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European Health Examination Survey—towards a sustainable monitoring system

Hanna Tolonen[1], Päivikki Koponen[2], Jennifer Mindell[3], Satu Männistö[1], Kari Kuulasmaa[1]

1 Department of Chronic Disease Prevention, National Institute for Health and Welfare (THL), Helsinki, Finland
2 Department of Health, Functional Capacity and Welfare, National Institute for Health and Welfare (THL), Helsinki, Finland
3 Research Department of Epidemiology and Public Health, University College London (UCL), London, UK

Correspondence: Hanna Tolonen, National Institute for Health and Welfare, (THL), Department of Chronic Disease Prevention, P.O. Box 30, 00271 Helsinki, Finland, Tel: +358 29 524 8638, Fax: +358 29 524 8338, e-mail: hanna.tolonen@thl.fi

Background: Health examination surveys (HESs), including both questionnaire and physical measurements, and in most cases also collection of biological samples, can provide objective health indicators. This information complements data from health interview surveys and administrative registers, and is important for evidence-based planning of health policies and prevention activities. HESs are valuable data sources for research. The first national HESs in Europe were conducted in the late 1950s and early 1960s. They have recently been carried out in an increasing number of countries, but there has been no joint standardization between the countries. **Methods:** The European Health Examination Survey Pilot Project was conducted in 2009–2012. The European Health Examination Survey Pilot Reference Centre was established and pilot surveys were conducted in 12 countries. **Results:** European standardized protocols for key measurements on main chronic disease risk factors (height, weight, waist circumference, blood pressure, blood lipids and fasting glucose or HbA_{1c}) were prepared. European-level training and external quality assessment were organized. Although the level of earlier experience, infrastructures, economic status and cultural settings varied between the pilot countries, it was possible to standardize measurements of HESs across the populations. Obtaining high participation rates was challenging. **Conclusion:** HESs provide high-quality and representative population data to support policy decisions and research. For future national HESs, centralized coordination, training and external quality assessment are needed to ensure comparability of the results. Further studies on effects of different survey methods on comparability of the results and on recruitment and motivation of survey participants are needed.

Introduction

Health examination surveys (HES), including both questionnaire and physical measurements, and in most cases also collection of biological samples such as blood, urine and saliva, are data sources for health indicators. HESs can provide objective measures for many health indicators that are not available from other data sources, including health interview surveys or administrative registers. A health interview survey (HIS) can be used to measure health behaviours, health status and diseases that are known to the person. HIS cannot provide indicators on undiagnosed conditions and is subject to reporting bias and cultural-based preferences in reporting of health problems. Administrative registers, like hospital records, are limited to those who have been diagnosed with the disease. Administrative registers often have rather limited information on individuals' background variables such as lifestyle, socioeconomic status and family composition. Comparability of data from health care utilization records is low due to differences in the structure of health care systems and recording practices.

The first national HESs on adults in Europe were conducted in the late 1950s and early 1960s (Figure 1).[1,2] Since then, nationally representative HESs have been carried out in at least 16 European Union (EU) Member States and European Free Trade Association/European Economic Area (EFTA/EEA) countries. In additional to these national HESs, in most countries, at least some regional, disease-specific or age-specific HESs have been conducted.[2] Finland, Germany, Ireland, Italy, Netherlands, Poland, Romania, Slovakia and UK (England and Scotland) have carried out national HESs repeatedly.[2] In the USA, a standardized nationally representative HES has been conducted since the 1960s [National Health and Nutrition Examination Survey (NHAHES)].[3] Also, countries such as Canada,[4] Mexico[5] and Korea[6] have conducted national HESs repeatedly.

Comparability of the results from national HESs has been limited due to differences in survey methods used in these surveys. For example, for weight measurement, the removal of clothing differs between surveys. In some surveys, participants have been measured in their underwear, and in other surveys, they are asked to remove only heavy outer garments. Accurate and comparable HES results require proper standardization of the measurement protocols and devices used, thorough training of the survey personnel and adequate quality control. For reporting, common definition of indicators is also required.

Standardized measurement protocols for cardiovascular disease risk factors were introduced by G. Rose in 1968[7]; they have been widely used by individual surveys. In the 1980s and 1990s, the World Health Organization (WHO) MONICA Project coordinated standardized cross-sectional cardiovascular disease risk factor surveys in 38 populations in 21 countries.[8] These surveys were regional and therefore not nationally representative. Since the mid-1990s, when the WHO MONICA Project ended, there has been no cross-national standardization for HESs in Europe. The WHO has prepared the Stepwise Approach for Risk Factor Surveillance, a standardized HES protocol that has been mainly targeted for low- and middle-income countries.[9]

The Feasibility of the European Health Examination Survey (FEHES) Project was conducted in 2006–2008 to assess the feasibility of conducting a standardized HES in all EU Member States and EFTA/EEA countries.[2,10,11] A strong demand for international standardization of the HES methods and for international coordination to

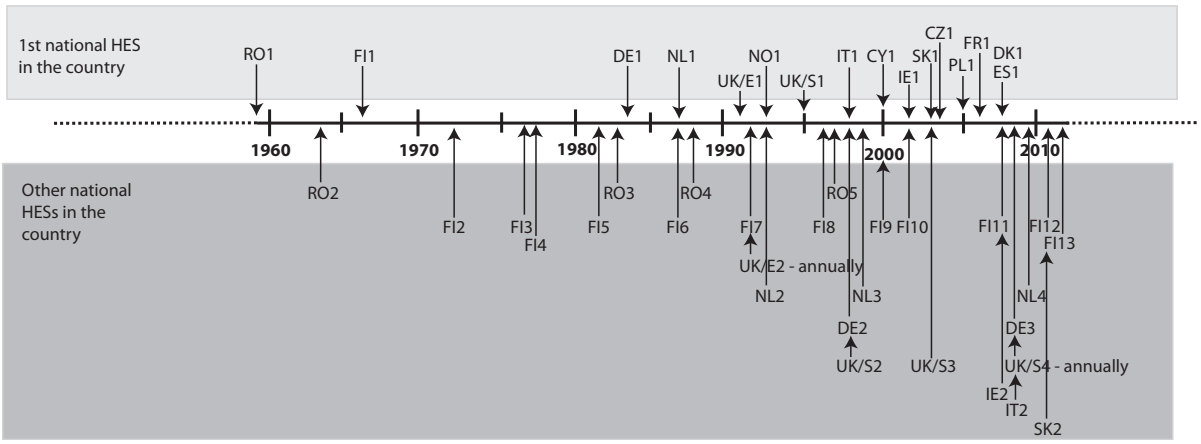

Figure 1 Time line of national HESs in EU Member States (*RO = Romania, FI = Finland, DE = Germany, NL = Netherlands, UK/E = UK/England, NO = Norway, UK/S = UK/Scotland, IT = Italy, CY = Cyprus, IE = Ireland, SK = Slovakia, CZ = Czech Republic, PL = Poland, FR = France, DK = Denmark, ES = Spain*)

ensure comparability of the national results was expressed by national experts of the FEHES network.

The FEHES Project concluded that it is feasible to conduct standardized national HESs in Europe and recommended setting up the European Health Examination Survey (EHES) in two phases[10]:

- Phase I: setting up the central coordination, and the planning and preparation of national HESs, including pilot surveys, in the first 8–12 countries.
- Phase II: full-size national HESs in those first countries, while other countries start planning and preparing for their national HES.

This article describes how the EHES Pilot Project was established, and tools developed to facilitate the standardization of HESs. Basic results from the EHES pilot surveys, relating to the organization and contents of the surveys, are also presented.

Establishing the EHES Pilot Project

Following the recommendations from the FEHES project, the setting up of the European HES started in autumn 2009 as the EHES Pilot Project. The first step was to establish the EHES Pilot Reference Centre (EHES RC). It was a joint operation of the National Institute for Health and Welfare (THL), Finland; Statistics Norway (SSB), Norway; and Istituto Superiore di Sanità (ISS), Italy. It received funding from the European Commission/DG Sanco for 2009–2012.

The EHES RC is a coordinating body for the EHES. It is responsible for:

- the development of the European-level standardized protocols for HESs and publication of those in the EHES Manual;
- providing professional support to the countries planning a national HES;
- developing a training programme, preparing training materials and organizing European-level training seminars;
- coordinating external quality control and preparing guidelines for internal quality control and
- establishing a centralized data management and reporting system for basic survey data.

In the beginning of 2010, 14 countries preparing for a national HES joined the EHES Pilot Project. The aim of the EHES Pilot Project was to prepare for a full-scale HES in these 14 countries and to pilot the fieldwork, data collection and assessment and reporting. Twelve of them completed the requirements of the Project, including successful pilot surveys (Figure 2). In four of the pilot countries (Italy, Germany, Netherlands and UK/England), a full-size national HES started already before or early in the Pilot Project. In these countries, the purpose of pilot survey was to evaluate the feasibility of incorporating EHES standardized protocols into the existing HES system. In remaining eight other countries, the feasibility of the EHES standards was tested in small pilot surveys. The pilot surveys received funding from the European Commission/DG Sanco for periods in 2010–2011.[12]

Tools Developed for the EHES

The EHES Manual

To minimize variation due to differences in measurement protocols, and also more widely in the survey processes, standardized measurement protocols and guidelines for planning the survey, implementation of the fieldwork and reporting were prepared and documented in the EHES Manual.[13–15] The EHES Manual includes information on sampling, ethical issues, organization of the fieldwork, protocols of the measurements, definition of indicators for reporting and other details relating to the planning and conducting of a national HES.

EHES standardized protocols and recommendations are based on review of existing international guidelines, protocols used and experience from the previous national HESs and scientific literature. Final versions were updated based on experience gained during the EHES pilot project.

Detailed standardized measurement procedures should be followed without national modifications. However, for topics such as sampling and ethical conduct, national circumstances, legislation and regulations vary between countries. Therefore, the EHES Manual cannot provide only one solution, but it lists the critical issues and provides guidelines and potential solutions.

Recommended measurements

In the EHES Pilot Project, standardization of the physical measurements and collection of biological samples was limited to key measurements of major chronic disease risk factors. For countries without previous experience of HES, it is recommended to start with few important measurements and do them well, then expand the set of measurements after they have acquired more experience in conducting basic HESs.

The EHES Manual has a core set of measurements: height, weight, waist circumference, blood pressure, blood lipids, fasting blood glucose or glycated haemoglobin (HbA_{1c}) and a questionnaire that should be included to all national HESs. The inclusion of these measurements is justified by their role as major risk factors for

Figure 2 Countries completing the fieldwork for the EHES Pilot Project

several chronic diseases and limited availability through other data sources. The accuracy of these EHES core measurements is known to be sensitive to deviations in the measurement procedures,[16–24] which also supports the need for standardization. The EHES Manual[13] provides detailed measurement protocols for all core measurements.

A set of core questions were selected to be included in all national HESs,[13] including questions on socio-economic position, health status, health care use and smoking. The questionnaire covers items that are important to know from the same individuals on whom the physical measurements are made and whose biological samples are collected. Whenever feasible, the questions were selected from the European Health Interview Survey.[25]

Training programme

For fieldwork personnel conducting the measurements, learning the standardized measurement protocols is the first step. Training should also include teaching practical skills to be able to follow the protocols correctly.

A training programme was developed in the EHES Pilot Project.[14] It includes European-level training and outlines the issues that should be included in the training of national survey personnel. A set of training material was prepared and made publicly available.[26] The training material includes guidelines for selection of the population sample, recruitment of survey participants, informed consents, measurement protocols for anthropometric measurements and blood pressure, blood sample collection and handling and questionnaire administration. Questionnaire administration includes guidelines how to check self-administered questionnaire and conduct an interview.

The aim of the European-level training is to train the trainers for each country. These national trainers would then be responsible for training within their own country. The main tools for the European-level training are training seminars. During the EHES Pilot Project, two European-level training seminars were organized: one on planning and preparation for the EHES at the national level, and another on fieldwork for the national HES. For full-scale national HESs, the need for the third training seminar on data analysis, reporting and dissemination of the survey results was identified.

Quality control

In EHES, special attention is given to quality control. Instructions on how to organize quality control are given in the EHES Manual.[14] They include guidelines for organizing internal quality control and external quality assessment by the EHES RC. The external quality assessment includes review of the national HES manuals, site visits, assessment of collected individual-level data and external laboratory quality assessment.

Results of the Pilot Surveys

During the EHES Pilot Project, the countries planned their national HES and prepared their own national HES manuals. A national HES manual template was prepared by the EHES RC to support the preparation of national HES manuals.[27] The pilot surveys tested local survey protocols in a small fieldwork pilot of people aged 25–64 years. A minimum sample size (number of persons examined) for the pilot surveys was 200 individuals. The average participation rate for the pilot surveys was 45%, varying from 25 to 63%. Participation rates were lower in men than in women in all but one survey.

The way the health examinations were organized varied between surveys. In one survey, all the examinations were conducted at the home of the participants, and in another survey, they took place at a mobile examination unit (a specially equipped bus). The other 10 surveys used a series of fixed local settings for the health examinations. These were either clinical settings in local health care centres or examination centres especially set up for this purpose in other premises such as community houses and office spaces. In three surveys, using fixed examination centres, home visits were offered to those not able or not willing to come to the examination centre. The frequency of home visits in these surveys varied. In two countries, home visits were not considered feasible, based on previous experience that people were reluctant to let survey fieldwork personnel into their home, or access to the apartment buildings in the cities would be limited due to locked front doors (Table 1).

In each pilot country, training was organized nationally for the fieldwork personnel involved in the pilot survey. Those responsible

for the national training had participated in the training seminars organized by the EHES RC. The duration of the national training varied from 1 day to 3 weeks, depending on the previous experience of the fieldwork personnel and number and type of measurements included in the survey (Table 1). In all countries, the fieldwork personnel went through the survey protocol, measurement techniques were demonstrated by trainers and fieldwork personnel also practiced measurements on volunteers during the training sessions. Training was seen as an important part of the standardization and quality assurance for the surveys. In several countries it was noted that during the training, more emphasis should be given for obtaining informed consent, the scope and objectives of the survey and the content of the questionnaire. Practical hands-on training with volunteers was also considered important. For small pilot surveys, the duration of training was felt to be adequate, but for future full-size HESs, several countries felt that longer training periods would be needed.

Of the recommended EHES core measurement, height, weight, waist circumference, blood pressure and total and high-density lipoprotein cholesterol were included in all EHES pilot surveys. Fasting glucose was measured in seven surveys, HbA_{1c} was measured in one survey and both fasting glucose and HbA_{1c} measurements were included in four surveys.

Table 1 Examination site, and duration and contents of the training

Pilot survey	Examination site	Possibility for home visit offered	Duration of training of the fieldwork staff	Personnel had previous experience on HES
CZ	Fixed location	No	1 day	Yes
DE	Fixed location	No	3 weeks	No
EL	Fixed location	Yes	2 days	Yes, partly
FI	Fixed location	No	2.5 days	Yes
IT	Fixed location	No	5 days	No
MT	Fixed location	Yes	5 days	No
NL	Fixed location	Yes	1 day	No
NO	Mobile unit	No	3 days	Yes, partly
PL	Fixed location	No	6 days	Yes
PT	Fixed location	No	4 days	No
SK	Fixed location	No	1 day	Yes
UK/England	Home	Not relevant	1 day for those with previous experience	Yes, partly

At least one additional measurement was included in 11 pilot surveys. Additional measurements varied a lot, including hip circumference, spirometry, body fat measurement by bioimpedance, visual acuity, electrocardiography, several functional capacity tests, oral health examination and cognitive function tests. The most common additional measurement was hip circumference, which was included in seven surveys. Body fat measurement and spirometry were also undertaken in more than one survey. (Table 2)

Urine (24-h or spot) samples were collected in more than one survey and saliva samples in one survey. Most surveys also collected more blood than was required for EHES core measurements of lipids and glucose. From these additional blood samples, triglycerides, C-reactive protein, gamma-glutamyl transferase and number of other biological markers were analysed. In nine surveys, additional blood samples were taken for storage for future analysis (Table 2).

In two pilot surveys, questionnaires were filled-in during the interview; in five surveys, questionnaires were self-administered and in five surveys, both interview and self-administration were used. In most surveys, self-administered questionnaires were sent to the survey invitees together with the invitation and they were asked to fill them in before coming to the examination. Questionnaires were checked at the examination centre for completeness (Table 3).

Questionnaires used in the pilot surveys were not identical. In the countries with an ongoing national HES or existing HES systems, there was a need to maintain questions used in previous surveys to ensure valid trend estimates. Also, the development of the EHES core questionnaire was not finished by the time that the first pilot surveys got started, resulting in small deviations between the EHES core questionnaire and those used in the surveys. Deviations were usually related to specifications in the questions such as 'diagnosed by a medical doctor' or 'during the past two weeks'.

Background items of sex, date of birth, education, labour status, household size and income; health status and smoking questions were included in all surveys, except for occasional questions that were missing from one or two surveys. Health care questions were missing from about half the surveys.

Each survey included some additional questions. Most commonly sets of additional questions were related to diet and alcohol use, physical activity and/or medications used. Questions about social support were also included in several surveys (Table 3).

Table 2 Additional physical measurements, biological samples and laboratory analysis

Pilot survey	Additional physical measurements	Additional blood samples stored for future use	Additional biological samples	Additional laboratory analysis[a]
CZ	None	No	None	None
DE	Hip circumference, functional capacity tests, cognitive function tests, SD-sonography	Yes	Spot urine	Allergic sensitization, blood count, calcium, CRP, GGT, GOT (ASAT), GPT (ALAT), Hb, kidney functions, nutrients, triglycerides, rheumatic diseases
EL	Hip circumference, body fat	Yes	None	ALT, AST, creatinine, total protein, totals CA^{2++}, urine acid
FI	Hip circumference, body fat	Yes	None	Apo-A1, Apo-B, blood count, CRP, DNA, GGT, RNA, triglycerides
IT	ECG, spirometry, carbon monoxide, bone density	Yes	24-h urine	Creatinine (blood), haemochrome, sodium and potassium excretion, triglycerides, urine creatinine and albumin
MT	Spirometry, visual acuity	Yes	None	Lead
NL	Hip circumference	Yes	None	Triglycerides
NO	Dental examination	No	None	None
PL	Hip circumference, ECG	Yes	None	None
PT	Hip circumference	Yes	None	ALT, AST, blood count, creatinine, CRP, DNA, GGT, triglycerides
SK	Body fat	No	None	Triglycerides
UK/England	Hip circumference	Yes	Saliva	Cotinine

[a]CRP = C-reactive protein, GGT = gamma-glutamyl transferase, ALT = alanine aminotransferase, AST = aspartate aminotransferase.

Table 3 Questionnaire administration mode and additional questionnaire modules

Pilot survey	Questionnaire administration	Additional questions
CZ	Self-administered, checked at the examination	Diet
DE	Interview and self-administered, checked at the examination	Diet and alcohol, injuries, living environment, mood, pain, sleeping habits/problems, social support, used medications, vision and hearing
EL	Interview	Diet and alcohol, physical activity
FI	Self-administered, checked at the examination	Diet and alcohol, family history of chronic conditions, physical activity, quality of life, sleeping habits/problems, used medications
IT	Interview and self-administered	ADL-IADL, diet and alcohol, family history of cardiovascular diseases, physical activity, self-rated health, used medications
MT	Interview	Passive smoking, i.e. exposure to tobacco smoke indoors
NL	Self-administered, checked at the examination	Diet and food supplements, mood, physical activity, sedentary activities, social support
NO	Self-administered, checked at the examination	Alcohol, physical activity
PL	Interview and self-administered, checked at the examination	Diet and alcohol, depression, physical activity, quality of life, social support, used medications
PT	Interview and self-administered, checked at the examination	Diet and alcohol, exposure to sun, mental health, physical activity, quality of life, social support, used medications
SK	Self-administered, checked at the examination	Diet, physical activity, stress
UK/England	Interview and self-administered	Attitudes to personal health and lifestyle, chronic pain, dental health, diet and alcohol, ethnicity, religion, sexual orientation, self-care, social care, used medications, well-being

During the EHES Pilot Project, the EHES RC conducted site visits to evaluate the pilot surveys. The local fieldwork personnel were observed taking the measurements (with the consent of the person being examined). The staff involved in the planning and organizing of the survey were interviewed. Feedback was provided immediately on site, and all observations were documented in the site visit reports. Some minor deviations from the EHES measurement protocols were observed during the site visits, and were usually corrected immediately after feedback. Deviations were usually related to the posture of the subject during the blood pressure measurement (legs crossed or unsupported arm) or failure to use a step when the height was measured of a participant who was taller than person making the measurement. The site visits also provided valuable information for the EHES RC on cultural norms affecting the measurement protocols, such as the extent of undressing for the anthropometric measurements.

Discussion

The major chronic diseases are leading causes of death and disability in Europe. Most of these have common risk factors: obesity, hypertension, elevated blood lipids and smoking. These risk factors are modifiable, and therefore, a large proportion of premature deaths and complications causing work disability could be prevented. Nevertheless, Organisation for Economic Co-operation and Development data show that 97% of the annual health expenditure goes for health care and treatment of diseases and only 3% for prevention in the EU Member States.[28] Appropriate and cost-effective targeting of prevention activities and their evaluation require health information, much of which is available only through HES.

The World Health Assembly (WHA65[8]) has adopted a global target of a 25% reduction in premature mortality from non-communicable diseases by 2025.[29] To promote this target, a set of voluntary global targets for the prevention and control of non-communicable diseases have been defined. These targets are based on monitoring a set of 25 health indicators, including mean population intake of salt per day, prevalence of raised blood glucose, blood pressure and total cholesterol and prevalence of overweight and obesity.[30] National HESs would be needed to fulfil these WHO voluntary global targets. Within Europe, this could be done through the EHES framework.

The EHES Pilot Project has shown that it is feasible to conduct standardized national HESs in countries with different infrastructures, economic status and cultural settings. National HESs with representative samples through EHES framework can provide reliable and comparable health information on European populations to be used for planning of prevention activities. Currently, the health information provided by EHES is focused on most common chronic disease risk factors, but surveys could easily be expanded to cover other health indicators and determinants of health.

The vision of EHES is to become a sustainable system of national HESs, covering all EU Member States and EFTA/EEA countries. It would provide nationally representative, high-quality and comparable information to support the planning and evaluation of health policies and prevention activities. Data and biological samples collected through national HESs under the framework of EHES would also support a wide range of research. This is needed for translating the data into interpretable information for the benefit of public health. Further studies are also needed to improve the data collection methods, especially recruitment and motivation of survey participants.

After the EHES pilot phase ended, the established EHES network exists but without centralized coordination. The EHES RC has no funding to continue the coordination and cross-national standardization of national HESs. However, several European countries are now conducting their national HESs and more countries are planning to start their national HES within the next few years. The continuation of the EHES RC activities is needed to ensure that data collected in future HESs in Europe are comparable and can provide best possible evidence base for health policy decisions.

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Conflicts of interest: None declared.

Key points

- Reliable and comparable health information is needed for evidence-based planning and evaluation of health policies and prevention activities as well as for research.
- HESs can provide key health data that are not available from other data sources.
- EHES has set up European-level support and standardization for national HESs.
- The EHES Pilot Project demonstrated that it is feasible to conduct standardized national HESs in countries with different infrastructures, economic status and cultural settings.
- The sustainability of the EHES Reference Centre is not secured, and therefore, the standardization of forthcoming national HESs is endangered.

References

1 European Health Interview & Health Examination Survey Database. Available at: https://hishes.iph.fgov.be/ (2011).

2 Tolonen H, Koponen P, Aromaa A, et al, editors. *Review of Health Examination Surveys in Europe,* Helsinki, Available at: http://urn.fi/URN:ISBN:978-951-740-843-1. (2008).

3 Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey - History. Available at: http://www.cdc.gov/nchs/nhanes/history.htm (2011).

4 Statistics Canada. Canadian Health Measurers Survey (CHMS), Available at: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5071&Item_Id=129548&lang=en (2012).

5 Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, et al. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX), Available at: http://ensanut.insp.mx/informes/ENSANUT2012ResultadosNacionales.pdf (2012).

6 Rhee SY, Hwang YC, Chung HY, Woo JT. Vitamin D and diabetes in Koreans: analyses based on the Fourth Korea National Health and Nutrition Examination Survey (KNHANES), 2008-2009. *Diabet Med,* 2012;29:1003–10.

7 Rose GA, Blackburn HW. *Cardiovascular Survey Methods*. Geneva: World Health Organization, 1968.

8 Tunstall-Pedoe H, editor. *MONICA Project. MONICA, monograph, and multimedia sourcebook: world's largest study of heart disease, stroke, risk factors, and population trends 1979-2002*. Geneva: World Health Organization, 2003.

9 WHO. STEPwise approach to chronic disease risk factor surveillance (STEPS). Available at: http://www.who.int/chp/steps/riskfactor/en/index.html (2012).

10 Tolonen H, Koponen P, Aromaa A, et al. Recommendations for Organizing a Standardized European Health Examination Survey. Helsinki: National Public Health Institute, Available at: http://urn.fi/URN:ISBN:978-951-740-840-0 (2008).

11 Tolonen H, Koponen P, Aromaa A, et al, editors. *Recommendations for the Health Examination Surveys in Europe.* Helsinki: National Public Health Institute, Available at: http://urn.fi/URN:ISBN:978-951-740-838-7 (2008).

12 Kuulasmaa K, Tolonen H, Koponen P, et al. An overview of the European Health Examination Survey Pilot Joint Actio. *ArchPublic Health,* 2012;70:20.

13 Tolonen H, editor. *EHES Manual. Part B. Fieldwork procedures.* Helsinki: National Institute for Health and Welfare, Available at: http://urn.fi/URN:ISBN:978-952-245-843-8 (2013).

14 Tolonen H, editor. *EHES Manual. Part A. Planning and preparation of the survey.* Helsinki: National Institute for Health and Welfare, Available at: http://urn.fi/URN:ISBN:978-952-245-842-1 (2013).

15 Tolonen H, editor. *EHES Manual. Part C. European level collaboration.* Helsinki: National Institute for Health and Welfare, Available at: http://urn.fi/URN:ISBN:978-952-245-846-9 (2013).

16 Bosy-Westphal A, Booke CA, Blocker T, et al. Measurement site for waist circumference affects its accuracy as an index of visceral and abdominal subcutaneous fat in a Caucasian population. *J Nutr,* 2010;140:954–61.

17 Hagan RD, Upton SJ, Avakian EV, Grundy S. Increases in serum lipid and lipoprotein levels with movement from the supine to standing position in adult men and women. *Prev Med,* 1986;15:18–27.

18 Handler J. The importance of accurate blood pressure measurement. *Permanente J,* 2009;13:51–4.

19 Jamieson MJ, Webster J, Philips S, et al. The measurement of blood pressure: sitting or supine, once or twice? *J Hypertens* 1990;8:635–40.

20 Keele-Smith R, Price-Daniel C. Effects of crossing legs on blood pressure measurement. *Clin Nurs Res,* 2001;10:202–13.

21 Kjeldsen SE, Eide I, Leren P, Foss OP. Effects of posture on serum cholesterol fractions, cholesterol ratio and triglycerides. *Scand J Clin Lab Invest,* 1983;43:119–21.

22 Naito HK, Kwak YS. Accurate measurement of serum total cholesterol: the need for standardization. *J Am Coll Nutr,* 1992;11(Suppl):8S–15S.

23 O'Brien E, Asmar R, Beilin L, et al. European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement. *J Hypertens,* 2003;21:821–48.

24 Statland BE, Bokelund H, Winkel P. Factors contributing to intra-individual variation of serum constituents: 4. Effects of posture and tourniquet application on variation of serum constituents in healthy subjects. *Clin Chem,* 1974;20:1513–9.

25 Commission regulation (EU) No 141/2013 of 19 February 2013 implementing Regulation (EC) No 1338/2008 of the European Parliament and of the Council on Community statistics on public health and health and safety at work, as regards statistics based on the European Health Interview Survey (EHIS), 141/2013, 2013.

26 European Health Examination Survey. EHES Training materials. Available at: http://www.ehes.info/training_materials/index.htm (2012).

27 European Health Examination Survey. National manuals. Available at: http://www.ehes.info/manuals/national_manuals/national_manuals.htm (2012).

28 OECD. OECD Health Data 2006. Statistics and Indicators for 30 Countries. Paris: CDROM, 2006.

29 World Health Organization. Sixty-fifth World Health Assembly. Decisions and list of resolutions. Geneva: World Health Organization, A65/DIV/3, 2012.

30 World Health Organization. Report of the Formal Meeting of Member States to conclude to work on the comprehensive global monitoring framework, including indicators, and a set of voluntary global targets for the prevention and control of noncommunicable diseases. Geneva: World Health Organization, A/NCD/2, 2012.

Annex I. Sites and key personnel contributing to the EHES Pilot Project

Czech Republic

National Institute of Public Health, Prague: Ruzena Kubinova, Nada Capkova, Jana Kratenova and Michala Lustigova.

Finland

National Institute for Health and Welfare (THL). EHES Reference Centre: Kari Kuulasmaa, Hanna Tolonen, Katri Kilpeläinen, Päivikki Koponen, Sanna Ahonen, Johanna Mäki-Opas, Ari Haukijärvi, Tarja Tuovinen, Georg Alfthan, Jari Kirsilä. National pilot survey: Satu Männistö, Katja Borodulin, Liisa Saarikoski, Anne Juolevi, Markku Peltonen, Tiina Laatikainen, Erkki Vartiainen, Jouko Sundvall, Laura Lund, Antti Jula, Eija Purkamo.

Germany

Robert Koch Institute, Berlin. For the DEGS Study Team: Antje Gösswald, Cornelia Lange, Panagiotis Kamtsiuris.

Greece

Hellenic Health Foundation, Athens. Antonia Trichopoulou, Valentini Konstantinidou, Androniki Naska, Dimosthenis Zilis, Vardis Dilis, George Adarakis, Ioulia Goufa, Georgia Stasinopoulou, Elisabeth Valanou, Perikles Karathanasis, Nikolaos Bilalis, Philippos Orfanos, Tina Karapetyan, Despina Oikonomidou, Eirini Frangogeorgi and Konstantinos Mine.

Italy

Istituto Superiore di Sanità, Rome. EHES Reference Centre: Susanna Conti, Mark Kanieff;

National Pilot Survey: Luigi Palmieri, Chiara Donfrancesco, Cinzia Lo Noce, Francesco Dima, Amalia De Curtis, Licia Iacoviello, Diego Vanuzzo, Simona Giampaoli.

Malta

Department of Health Information & Research, Gwardamangia: Neville Calleja, Dorothy Gauci.

The Netherlands

National Institute of Public Health and the Environment (RIVM), Bilthoven: W.M. Monique Verschuren.

Norway

Norwegian Institute of Public Health: Grethe S. Tell, Patricia Schreuder, Sidsel Graff-Iversen, Nina Hovland; University of Bergen: Kristin Klock; Statistics Norway. EHES Reference Centre: Johan Heldal, Susie Jentoft.

Poland

The Cardinal Stefan Wyszynski Institute of Cardiology, Warsaw: Grażyna Broda, Aleksandra Piwonska, Jerzy Piwoński, Paweł Kurjata, Walerian Piotrowski, Maria Polakowska, Anna Waśkiewicz, Elzbieta Sygnowska.

Portugal

Instituto Nacional de Saúde Dr. Ricardo Jorge, Lisbon: Carlos Dias, Ana Paola Gil.

Slovakia

Regional Authority of Public Health, Banská Bystrica. Maria Avdicova, Katarina Francisciova, Jana Namesna, Silvia Kontrosova.

UK

UCL (University College London), London: Jennifer Mindell, Nicola Shelton, Barbara Carter-Szatynska, Alison Moody. NatCen Social Research, London: Rachel Craig, Susan Nunn, Deanna Pickup, Chloe Robinson. The Health and Social Care Information Centre, Leeds: Steve Webster, Victoria Cooper.