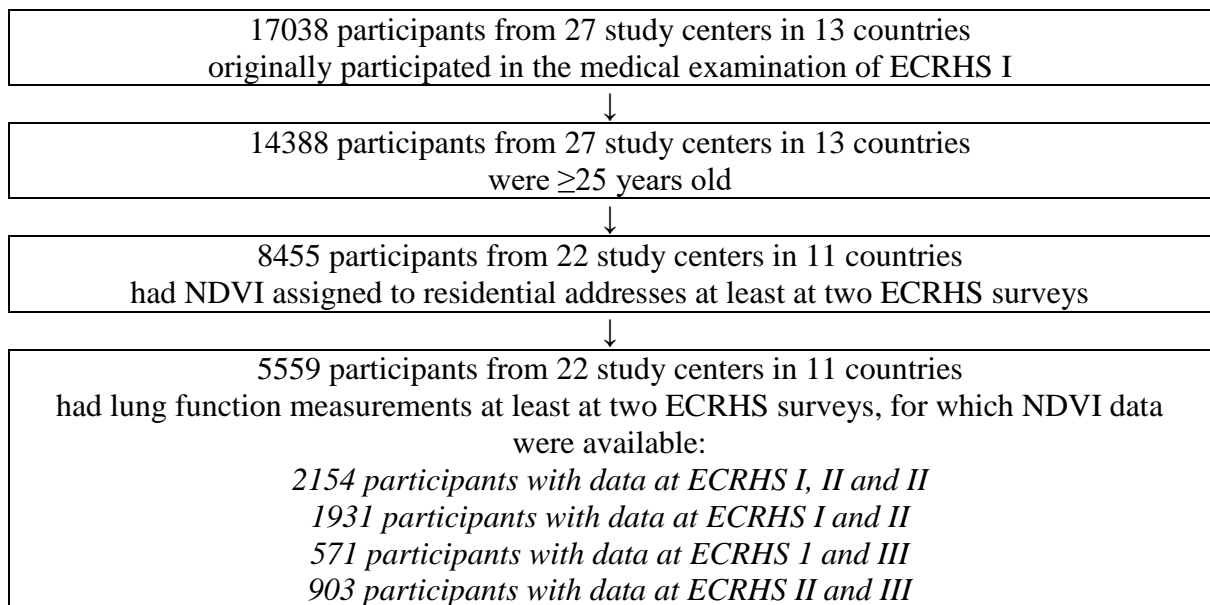


Figure S1. Flowchart of the study participants.

Table S1. Spirometers used for lung function measurements at every ECRHS survey.

Study centre	ECRHS I	ECRHS II	ECRHS III
Reykjavik	SensorMedics displacement	SensorMedics displacement	NDD
Umeå	SensorMedics displacement	SensorMedics displacement	NDD
Bergen	SensorMedics displacement	SensorMedics displacement	NDD
Uppsala	SensorMedics displacement	SensorMedics displacement	NDD
Tartu	Jaeger pneumotach	Jaeger pneumotach	NDD
Gothenburg	SensorMedics displacement	SensorMedics displacement	NDD
Norwich	Biomedin spiro	Biomedin spiro	NDD
Ipswich	Biomedin spiro	Biomedin spiro	NDD
Antwerp city	SensorMedics displacement	Jaeger pneumotach	NDD
South Antwerp	SensorMedics displacement	Jaeger pneumotach	NDD
Erfurt	Jaeger pneumotach	Jaeger pneumotach	NDD
Paris	Biomedin spiro	Biomedin spiro	NDD
Basel	SensorMedics hot wire	SensorMedics hot wire	NDD
Grenoble	Biomedin spiro	Biomedin spiro	NDD
Verona	Biomedin spiro	Biomedin spiro	Biomedin spiro
Pavia	Biomedin spiro	Biomedin spiro	NDD
Turin	Biomedin spiro	Biomedin spiro	Biomedin spiro
Oviedo	Biomedin spiro	Biomedin spiro	NDD
Galdakao	Biomedin spiro	Biomedin spiro	NDD
Barcelona	Biomedin spiro	Biomedin spiro	NDD
Albacete	Biomedin spiro	Biomedin spiro	NDD
Huelva	Biomedin spiro	Biomedin spiro	NDD

Table S2. Landsat 4-5 TM satellite images used for NDVI calculations.

#	Study centre	ECRHS I			ECRHS II			ECRHS III		
		Date	Path	Row(s)	Date	Path	Row(s)	Date	Path	Row(s)
1	Reykjavik	31.08.90	221	15	15.08.98	220	15	19.07.06	220	15
2	Umeå	14.06.89	192	14, 15, 16	30.07.03	193	15, 16	28.06.09	193	14, 15, 16
		21.06.89	193	15, 16	23.07.04	194	15, 16	26.06.09	195	14, 15, 16
		19.06.89	195	14, 15, 16	19.07.03	196	15	24.06.09	197	14, 15
		15.07.90	196	14, 15, 16						
3	Bergen	27.07.90	200	15, 16, 17, 18, 19	15.07.03	200	16, 19	29.09.10	199	15, 16, 17, 18
		25.07.90	202	16, 17, 18	06.07.03	201	17, 18	04.09.10	200	19
								27.09.10	201	16, 17, 18, 19
4	Uppsala	23.06.89	191	18, 19	11.09.04	192	18, 19, 20	30.06.09	191	18, 19
		07.07.89	193	18, 19	24.08.04	194	18	28.06.09	193	18, 19
					07.09.03	194	19			
5	Tartu	13.05.90	187	19	03.08.99	186	19	08.06.11	187	19
6	Gothenburg	05.07.89	195	19, 20	07.06.02	195	19, 20	26.06.09	195	19, 20
		03.07.89	197	19	14.06.02	196	19	03.07.09	196	19
7	Norwich	11.07.90	200	23	16.05.02	201	23	26.06.11	201	23
8	Ipswich	11.07.90	200	24	16.05.02	201	24	05.07.11	200	24
								26.06.11	201	24
9	Antwerp city	14.07.90	197	25	19.09.03	198	24, 25	06.09.10	198	24, 25
		13.07.90	198	24, 25						
		20.07.90	199	24						
10	South Antwerp	14.07.90	197	25	19.09.03	198	24, 25	06.09.10	198	24, 25
		13.07.90	198	24, 25						
		20.07.90	199	24						
11	Erfurt	30.07.92	194	24, 25	06.08.03	194	24, 25	08.07.10	194	24, 25
12	Paris	09.05.87	199	26	09.08.03	199	26	16.07.06	199	26
13	Basel	18.05.92	195	27, 28	23.06.02	195	27, 28	31.07.10	195	27, 28
14	Grenoble	01.07.85	196	28, 29	14.06.02	196	28, 29	09.06.06	196	28, 29
15	Verona	30.07.91	192	28, 29	07.07.03	192	28, 29	10.07.10	192	28, 29

					30.07.03	193	28	17.07.10	193	28
16	Pavia	31.05.90	193	29	31.07.01	194	28, 29	30.07.09	193	29
17	Turin	18.05.92	195	29	05.07.03	194	29	24.05.11	194	29
18	Oviedo				05.08.03	203	30	24.06.11	203	30
19	Galdakao				07.08.03	201	30	26.06.11	201	30
20	Barcelona				20.05.02	197	31	04.10.11 11.10.11	197 198	31 31
21	Albacete				26.09.03 17.09.03	199 200	33 33	09.10.11	200	33
22	Huelva				15.09.03	202	34	05.09.11	202	34

Table S3. Associations between residential greenness (NDVI) in 100m and 300m buffers around home and lung function change over a 20-year period¹, assessed by mixed linear models. Effect estimates are expressed as change following a 0.2-increase in NDVI.

Model	FEV ₁ (mL/year)			FVC (mL/year)			FEV ₁ /FVC (%/year)		
	n	β	95% CI	n	β	95% CI	n	β	95% CI
NDVI in 100m buffer									
Minimally adjusted ²	5559	-0.47	(-1.16 to 0.22)	5559	-0.83	(-1.67 to 0.02)	5559	0.009	(-0.002 to 0.021)
Main ³	5316	-0.56	(-1.29 to 0.17)	5316	-1.05	(-1.93 to -0.16)	5316	0.011	(-0.001 to 0.023)
NDVI in 300m buffer									
Minimally adjusted ²	5559	-0.39	(-1.12 to 0.33)	5559	-1.01	(-1.89 to -1.13)	5559	0.012	(0.000 to 0.024)
Main ³	5316	-0.37	(-1.13 to 0.39)	5316	-1.08	(-2.00 to -0.17)	5316	0.014	(0.001 to 0.026)

CI – confidence interval; FEV₁ - forced expiratory volume in 1 second; FVC – forced vital capacity; NDVI – Normalized Difference Vegetation Index.

Boldface indicates p-value <0.05.

¹An interaction term between the greenness variable and age at lung function measurements captures the effect of greenness on the rate of change of lung function parameter.

² With random intercepts for subjects nested within centers, and adjusted for sample, sex, age, age squared, and height.

³ With random intercepts for subjects nested within centers, and adjusted for sample, sex, age, age squared, height, age at completion of full-time education, occupation, weight, and smoking status and lifetime pack-years smoked.

Table S4. Additional associations between residential greenness (NDVI) in a 500m buffer and lung function change over a 20-year period¹, assessed by mixed linear models. Effect estimates are expressed as change following a 0.2-increase in NDVI.

Model	FEV ₁ (mL/year)			FVC (mL/year)			FEV ₁ /FVC (%/year)		
	n	β	95% CI	n	β	95% CI	n	β	95% CI
Main with BMI ²	5316	-0.57	(-1.33 to 0.20)	5316	-1.29	(-2.22 to -0.37)	5316	0.012	(-0.001 to 0.025)
Minimally adjusted, with fixed effect for center ³	5559	-0.73	(-1.47 to -0.001)	5559	-1.42	(-2.31 to -0.53)	5559	0.011	(-0.001 to 0.023)
Main, with fixed effect for center ⁴	5316	-0.56	(-1.33 to 0.21)	5316	-1.26	(-2.19 to -0.34)	5316	0.012	(-0.001 to 0.025)

CI – confidence interval; FEV₁ - forced expiratory volume in 1 second; FVC – forced vital capacity; NDVI – Normalized Difference Vegetation Index
 Boldface indicates p-value <0.05.

¹ An interaction term between the greenness variable and age at lung function measurements captures the effect of greenness on the rate of change of lung function parameter.

² With random intercepts for subjects nested within centers, and adjusted for sample, sex, age, age squared, age at completion of full-time education, occupation, BMI, and smoking status and lifetime pack-years smoked

³ With random intercepts for subjects, and adjusted for centers, sample, sex, age, age squared, and height.

⁴ With random intercepts for subjects, and adjusted for centers, sample, sex, age, age squared, height, age at completion of full-time education, occupation, weight, and smoking status and lifetime pack-years smoked

Table S5. Associations between presence of green space of at least one hectare in a 300 m buffer¹ around home and lung function change over a 20-year period², assessed by mixed linear models.

Model/type of green spaces	FEV ₁ (mL/year)			FVC (mL/year)			FEV ₁ /FVC (%/year)		
	n	β	95% CI	n	β	95% CI	n	β	95% CI
Minimally adjusted ³									
Agricultural	2821	-0.65	(-2.18 to 0.88)	2820	-2.09	(-3.91 to -0.27)	2820	0.025	(-0.001 to 0.051)
Forest	2821	-2.31	(-3.98 to -0.65)	2820	-4.76	(-6.74 to -2.79)	2820	0.026	(-0.002 to 0.055)
Urban green	2821	-1.81	(-3.27 to -0.34)	2820	-1.72	(-3.47 to 0.02)	2820	-0.004	(-0.030 to 0.021)
Main ⁴									
Agricultural	2744	-0.60	(-2.24 to 1.42)	2744	-2.55	(-4.49 to -0.62)	2742	0.034	(0.005 to 0.062)
Forest	2744	-2.31	(-4.09 to -0.53)	2744	-4.93	(-7.03 to -2.84)	2742	0.025	(-0.006 to 0.056)
Urban green	2744	-1.92	(-3.49 to -0.36)	2744	-1.10	(-2.95 to 0.75)	2742	-0.017	(-0.044 to 0.010)

CI – confidence interval; FEV₁ - forced expiratory volume in 1 second; FVC – forced vital capacity.

Boldface indicates p-value <0.05.

¹ Reference is no green spaces.

² An interaction term between the green spaces variable and age at lung function measurements captures the effect of green spaces on the rate of change of lung function parameter.

³ With random intercepts for subjects nested within centers, and adjusted for sample, sex, age, age squared, and height.

⁴ With random intercepts for subjects nested within centers, and adjusted for sample, sex, age, age squared, height, age at completion of full-time education, occupation, weight, and smoking status and lifetime pack-years smoked.

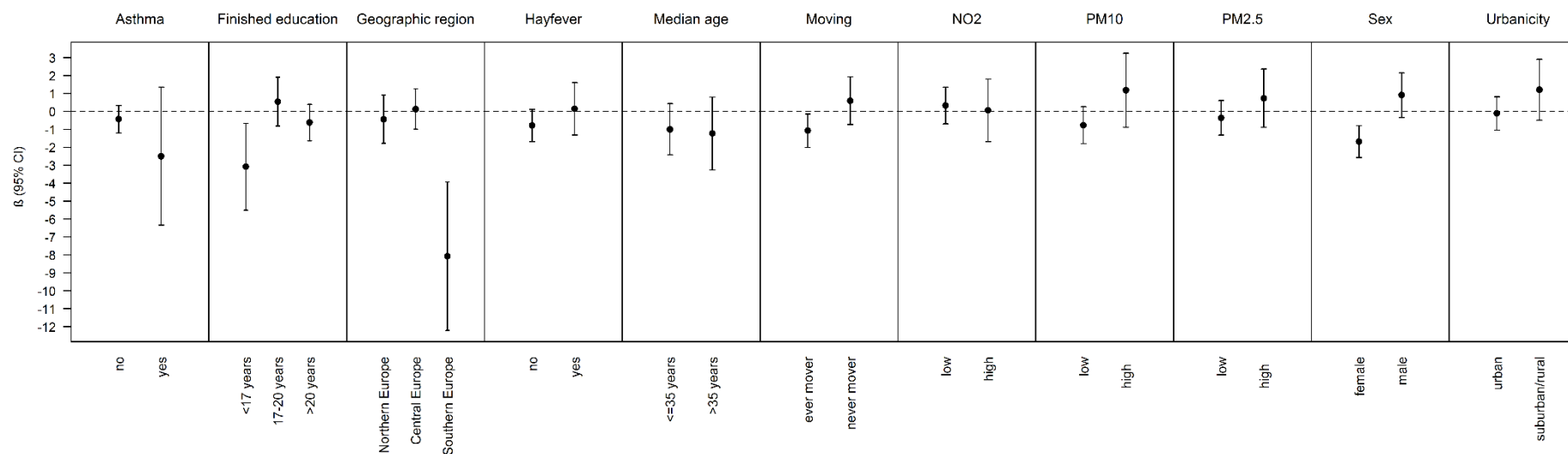


Figure S2. Associations between residential greenness (NDVI) in a 500m buffer around home and FEV₁ change (mL/year) over a 20-year period, assessed by adjusted mixed linear models (with random intercepts for subjects nested within centers, and adjusted for sample, sex, age, age squared, height, age at completion of full-time education, occupation, weight, and smoking status and lifetime pack-years smoked) and stratified by potential effect modifiers. All potential modifiers refer to ECRHS I data except moving; moving history (ever mover, never mover) considered all ECRHS data across three surveys. Effect estimates are expressed as change following a 0.2-increase in NDVI.

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Financial support for ECRHS I: The co-ordination of this work was supported by the European Commission and the authors and participants are grateful to the late C. Baya and M. Hallen for their help during the study and K. Vuylsteek and the members of the COMAC for their support. The following grants helped to fund the local studies: Australia: Asthma Foundation of Victoria, Allen+Hanburys; Belgium: Belgian Science Policy Office, National Fund for Scientific Research; Estonia: Estonian Science Foundation, grant no 1088; France: Ministère de la Santé, Glaxo France, Institut Pneumologique d'Aquitaine, Contrat de Plan Etat-Région Languedoc-Rousillon, CNMATS, CNMRT (90MR/10, 91AF/6), Ministre délégué de la santé, RNSP, France, GSF; Germany: Bundesminister für Forschung und Technologie; Italy: Ministero dell'Università e della Ricerca Scientifica e Tecnologica, CNR, Regione Veneto grant RSF n. 381/05.93; Norway: Norwegian Research Council project no. 101422/310; Portugal: Glaxo Farmacêutica Lda, Sandoz Portuguesa; Spain: Fondo de Investigación Sanitaria (#91/0016-060-05/E, 92/0319 and #93/0393), Hospital General de Albacete, Hospital General Juan Ramón Jiménez, Dirección Regional de Salud Pública (Consejería de Sanidad del Principado de Asturias), CIRIT (1997 SGR 00079) and Servicio Andaluz de Salud; Sweden: The Swedish Medical Research Council, the Swedish Heart Lung Foundation, the Swedish Association against Asthma and Allergy; Switzerland: Swiss National Science Foundation grant 4026-28099; UK: National Asthma Campaign, British Lung Foundation, Department of Health, South Thames Regional Health Authority.

Financial Support for ECRHS II: Australia: National Health & Medical Research Council; Belgium: Antwerp: Fund for Scientific Research (grant code, G.0402.00), University of Antwerp, Flemish Health Ministry; Estonia: Tartu Estonian Science Foundation grant no 4350, France: (All) Programme Hospitalier de Recherche Clinique—Direction de la Recherche Clinique (DRC) de Grenoble 2000 number 2610, Ministry of Health, Ministère de l'Emploi et de la Solidarité, Direction Générale de la Santé, Centre Hospitalier Universitaire (CHU) de Grenoble; Bordeaux: Institut Pneumologique d'Aquitaine; Grenoble: Comité des Maladies Respiratoires de l'Isère Montpellier: Aventis (France), Direction Regionale des Affaires Sanitaires et Sociales Languedoc-Roussillon; Paris: Union Chimique Belge-Pharma (France), Aventis (France), Glaxo France, Germany: Erfurt: GSF—National Research Centre for Environment and Health, Deutsche Forschungsgemeinschaft (grant code, FR1526/1-1); Hamburg: GSF—National Research Centre for Environment and Health, Deutsche Forschungsgemeinschaft (grant code, MA 711/4-1); Iceland: Reykjavik, Icelandic Research Council, Icelandic University Hospital Fund; Italy: Pavia: GlaxoSmithKline Italy, Italian Ministry of University and Scientific and Technological Research (MURST), Local University Funding for Research 1998 and 1999; Turin: Azienda Sanitaria Locale 4 Regione Piemonte (Italy), Azienda Ospedaliera Centro Traumatologico Ospedaliero/Centro Traumatologico Ortopedico—Istituto Clinico Ortopedico Regina Maria Adelaide Regione Piemonte; Verona: Ministero dell'Università e della Ricerca Scientifica (MURST), Glaxo Wellcome s.p.a.; Norway: Bergen: Norwegian Research Council, Norwegian Asthma and Allergy Association, Glaxo Wellcome AS, Norway Research Fund; Spain: Fondo de Investigación Sanitarias (grant codes, 97/0035-01, 99/0034-01 and 99/0034-02), Hospital Universitario de Albacete,

Consejería de Sanidad; Barcelona: Sociedad Española de Neumología y Cirugía Torácica, Public Health Service (grant code, R01 HL62633-01), Fondo de Investigaciones Sanitarias (grant codes, 97/0035-01, 99/0034-01, and 99/0034-02), Consell Interdepartamental de Recerca i Innovació Tecnològica (grant code, 1999SGR 00241) Instituto de Salud Carlos III; Red de Centros de Epidemiología y Salud Pública, C03/09, Red de Bases moleculares y fisiológicas de las Enfermedades Respiratorias, C03/011 and Red de Grupos Infancia y Medio Ambiente G03/176; Huelva: Fondo de Investigaciones Sanitarias (grant codes, 97/0035-01, 99/0034-01, and 99/0034-02); Galdakao: Basque Health Department; Oviedo: Fondo de Investigaciones Sanitarias (97/0035-02, 97/0035, 99/0034-01, 99/0034-02, 99/0034-04, 99/0034-06, 99/350, 99/0034--07), European Commission (EU-PEAL PL01237), Generalitat de Catalunya (CIRIT 1999 SGR 00214), Hospital Universitario de Albacete, Sociedad Española de Neumología y Cirugía Torácica (SEPAR R01 HL62633-01) Red de Centros de Epidemiología y Salud Pública (C03/09), Red de Bases moleculares y fisiológicas de las Enfermedades Respiratorias (C03/011) and Red de Grupos Infancia y Medio Ambiente (G03/176; 97/0035-01, 99/0034-01, and 99/0034-02); Sweden: Göteborg, Umeå, Uppsala: Swedish Heart Lung Foundation, Swedish Foundation for Health Care Sciences and Allergy Research, Swedish Asthma and Allergy Foundation, Swedish Cancer and Allergy Foundation, Swedish Council for Working Life and Social Research (FAS); Switzerland: Basel Swiss National Science Foundation, Swiss Federal Office for Education and Science, Swiss National Accident Insurance Fund; UK: Ipswich and Norwich: Asthma UK (formerly known as National Asthma Campaign).

Financial Support for ECRHS III: Australia: National Health & Medical Research Council; Belgium: Antwerp South and Antwerp City: Research Foundation Flanders (FWO), grant code G.0.410.08.N.10; Estonia: Tartu: SF0180060s09 from the Estonian Ministry of Education; France: (All) Ministère de la Santé, Programme Hospitalier de Recherche Clinique (PHRC) national 2010, Bordeaux: INSERM U897 Université Bordeaux segalen, Grenoble: Comité Scientifique AGIRadom 2011, Paris: Agence Nationale de la Santé, Région Ile de France, domaine d'intérêt majeur (DIM); Germany: Erfurt: German Research Foundation HE 3294/10-1, Hamburg: German Research Foundation MA 711/6-1, NO 262/7-1; Iceland: Reykjavik: The Landspítali University Hospital Research Fund, University of Iceland Research Fund, ResMed Foundation, California, USA, Orkuveita Reykjavíkur (Geothermal plant), Vegagerðin (The Icelandic Road Administration (ICERA)); Italy: All Italian centres were funded by the Italian Ministry of Health, Chiesi Farmaceutici SpA, in addition Verona was funded by Cariverona foundation, Education Ministry (MIUR); Norway: Norwegian Research council grant no 214123, Western Norway Regional Health Authorities grant no 911631, Bergen Medical Research Foundation; Spain: Fondo de Investigación Sanitaria (PS09/02457, PS09/00716, PS09/01511, PS09/02185, PS09/03190), Servicio Andaluz de Salud, Sociedad Española de Neumología y Cirugía Torácica (SEPAR 1001/2010), Fondo de Investigación Sanitaria (PS09/02457), Barcelona: Fondo de Investigación Sanitaria (FIS PS09/00716), Galdakao: Fondo de Investigación Sanitaria (FIS 09/01511), Huelva: Fondo de Investigación Sanitaria (FIS PS09/02185) and Servicio Andaluz de Salud, Oviedo: Fondo de Investigación Sanitaria (FIS PS09/03190); Sweden: All centres were funded by The Swedish Heart and Lung Foundation, The Swedish Asthma and Allergy Association, The Swedish Association against Lung and Heart Disease, Swedish Research Council for health, working life and welfare (FORTE), Göteborg: also received further funding from the Swedish Council for Working life and Social Research. Umeå: also received funding from Vasterbotten County Council ALF grant; Switzerland: The Swiss National Science Foundation (grants no 33CSCO-134276/1, 33CSCO-108796, 3247BO-104283, 3247BO-104288, 3247BO-104284, 3247-065896, 3100-059302, 3200-052720, 3200-042532, 4026-028099), The Federal office for forest, environment and landscape, The Federal Office of Public Health, The Federal Office of Roads and Transport, the canton's government of Aargau, Basel-Stadt, Basel-Land, Geneva, Luzern, Ticino, Valais and Zürich, the Swiss Lung League, the canton's Lung League of Basel Stadt/ Basel, Landschaft, Geneva, Ticino, Valais and Zurich, SUVA, Freiwillige Akademische Gesellschaft, UBS Wealth Foundation, Talecris Biotherapeutics GmbH, Abbott Diagnostics, European Commission 018996 (GABRIEL), Wellcome Trust WT 084703MA; UK: Medical Research Council (Grant Number 92091), support also provided by the National Institute for Health Research through the Primary Care Research Network.