Katja Borodulin
Katri Sääksjärvi
(eds.)

FinHealth 2017 Study – Methods

REPORT

17 | 2019

REPORT 17/2019

Katja Borodulin and Katri Sääksjärvi (editors)

FinHealth 2017 Study – Methods

Finnish institute for health and welfare

Layout: Laura Sares-Jäske and Katri Sääksjärvi

ISBN 978-952-343-449-3
ISSN 1798-0089
http://urn.fi/URN:ISBN:978-952-343-449-3

THL Report 17/2019

Foreword

This report is targeted for researchers who use data of the FinHealth 2017 Study for scientific purposes. Furthermore, this report offers information for those who plan and conduct large population based health examination surveys.

We warmly thank all experts who have contributed to the planning and implementation of the FinHealth 2017 Study. Their valued expertise and efforts laid the basis for this methodology report. Of the extensive pool of experts involved in the FinHealth Study, some have co-authored this methodology report (see Appendix 1). We highly appreciate their time devoted contributing to this report.

We also would like to thank:

- all the 7050 subjects who gave their time to take part in the survey,
- the study personnel working persistently to collect the data,
- the municipalities and other organizations that offered their facilities for the use of the FinHealth Study,
- Research Professor Seppo Koskinen who lead the FinHealth 2017 Study and contributed to planning and reviewing this report,
- Research Professor Pekka Jousilahti and Research Manager Päivikki Koponen who actively participated in the planning and implementation of the survey as well as planning, drafting and critically reviewing this report,
- MSc Laura Sares-Jäske for her assistance with layout, references and mark up when revising this report,
- the Finnish Institute for Health and Welfare for providing excellent research facilities and support, and
- the numerous agencies who contributed to the funding of the survey.

We hope this report offers you the methodological information you are seeking and engourages you to carry out research using population based studies.

Katja Borodulin and Katri Sääksjärvi

Abstract

Katja Borodulin and Katri Sääksjärvi (eds.), FinHealth 2017 Study – Methods. Finnish Institute for Health and Welfare. Report 17/2019. 132 pages. Helsinki, Finland 2019. ISBN 978-952-343-449-3

This report describes the planning, design and implementation as well as the methods and contents of the FinHealth 2017 Study, a comprehensive nationally representative health examination survey. The report is targeted to researchers using the data for various health and welfare monitoring and scientific research purposes, and to those who are planning or conducting large population based health examination surveys.

The main aim of the study is to produce reliable and up-to-date information on health, wellbeing, health behaviour and functional capacity as well as their determinants in the Finnish adult population in 2017. As the FinHealth 2017 Study combines the traditions of previous Health 2000/2011 Surveys and National FINRISK 1972-2012 Studies and is largely comparable with them, changes in public health can be evaluated over time.

The sampling design was one- and two-stage stratified, random sample comprising individuals aged 18 years or older and living in mainland Finland (N=10247, eligible sample). Furthermore, for the Eastern Finland Study with condensed study content, an additional sample was drawn (N=1718, eligible sample) to increase the sample size in the regions of North Karelia and North Savo. This enables analyses on longer time trends utilizing the National FINRISK Studies.

The fieldwork was carried out in 2017 by the Finnish Institute for Health and Welfare. The survey covers different topics extensively, such as self-perceived health, quality of life, functional capacity, lifestyles, as well as major public health problems and their risk factors. Need for care and use of health services are also assessed. The data were gathered using health examination measurements and self-administered questionnaires. Blood and urine samples were also taken from the participants. In addition, register based information was linked to the survey data.

In the FinHealth main sample, participation rate was 58.1% for the health examination, and 68.8% for participating at any phase of data collection. In the Eastern Finland Study, the corresponding proportions were 57.4% and 68.1%.

The FinHealth 2017 Study provides exceptionally good opportunities for health and welfare monitoring as well as for multidisciplinary public health and epidemiologic research. First results of the survey were published in 2018. Register based follow-up further enhances the possibilities for scientific research.

Keywords: FinHealth 2017 Study, health examination survey, health, wellbeing, health behaviour, functional capacity, epidemiology, methods, health monitoring

Tiivistelmä

Katja Borodulin ja Katri Sääksjärvi (toim.), [FinTerveys 2017 -tutkimus – Menetelmät]. Terveyden ja hyvinvoinnin laitos. Raportti 17/2019. 132 sivua. Helsinki 2019. ISBN 978-952-343-449-3

Tässä raportissa kuvataan FinTerveys 2017 -tutkimuksen suunnittelua, toteutusta, sisältöä ja menetelmiä. FinTerveys 2017 -tutkimus on laaja kansallisesti edustava terveystarkastustutkimus. Raportti on suunnattu tutkijoille, jotka käyttävät tutkimuksen aineistoa väestön terveyden ja hyvinvoinnin seurantaan ja tieteelliseen tutkimukseen, sekä niille, jotka suunnittelevat ja toteuttavat laajoja väestötutkimuksia.

Tutkimuksen tavoitteena on tuottaa luotettava ja ajankohtainen kuva Suomen aikuisväestön terveydestä, hyvinvoinnista, terveyskäyttäytymisestä, toimintakyvystä ja niihin liittyvistä tekijöistä vuonna 2017. Myös muutoksia väestön terveydessä voidaan arvioida, sillä FinTerveys 2017 -tutkimus yhdistää aiempien Terveys 2000/2011- ja Kansallisten FINRISKI 1972-2012 -tutkimusten pitkät perinteet ja on niiden kanssa laajalti vertailukelpoinen.

Yksi- ja kaksiasteisesti poimittu satunnaisotos koostui 18 vuotta täyttäneistä manner-Suomessa asuvista henkilöistä (N=10247, korjattu otos). Itä-Suomen tutkimukselle, joka sisälsi rajoitetumman tutkimussisällön, poimittiin lisäotos (N=1718, korjattu otos) otoskoon kasvattamiseksi Pohjois-Karjalassa ja Pohjois-Savossa. Tämä Itä-Suomen lisäotos mahdollistaa pitkien aikatrendien analysoimisen Kansallisia FINRISKI -tutkimuksia hyödyntäen.

Terveyden ja hyvinvoinnin laitos toteutti tutkimuksen kenttävaiheen vuonna 2017. Tutkimus kattaa laajasti eri teemoja, mm. koettu terveys, elämänlaatu, toimintakyky, elintavat, yleisimmät kansanterveysongelmat sekä niiden riskitekijät. Lisäksi arvioidaan hoidon ja avun tarvetta sekä terveyspalvelujen käyttöä. Tiedot kerättiin terveystarkastusmittauksin ja kyselylomakkein. Tutkittavilta otettiin myös veri- ja virtsanäytteitä. Tutkimusaineistoa on täydennetty yhdistämällä siihen kansallisista rekistereistä saatavia tietoja.

FinTerveys-tutkimuksen pääotokseen kuuluvista terveystarkastukseen osallistui 58,1 %, ja 68,8 % osallistui ainakin yhteen tiedonkeruun vaiheeseen. Itä-Suomen tutkimuksen otoksessa vastaavat osuudet olivat 57,4 % ja 68,1 %.

FinTerveys 2017 -tutkimuksen aineisto tarjoaa ainutlaatuisen mahdollisuuden sekä väestön terveyden ja hyvinvoinnin seurantaan että monitieteelliseen terveystutkimukseen. Ensimmäiset tulokset tutkimuksesta julkaistiin vuonna 2018. Rekisteriseurantatiedot lisäävät aineiston käyttökelpoisuutta tieteelliseen tutkimukseen.

Avainsanat: FinTerveys 2017 -tutkimus, terveystarkastustutkimus, terveys, hyvinvointi, elintavat, toimintakyky, epidemiologia, menetelmät, terveysseuranta

Sammandrag

Katja Borodulin och Katri Sääksjärvi (red.), Undersökningen FinHälsa 2017 – Metoder. Institutet för hälsa och välfärd. Rapport 17/2019. 132 sidor. Helsingfors, Finland. ISBN 978-952-343-449-3

Denna rapport beskriver planeringen, genomförandet liksom metoderna och innehållen i undersökningen FinHälsa 2017, en omfattande nationellt representativ hälsoundersökningsstudie. Rapporten riktar sig till forskare som kan använda uppgifterna för diverse syften inom övervakningen av hälsa och välfärd samt vetenskaplig forskning, och till dem som planerar och genomför stora befolkningsstudier om hälsa.

Syftet med studien är att skapa tillförlitlig och aktuell information om den vuxna befolkningens hälsa, välfärd, levnadsvanor och funktionsförmåga liksom samhörande faktorer i den finska vuxna befolkningen 2017. Eftersom undersökningen FinHälsa 2017 kombinerar traditionerna från Hälsa 2000/2011 -undersökningarna och nationella FINRISK 1972-2012 -studierna och i stor utsträckning är jämförbar med dem, kan förändringar i folkhälsan utvärderas över tid.

Som urvalsmetod användes ett- och tvåstegs stratifierat slumpmässigt sampel av personer som fyllt 18 år och som bor i fasta Finland (N= 10247, korrigerat sampel). Dessutom användes ett ytterligare sampel (N=1718, korrigerat sampel) för att öka samplet i regionerna norra Karelen och norra Savolax för undersökningen i östra Finland med ett begränsat studieinnehåll. Detta möjliggör analyser av trender över längre tidsperioder, genom att även använda de nationella FINRISK studierna.

Fältarbetet genomfördes 2017 av Institutet för hälsa och välfärd. Undersökningen berör olika tema på ett omfattande sätt, såsom självskattad hälsa, livskvalitet, funktionsförmåga, levnadsvanor, liksom centrala folksjukdomar och hälsoproblem och deras riskfaktorer. Behov av vård och användning av hälsotjänster evaluerades också. Data insamlades genom hälsoundersökningar och frågeformulär. Av deltagarna togs även blod- och urinprov. Dessutom kopplades information från register till studien.

Av personerna i undersökningen FinHälsas huvudsakliga sampel deltog 58,1 % i hälsoundersökningen och 68,8 % i åtminstone någon del av datainsamlingen. För undersökningen i östra Finland var motsvarnade deltaganden 57,4 % och 68,1 %.

Undersökningen FinHälsa 2017 erbjuder goda möjligheter för hälso- och välfärds övervakning i befolkningen liksom för multidisciplinär forskning inom hälsovetenskap. De första resultaten av undersökningen publicerades 2018. Uppföljning via register främjar möjligheterna till vetenskaplig forskning.

Nyckelord: Undersökningen FinHälsa 2017, hälsoundersökningsstudie, hälsa, välfärd, levnadsvanor, funktionsförmåga, epidemiologi, metoder, övervakning av hälsa

Contents

1 Introduction

Katja Borodulin, Katri Sääksjärvi and Seppo Koskinen

This report descbribes in detail the methods used in the FinHealth 2017 Study. The FinHealth 2017 Study is a comprehensive nationally representative health examination survey. The aims of the survey are to produce reliable and up-to-date information on health, health behaviour, functional capacity, and wellbeing in the adult population in Finland, and further to study the determinants and changes in the covered topics. Further, the FinHealth 2017 Study adds up to the surveys which have a major role in the national health monitoring system, and which have been carried out since the late 1960s (Aromaa et al. 2019). The Department of Public Health Solutions at the Finnish Institute for Health and Welfare (THL) coordinated the survey in cooperation with an extensive network of experts.

The FinHealth 2017 Study included a health examination, where various measurements, blood sample collections, and health interviews were carried out. Additionally, self-administered questionnaires were gathered with information on different topics, such as self-perceived health, quality of life, health behaviour, history of diseases and related conditions, use of medication, use of health services, as well as need and use of care and assistance. The study protocol merged the protocols of the previously implemented National FINRISK 1972–2012 Studies (Borodulin et al. 2018) and the Health 2000/2011 Surveys (Heistaro 2008, Lundqvist & Mäki-Opas 2016), which enables high comparability over time.

The methods in the FinHealth 2017 Study and the preceding health examination studies at THL constitute a solid platform for expertise in monitoring, evaluating and projecting population health. This expertise requires continued national and international collaboration. We seek for high comparability over time and across countries. Our work receives mutual support and benefits from the European Health Examination Survey guidelines (Tolonen et al. 2018), which emphasise the need to monitor population health and the use of survey based information for evidence informed planning and evaluation of health policies and preventive activities. The continued development and evaluation of health examination methodology will assist us, for example, in recognizing new public health problems, developing novel research methods, and reaching higher participation rates.

2 Planning and preparation

2.1 Project organisation and funding

Katja Borodulin and Seppo Koskinen

The project organisation involved a wide range of organisations and experts. THL had the overall responsibility for the project planning and implementation. A large number of specialists from different organisations participated in the project organisation. An Executive Board was set up to plan, direct and evaluate the FinHealth 2017 Study. The Executive Board comprised experts from THL. Much of the implementation, planning and execution was done by the Fieldwork coordination team at THL. Expert groups on different main topics of the survey participated in all phases of the preparation and execution of the survey. The topics covered by these teams were e.g. cardiovascular diseases and diabetes, mental health, musculoskeletal disorders, oral health, reproductive health, diet, health behaviour, functioning, and need and use of services.

The project organisation involved more than 200 researchers and other experts covering different topics and taking part in planning, training and supervision of the field examinations, as well as reporting. In addition, many other researchers from a number of research institutes, universities, hospitals and clinical health care facilities use the data in their research. The main results covering persons aged 30 and over were published in spring 2018 under the title "Health, functional capacity and welfare in Finland – FinHealth 2017 Study" (Koponen et al. 2018). Results on some key indicators can be also found from the interactive health indicator portal Terveytemme.fi (Our health). Furthermore, the results from the National FinDiet Sub-study on dietary habits and nutrient intake of the adult population were published in 2018 (Valsta et al. 2018). The main results concerning young adults (18–29-year-olds) were published in spring 2019 (Jääskeläinen et al. 2019).

The overall costs of preparing and implementing the fieldwork, management and quality control for the data, and preparing the baseline report totalled approximately 2.6 million Euros. This included a large amount of work carried out by permanent staff members and experts at THL and other participating organisations as part of their daily work. The funding was collected from several sources. The largest contribution was received from THL budget, The Social Insurance Institution of Finland, and the FinGen Research Project. The other main sponsors were European Food Safety Agency, the Juho Vainio Foundation, the Regional Council of North Karelia, the Gyllenberg Foundation, the Finnish Diabetes Association and the University of Tampere/Elsemay Björn Fund.

2.2 Ethical approval

Katja Borodulin

The FinHealth 2017 Study received approval from the Coordinating Ethics Committee at the Hospital District of Helsinki and Uusimaa (Reference 37/13/03/00/2016). The study followed the principles of good scientific practice at THL and the ethical principles of the Declaration of Helsinki for medical research involving human subjects. Participants at the health examination received and read an information leaflet on the study protocol, were informed at the reception of the health examination and gave their signed informed consent (see Chapter 3 for more details).

2.3 Sampling design

Tommi Härkänen, Anne Juolevi, Harri Rissanen and Katja Borodulin

The sampling design of the FinHealth 2017 Study was based on the Health 2000 Survey sampling design in order to form representative data on the Finnish population. We first give an overview of the Health 2000 and 2011 Survey sampling designs and after that we describe the FinHealth sampling design.

Sampling design of the Health 2000 and 2011 Surveys

The target population of the Health 2000 Survey comprised individuals aged 18 years or older and living in mainland Finland on 1 July 2000 (Laiho 2004). In addition to the household population, people living in institutions were included. The Autonomous Territory of Åland and other municipalities on islands not accessible by road were excluded.

A stratified one- and two-stage sampling design was used. Mainland Finland was divided into 20 strata defined by the 15 largest cities and towns (their health centres) and the remaining rural areas based on the five university hospital regions. The 15 towns were selected with probability 1 (one-stage sampling), and the remaining 65 health centres were selected from the rural strata using a systematic probabilities proportional to size (PPS-SYS) design (two-stage sampling). The second stage involved sampling individual persons from those districts. The sample size for each health centre within a stratum was equal so that the total sample size in a stratum was proportional to the target population. Oversampling of the people aged 80 and older was carried out using double inclusion probabilities. The total sample size was 9,922. Those who were at least 30 years of age (N=8,028) were invited to participate

in the health examination; young adults (N=1,894) were invited to participate in the health interview and to fill in the questionnaires. In 2011 all members of the Health 2000 Survey sample who were alive, living in Finland in 2011, had contact details available and had not refused to participate in further surveys were invited to take part in the Health 2011 Survey (N=8 135). A new random sample of persons aged 18–29 years was also included (N=1994) (Härkänen et al. 2016).

Sampling design of the FinHealth 2017 Study

To reduce the costs of the field work, only 50 health centre districts (HCDs) out of the 80 HCDs of the Health 2000 Survey were selected for the FinHealth 2017 Study. These 50 HCDs were the 15 largest cities and seven randomly selected HCDs from each of the five rural strata.

Due to the fact that there were changes in the municipal borders between 2000 and 2017, the geographical coordinates of addresses in 2016 and the municipal boundaries in 2000 were applied to link the HCD codes with the Population Register Centre data covering the whole population of Finland in 2016. There can be overlap or underlap between the true municipal borders and the polygon-based, approximate municipal borders, but we consider these differences small, because these underlap or overlap areas are usually sparsely populated. The population sizes in 2016 based on the municipal boundaries in 2000 were based on the Population Register Centre data to determine the sample sizes for each HCD. The exact population sizes along with the actual samples were obtained from the Population Register Centre at the time of the sampling to calibrate the weights for analyses.

The sample size of individuals in each stratum was proportional to the corresponding population size (Table 2.3.1). Study subjects were at least 25 years of age, and a small sample (n=298) from the age group 18–24 years (all study areas) was also selected. These samples are called here as the main sample, in which the total sample size was 10,305. Two additional, geographically defined samples were selected from the study areas in North Karelia (n=1400, including an additional HCD of Kitee, Kesälahti and Rääkkylä) and North Savo (n=332) for comparison with the former FINRISK Study areas. The sample was drawn on November 17, 2016. The sample information was updated altogether 5 times (in 2017: Jan 16, March 20, June 12, Nov 1; and in 2018: April 25) from the population register, to receive information on deaths and changes in the place of residence.

Table 2.3.1. Sample sizes in the FinHealth 2017 Study.

Sample	Age group (yrs)	Men	Women	All
FinHealth young adult sample	18–24	164	134	298
FinHealth adult sample	25–34	883	837	1720
	35–44	890	837	1727
	45–54	903	845	1748
	55–64	1005	895	1900
	65–74	794	837	1631
	75–84	373	547	920
	85+	96	265	361
	All	4944	5063	10 007
FinHealth main sample (adult + young adult)	All	5108	5197	10 305
North Karelia additional sample	25–74	736	664	1400
North Savo additional sample	25–74	152	180	332
	All	888	844	1732
All samples		**5996**	**6041**	**12 037**

Representativeness of the samples

In the main sample, the HCDs of the rural strata were selected in 2000 using the PPS-SYS sampling based on the population sizes in 2000, thus the sample sizes per HCD were adjusted by the population growth between 2000 and 2016 to retain equal sampling probabilities per individual. As the sample sizes in the 15 largest cities as well as the total sample sizes in each rural stratum were proportional to the population sizes, the sampling probabilities were equal in the age group 25 years and older, but considerably lower in the age group 18-24 years, in which the sample size was small.

The additional samples from North Karelia and North Savo are not to be analysed as part of the main sample, because the study protocol was very much condensed, and the results would be less representative at the national level due to an excessive number of participants from these areas. In North Karelia, the HCD of Kitee, Kesälahti and Rääkkylä, was selected in the sample, thus it must be analysed as a separate stratum in the sampling design.

Samples for sub-studies and selected additional samples

Part of data collection was targeted to smaller sub-samples, called as sub-studies in this report (Table 2.3.2).

Table 2.3.2. Description of the sub-studies and additional samples of the FinHealth 2017 Study.

Name of sub-sample	Sample size	Age at sample draw	Area	Selection criteria
Young adults	298	18–24	All	Age
FinDiet	3112	18–74	All	18–24-year-olds: all included (n=298); 25-64-year-olds: a randomly chosen 30% sub-sample (n=2129); 65–74-year-old: a randomly chosen 42% sub-sample (n=685).
70-year-olds	1992	70+	All	Age
Joint function	4812	55+	All	Age
Physical activity and sleep	2000	25+	All	Randomly chosen 2000 individuals of the sample; not included in the diet sub-sample
Spot urine	2814	25–74	All	Those included in the FinDiet sub-sample
24-h urine	1555	25–74	Selected locations	Those included in the FinDiet sub-sample
Urine validation	692	25–74		Those included in the FinDiet sub-sample and the 24-h urine sub-sample
Bioimpedance validation	150	25–74	Helsinki	Area, randomly chosen 150 individuals from the sample in Helsinki
North Karelia additional sample	1400	25–74	North Karelia	Geographical location, including also the Kitee health centre district
North Savo additional sample	332	25–74	North Savo	Geographical location

The selections were based on, for example, age or geographical area. Age criteria were based on the age at the time of the sample draw (November 2016). Sub-studies were implemented on a smaller number of participants mainly to ease the burden of

the participant during the health examination. At the same time, the sample size was calculated to study reliably the phenomenon in focus of each sub-study. The contents of the measurements for sub-samples are described elsewhere in this report (see Chapter 20, and Chapters 15, 18 and 19 regarding the Questionnaire for persons aged 70 years or older).

2.4 Preparation of fieldwork

Katja Borodulin, Katri Sääksjärvi, Niina Kaartinen, Päivikki Koponen, Seppo Koskinen, Laura Råman, Päivi Sainio, Hanna Tolonen, Liisa Valsta and Hanna Valtonen

Planning of the FinHealth 2017 Study started in 2015. The fieldwork protocol including all questionnaires and the health examination was designed by the FinHealth field coordination team at THL (see Appendix 2) together with many experts from THL and from other academic institutions. Validated and commonly used methods were chosen whenever possible to ensure the quality of data and international comparability of the results. Moreover, the methods and contents of the survey were aimed to be as similar as possible with the previous health examination surveys at THL, i.e. the Health 2000/2011 Surveys and the National FINRISK Studies to ensure comparability of the results across the surveys. If the questions and protocols in these two previous surveys were different, the coordination team decided which of them was chosen.

A simplified schedule of planning and implementation of the FinHealth 2017 Study is described in Figure 2.4.1. The preparations took on average a full year of working time for a few experts and part time for several other experts. There were several important elements in the planning, including e.g. planning detailed protocols for the measurements, selection of the study locations, and preparation of the logistics system.

Figure 2.4.1. Schedule for planning and implementation of the FinHealth 2017 Study.

Recruitment of the fieldwork personnel

A total of 43 persons (including public health nurses, nurses, bioanalysts/laboratory technicians, physiotherapists and nutritionists) from six cities in Finland (Helsinki, Kuopio, Lahti, Oulu, Tampere and Turku) were recruited. Positions for the study nurses were advertised in all major local newspapers and other relevant locations. Job interviews were carried out in October through November 2016. The interviews were carried out by the field coordinator and the laboratory coordinator, who were most capable of identifying the needed practical skills and building functional, co-operative teams. For the FinDiet sub-study, the recruitment process and interviews

were carried out by the FinDiet coordinator. Six teams with six members were chosen to cover the six study areas. Furthermore, a separate team in the Helsinki headquarters with substitute workers and telephone service was recruited.

Pilot Study

A pilot Study was implemented to test the feasibility of the study protocol. It was designed to include all measurements and all elements in the data collection of the FinHealth 2017 Study.

A random sample of 200 men and women aged 18 years and above, in the cities of Espoo, Helsinki and Vantaa, were drawn from the population register. A personalized invitation letter together with the first questionnaire was sent to the sample by mail on August 2, 2016. The invitees were asked to confirm their pre-set health examination time by themselves using the online appointment application or by calling the toll-free service number. The recruitment process of the invitees is described in detail later in this report.

The pilot health examinations took place from August 22nd to September 6th in 2016 at four examination rooms at THL premises in Helsinki. Dietary interviews continued by phone until September 15th, 2016. The study personnel were permanent staff members from THL who also had a two-day training before the pilot. After the data collection period, all materials were coded to numerical formats and checked for accuracy and feasibility. All experiences, including those of study nurses and the participants were taken into account to make sure that the FinHealth 2017 Study would be as successful as possible. The participants were asked to fill in a feedback questionnaire (65 questionnaires were returned), and discussions with the study nurses were organized.

Several points of the feasibility were considered for conducting the full FinHealth 2017 Study:

- The participation rate of the pilot study was 50%, which was considered close to what was expected in the Helsinki region. The recruitment process was decided to be enhanced by sending teaser postcards to all participants prior to the formal invitation letter, by creating a detailed contact protocol that assisted in creating phone call lists and other tasks for reminding the invitees, and by paying attention to easy access to all examination locations.
- The participants used an online appointment application to confirm or change their pre-set examination time. A new logistics system was developed for this purpose. The application worked satisfactorily and the user feedback was encouraging enough to include the application in the FinHealth 2017 Study.
- The online system for filling in questionnaires was designed earlier at THL and developed for use in the pilot study. The system was accessed with

personalized user names and passwords that were given in the invitation letter. Based on the user feedback from the participants, the application worked satisfactorily and it was decided to be used in the study.

- The health examination protocol was tested for timing and order of the measurements. The timing of the measurements was not balanced between the examination rooms and this was taken into account in later decisions on the final protocol.
- The participants were generally satisfied with the study protocol, the contents of the study and the friendly personnel. However, they gave negative feedback mainly on the length of the questionnaires and the length of the health examination visit with some waiting time for the measurements. However, it was decided that no major parts of the questionnaires or examinations would be cut off, as the return rate of the questionnaires was acceptable and the length of the examination visit could be reduced with minor changes in the protocol.

Training of the study personnel

Training of the field work personnel was organized in two parts at THL in Helsinki, where the first part (Jan 12-13th, 2017) included training of the six fieldwork team leaders and their two substitute study nurses. This training focused at team leading tasks and administration. The second part (Jan 16-27th, 2017) was targeted to all study personnel and nutritionists and lasted two weeks. The training was planned by the FinHealth field coordination team.

The general training of all fieldwork personnel covered an introduction to the aims and protocols of the study, ethical issues, data protection and informed consent, quality assurance, safety instructions, the roles and responsibilities of the central office and the fieldwork personnel as well as rules and principles for communication. The study personnel received the full field manual in the training period so that they could check and recap the standards during the fieldwork and find instructions for challenging situations. In addition, general IT training and an introduction to the terms and conditions of employment (working hours, vacations, sick leaves, travel arrangements and allowances) was given.

The training was tailored to the content of the respective measurement stations and it covered lectures and practical training for interviewing techniques and measurements. The content and guidelines for each measurement station are explained in more detail under the specific chapters describing the contents of the health examination. Before the actual fieldwork, the personnel had one day of practice of the full study protocol with volunteer participants at THL and another day at the real study sites at the first six study locations across the country. The personnel also had short check-up lists to make sure all tasks were carried out as instructed.

At the end of the training period, the fieldwork personnel were asked to fill in a feedback questionnaire, which nearly all of them returned. Based on the feedback, all fieldwork personnel had received enough information about the survey aims, research ethics and obtaing informed consents, and the specific measurements. A few considered that the introduction to the terms and conditions of employment, and the training on IT programmes and equipment was somewhat insufficient. The personnel gave several comments indicating that they found the training inspiring. They also told that there was enough time for practicing each of the measurements. However, some of them felt that there should have been more time to practise the full protocol, and critique was also received on some unfinished materials and incomplete IT programmes.

3 Implementation

3.1 Central office, fieldwork locations, facilities and personnel

Katja Borodulin, Katri Sääksjärvi, Niina Kaartinen, Päivikki Koponen, Seppo Koskinen, Laura Råman, Päivi Sainio, Hanna Tolonen, Liisa Valsta and Hanna Valtonen

The fieldwork was conducted between 31st of January and 17th of May, 2017. The additional field work in the Eastern Finland sub-study in North Karelia and North Savo continued until 18th of June, 2017.

The central headquarters were located at the Finnish Institute for Health and Welfare (previously called the National Institute for Health and Welfare) in Helsinki, where also the management of the entire survey was situated. The central office offered the toll-free telephone service for the subjects, and managed the returned questionnaires, blood samples, and other materials. The blood samples were analysed and further stored at the central laboratory at THL (see Chapter 6).

The fieldwork was carried out in 50 locations across the country (Figure 3.1.1) by the six field teams. Each team had a detailed schedule (see Appendix 3). The schedule for each team was designed based on the distance from the central town of the corresponding team to optimise travel time and make the fieldwork as feasible as possible. The length of stay in each location depended on the number of subjects to be examined based on the sample design. The teams travelled between locations with rented cars bringing along all required examination equipment. Accommodation was arranged at hotels. Outside the central towns, each week started on Monday morning with a travel to the study site and ended by Friday evening upon returning to the central town.

The facilities required for the health examinations included five to six furnished examination rooms located in close proximity to one another. Other relevant requirements included a common waiting area and a toilet. The facilities for the health examination were requested from local health centres. Majority of the facilities were provided in co-operation by the local health centres, while just a few were rented from the private market. A few facilities were also provided by the local municipality, hospital district or university.

The six fieldwork teams comprised each six members. Each team had one study nurse who served as a team leader (hereafter called as leading study nurse). Each team member had a specified role in one examination room and the tasks were maintained throughtout the field phase (Table 3.1.1). Only one study nurse in each team travelled to stay some days with other teams to assure blood pressure

validation between the teams. The detailed description of the tasks for each examination room is given in the health examination section in this report (see Chapter 3.4). Furthermore, at the central office in Helsinki there were several substitution workers who covered sickness absences and travelled to the study locations when needed.

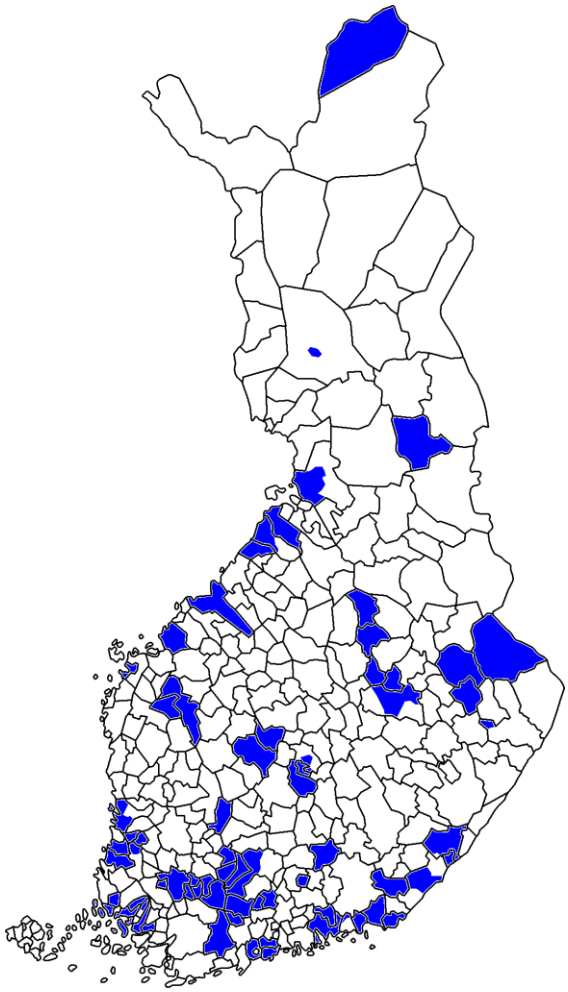


Figure 3.1.1. Study locations in the FinHealth 2017 Study.

Table 3.1.1. The roles and tasks of the personnel in each team.

Title	Examination room and task
Leading study nurse (team leader)	Examination room 1A; registration, information and consent, blood pressure, visual acuity, waist and hip circumference, questionnaires. Interaction with central office and study location, management of the team.
Study nurse	Examination room 1B; registration, information and consent, blood pressure, visual acuity, waist and hip circumference, questionnaires, travel between teams for blood pressure validation.
Bioanalysts 1 and 2	Examination room 2; height, weight, bioimpedance, blood draw.
Physiotherapist or study nurse	Examination room 3; functional capacity, cognitive tests, accelerometry, questionnaires.
Nutritionist	Examination room 4; 24-hour dietary interview.

3.2 Recruitment of the participants

Katri Sääksjärvi and Katja Borodulin

A pre-notice postcard was sent to all sampled persons two weeks before sending the invitation letter. The subjects were invited to participate in the health examination with a personalized invitation letter including a pre-set appointment time. The information leaflet and Questionnaire 1 were sent together with the invitation. The materials were sent in Finnish or Swedish. The language was selected based on the native language recorded in the Population Register. English versions of the invitation letter and information leaflet were also mailed in addition to the Finnish one, if the person had a mother tongue other than Finnish, Swedish or Sami. Also English versions of questionnaires could be mailed later or given at the examination site, if requested. Mail batches were sent every second Monday starting from 2.1.2017, 4–6 weeks before the pre-set appointment time for the health examination (Figure 3.2.1). Postal addresses were obtained from the population register. In the invitation letter, the subjects were asked to confirm their pre-set health examination time by themselves using the online appointment application or by calling the toll-free service number. In either case, the invitees had the option to change the appointment time and place for a more convenient one.

Private phone numbers for the sampled persons were obtained from a company offering telephone directory service, or collected when the invitees called to the service number of the survey. For those who had a mobile telephone number available, an automatic SMS reminder was sent two days before the appointment time whether or not the time was confirmed, as the appointment time was held assigned to the invitee even if the time was not confirmed. If the appointment was not confirmed at least two weeks before the health examination time, the central

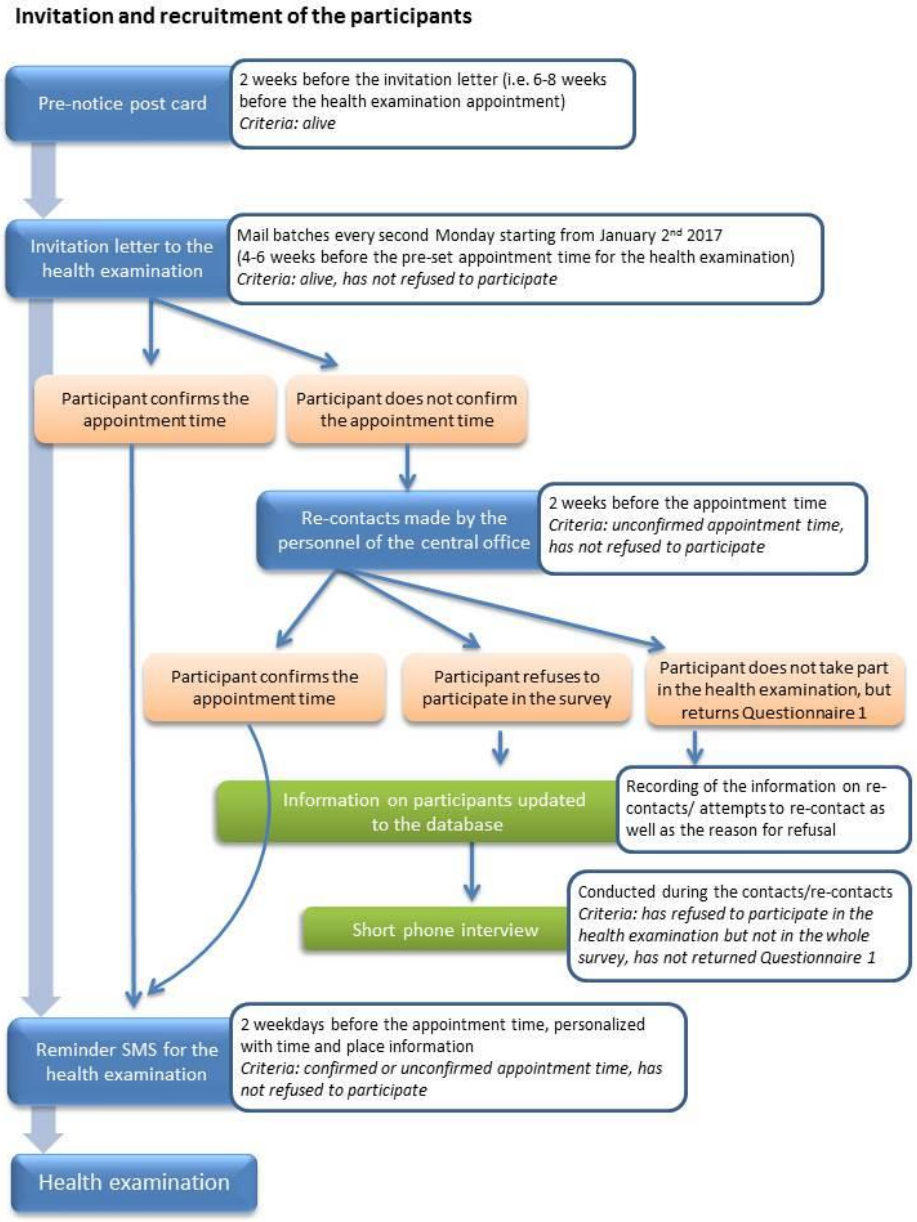


Figure 3.2.1. Recruitment protocol of the participants.

office personnel started re-contacting the invitees by phone calls and SMS messages or by postcards if a telephone number was not available.

The central office personnel were trained for re-contacting the invitees to motivate participation in the health examination. Along with reminding about the appointment time and the possibility to reschedule it, they offered detailed information about the survey and why it is important to participate, explained the confidentiality of information given by invitees during the survey, and informed about the laboratory test results and the personal Health Profile each participant would receive later. All persons unable or not willing to attend the health examination were asked to return the Questionnaire 1 or, if this was not possible, to attend a short phone interview. Information on re-contacts and attempts to re-contact was recorded into the database through the online service portal. In case of refusals, information on what part of the survey the subject was refusing from and the reason for it was also recorded in the database.

After the field teams had finished their journey according to the schedule, they returned to the corresponding central town of the team for a few days of additional health examination appointments. A new invitation letter for this ”last chance” health examination was sent to those who had not participated in the health examination but not refused from it. Invitees were asked to confirm their pre-set appointment time, re-contacted if necessary, and reminded with SMS messages according to the original recruitment procedure (Figure 3.2.1). For the Helsinki area the protocol was different, as a pre-set appointment time was not given due to the large number of potential participants. Instead they received a post card with an invitation to the health examination and a request to book the appointment time either online or by phone, using the toll free service number. Postcard was folded and sealed, because it included the individualised password information.

Later after the field phase, SMS reminders were sent to request those questionnaires not yet returned. After that, a second batch of questionnaires was mailed to those persons who were invited but had not participated in the health examination (Questionnaire 1), or had not returned the questionnaires given at the health examination. In addition, as a last wave of re-contacting in August 2017, the central office personnel performed short phone interviews by calling those subjects who had refused to participate in the health examination but not in the whole survey and had not returned Questionnaire 1. However, due to limited resources, only a small part of such subjects were re-contacted.

Special attention was paid to the recruitment of participants in order to achieve as high participation as possible, covering many methods described in the European Health Examination Survey protocol (Tolonen 2016a). No gifts or other compensation were used to increase participation, but the participants were promised that a feedback letter would be sent to them in a couple of weeks with their personal blood test results, and another one after the survey including a comprehensive personal Health Profile. The Health Profile included their own

results compared with the results of the general population in the respective age/sex group, as well as advice on health promotion and information on reference values (a more detailed description is given in Chapter 21). A free taxi ride to and from the health examination site was offered for people with physical disabilities or other problems in mobility.

Phone numbers were an essential part of the recontacting the participants and they were available for about two-thirds of the sample. Some of the numbers were, however, found to be incorrect or not in use anymore. Moreover, subjects with prepaid phones or secret numbers were not listed in telephone directories. Some efforts were made to search phone numbers from the internet, and occasionally phone numbers for business phones of the subjects were found. In those cases, extra attention during the phone call was paid to assuring the identity of the subject in order to make sure that the right person was invited to participate. However, this was time consuming, and most of the central office's resources were targeted to re-contacting those with a phone number available from the telephone directory service provider.

3.3 Informed consent

Katja Borodulin and Katri Sääksjärvi

An information leaflet describing the study and its objectives was sent to the subjects along with the invitation letter. At the study site, participants were asked if they had read the information leaflet and if they had additional questions. In the examination rooms study nurses explained the purpose of the study and informed the participant about the questionnaires, measurements and blood samples taken during the examination, and the linkage of register-based data and survey data, as well as how all these will be used for medical research purposes in the future. The voluntary nature of participation and the right to withdraw and cancel the participation at any stage was emphasized.

The participants gave their written informed consent in two identical copies. If the participant was unable to fill in the consent form due to physical or cognitive disability, the consent was signed by a third party, in most cases by an accompanying family member or personal assistant. Use of a third party was marked in the questionnaire (n=81, i.e. 1.4 % of the participants were unable to give the consent themselves). The study nurses checked that the signature and other information was correct and then, by signing the consent form, confirmed that the subject had been informed and gave the consent voluntarily.

The FinHealth 2017 Study had two separate consent forms. The first one, signed upon arrival at the registration, was the main consent of the FinHealth 2017 Study. If

the participant refused to sign this first consent, the examination was not started and the refusal to participate in the health examination was recorded in the logistics system (the participant could still fill in Questionnaire 1 if willing). The second consent concerned the use of samples and information collected in the survey by the THL Biobank. A separate Biobank information leaflet was given to the participant, and the participant was given time to read the information leaflet. The signatures for the Biobank consent were obtained at the second examination room from both the participant and the study personnel, before taking the blood samples. For the Biobank consent, only participant's own signature was accepted, and if this was not possible due to the participant's physical or cognitive disability, the samples for the Biobank were not taken.

3.4 Health examination

Katja Borodulin, Katri Sääksjärvi, Niina Kaartinen, Päivikki Koponen, Seppo Koskinen, Laura Råman, Päivi Sainio, Hanna Tolonen, Liisa Valsta and Hanna Valtonen

The health examination protocol is presented in Figure 3.4.1. The used measurement devices and techniques as well as their detailed contents are described in separate chapters in this report. The identification of individuals, including sticker identification numbers is described in Chapter 5.1. Each examination day was scheduled in advance with pre-arranged time slots for the participants. Daily visits were managed using a daily visit list.

The participant arrived at the first examination room, where the leading study nurse (examination room 1A) and study nurse 2 (examination room 1B) had the following tasks: welcome the participant, check identity, give information on the study and receive signed consent, place sticker (see Chapter 5.1) on the daily visit list and on the questionnaires, check and help (if needed) with Questionnaire 1, give information and guidance on THL Biobank and the biobank consent, give information and guidance for Questionnaire 2, Food frequency questionnaire (FFQ), Food propensity questionnaire (FPQ) (sub-study), Questionnaire for persons aged 70 years or older (sub-study), measure upper arm circumference, measure pulse rate and blood pressure, measure waist and hip circumference, test visual acuity (near and distance) and give feedback on the measurement results. Participants were given a folder including these material as well as sticker labels with bar codes for collection of biological samples (see Chapter 6.2). The study nurses in the examination rooms 1A and B also tried to contact by phone those who didn't arrive for the appointment (no-show subjects).

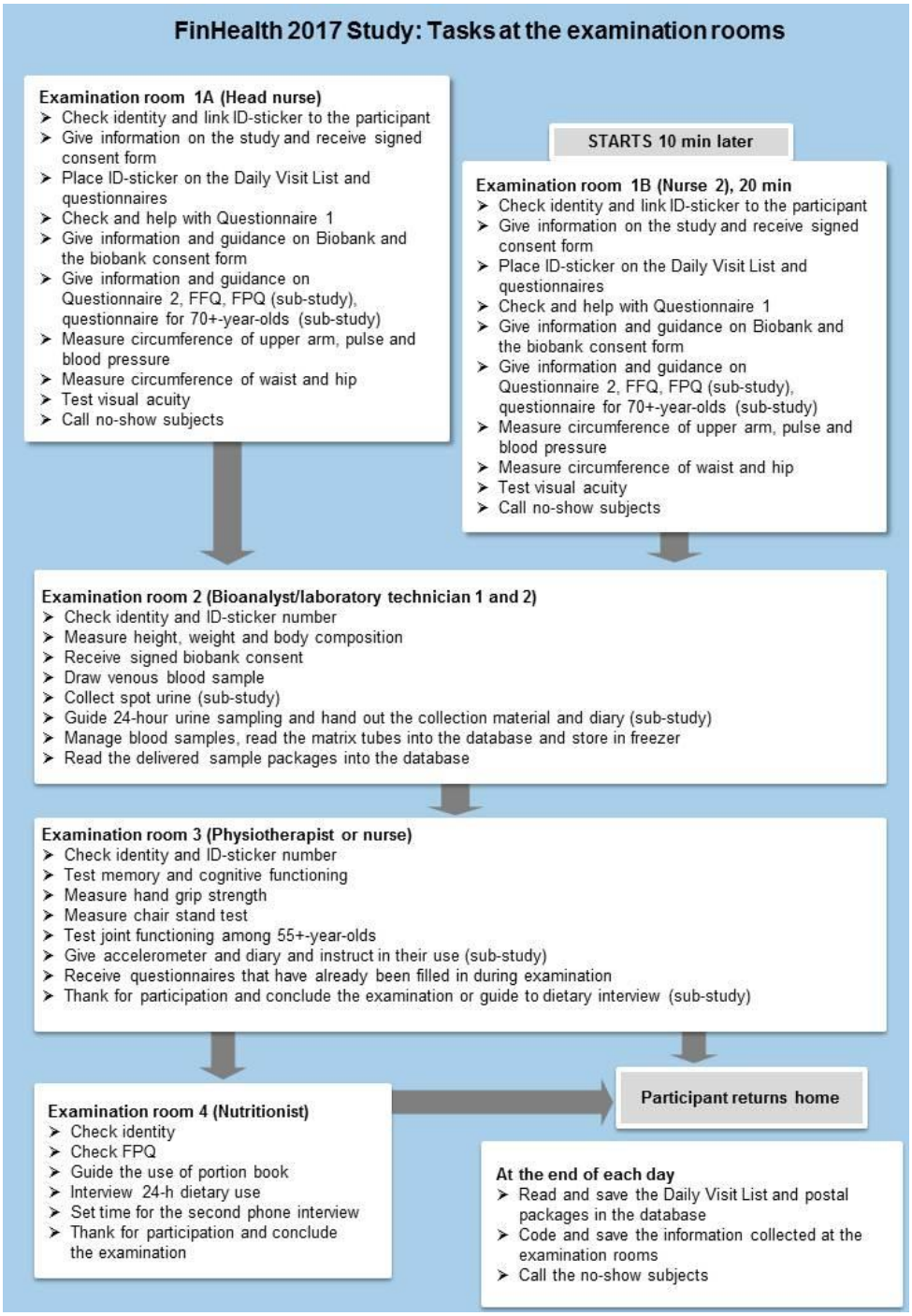


Figure 3.4.1. The health examination protocol in the FinHealth 2017 Study.

The participants were asked to fill in the Questionnaire 1 before arriving at the examination. If the form had not been completed, study nurse encouraged and helped the subject to fill in the questionnaire. The other questionnaires were given to take-home or filled in while waiting for admission to the following examination rooms (if feasible). Participants were asked to mail these questionnaires to the central office using a free-of-charge envelope, or return them in the third examination room or the dietary interview room.

The tasks of the two bioanalysts or laboratory technicians in the second examination room were the following: check identity and sticker (see Chapter 5.1), measure height, weight and body composition (bioimpedence), give feedback on these measurement results, receive the signed biobank consent and check if the subject had any questions concerning the THL Biobank, draw blood samples, collect spot urine (sub-study), give information and guidance on 24-hour urine sampling and hand out the collection material and diary (sub-study). While the other bioanalyst/study nurse was carrying out these tasks the other's tasks were: to manage (e.g. sentrifuge, divide, freeze) blood samples, read the matrix tubes into the database and store them in the freezer, and read the sample packages into the database before sending them to the central office.

In the the third examination room a physiotherapist or study nurse carried out the functional capacity tests. The tasks in this room were as follows: check identity, carry out tests on cognitive functioning, hand grip strength and chair stand, joint functioning among 55+-year-olds, give information and guidance on how to wear the accelerometer and fill in the diary on physical activity and sleep (sub-study), receive questionnaires that had already been filled in during the examination or remind the subject to fill them in at home, and finally thank for participation and ask if the participant had any further questions about the survey or his/her personal results and give feedback on the measurement results. If the participant belonged to the dietary interview sub-sample, the final task was to guide the participant to the room where the dietary interview was carried out.

The final, fourth examination room was reserved for the dietary interview by a nutritionist, with the following tasks: check identity, check the FPQ, guide the use of picture book on meal portions, carry out a 24-hour dietary interview, make an appointment for the phone interview, and thank for participation and ask if the participant had any further questions about the dietary survey.

At the end of each day, the teams saved the information that was collected during the day in electronic format. Questionnaires were packed into postal packages and further shipped to THL. Further, the teams tried to contact the no-show subjects by phone, and printed out the daily visit lists for the subsequent day.

The protocol was mostly identical for all teams, except for some sub-studies; as the 24-h urine collection was implemented only in selected locations to ensure logistics for the samples (described in detail in Chapter 20.3) and the body composition validation sub-study was implemented only in Helsinki. The sub-study

of the additional eastern Finland sample was carried out after the FinHealth protocol had ended with a condensed protocol (see Chapter 20.4). The sample sizes for the sub-studies are presented in detail in Chapters 2.3, 4 and 20. The detailed description of the sub-studies and additional samples are presented in detail in Chapter 20.

A tailored daily schedule of the appointments was created for different study locations. In the morning shifts examination times took place from 7.30 am until 14.30 pm, and in the evening shifts from 11.00 am until 18.00 pm. In most weeks, Mondays and Fridays were morning shifts and Tuesdays and Thursdays evening shifts. Every second Wednesday was either a morning or an evening shift. The time slots were given in 10-minute intervals, making up to 38 appointment times per day (see Appendix 4). Every fourth appointment time was reserved for a dietary sub-study participant to ensure smooth flow between the participants. Furthermore, lunch and coffee breaks for the study personnel were included in the daily schedules. Other types of daily schedules were also applied, such as short morning shifts and late evening shifts. When moving from one location to the next one, the teams spent on average one hour in packing and one hour in unpacking the equipment.

The appointment times were divided beforehand for each participant. On average some 30 subjects per day in each team were invited. The schedule was planned in such a way that with about 60% participation rate, there would be a feasible and smooth day of some 18 participants per day. The number of participants per day varied from just a couple of persons up to a maximum of 27 participants. If the schedule seemed too tight, based on the confirmed appointment times, the personnel of the central office helped in balancing the daily visit lists by calling the participants to rebook another appointment time.

The duration of the health examination for each participant was approximately one hour, or 1h 45 minutes if the dietary interview was included. The actual time spent in the examination varied based on the age and functional capacity of the participant, with longer durations among older people. There were certain rush hours in the examinations, such as early mornings and lunch breaks that sometimes caused queuing. The participants could also change their scheduled times independently in the electronic portal, making it difficult to foresee and prevent the potential rush hours.

The first day of the field phase was January 30th, 2017, when the study personnel invited friends or relatives to take part and to train their routines in a less stressful situation. The field phase started officially on January 31st 2017. On the first actual field day the daily schedule was made less tight with a 30 minute interval between the appointment times, so that the nurses could train their routines in a slower pace.

The participants received feedback on their measurements on several occasions: immediately during the examination, after the laboratory analysis results were available and after the questionnaire data was available for analyses. The feedback procedure is described in detail in Chapter 21.1.

3.5 Questionnaires

Katja Borodulin

The FinHealth 2017 Study included several questionnaires (Table 3.5.1).

Table 3.5.1. Questionnaires in the FinHealth 2017 Study.

Name of the questionnaire and main contents	Selection criteria	Phase of Survey when given	Language
Questionnaire 1 Health status, functional capacity and wellbeing, exercise, smoking, nutrition, alcohol consumption, weight and height, sleep, background information, women's health	Entire sample	Mailed with the invitation letter	Finnish, Swedish, English
Questionnaire 2 Health status, illnesses of family members, weight management, physical activity, work ability and working conditions, use of health care, provision of assistance, quality of life, social relationships, smoking, nutrition, lifestyle counselling, sleep, mood, sexual and reproductive health	If participated in health examination	At health examination to be filled in at home or during the examination visit	Finnish, Swedish, English
Food frequency questionnaire Meal frequency, special diet, consumption of foods, beverages and supplements	If participated in health examination	At health examination to be filled in at home or during the examination visit	Finnish, Swedish, English
Food propensity questionnaire Consumption of specific foods	FinDiet sub-study	To be filled during health examination (or later at home)	Finnish, Swedish, English
Questionnaire for persons aged 70 years or older Housing, living environment, use of assistive devices, daily activities, oral health, receiving help	Age 70 years or over at the time of sample draw (Nov 2016)	At health examination to be filled in at home or during the examination visit	Finnish, Swedish, English
Physical activity and sleep diary (Accelerometer diary)	Physical activity and sleep sub-study	At health examination to be filled in at home	Finnish, Swedish
Urine collection diary	FinDiet sub-study and selected locations	At health examination to be filled in at home	Finnish, Swedish
Urine collection validation diary	FinDiet sub-study and capital region	At health examination to be filled in at home	Finnish

Questionnaire 1 was mailed with the invitation letter to the entire sample. It was also re-sent after the health examination phase for those who had not participated in the examination. All other questionnaires were given only to those who had participated in the health examination or who were selected for certain sub-studies. All questionniares are shown at the website of the FinHealth 2017 Study (www.thl.fi/finhealth).

3.6 Short phone interview

Katja Borodulin

A short phone interview was offered to those participants, who could not take part in the health examination or did not want or were not able to fill in Questionnaire 1. These were mostly older participants who refused from the health examination due to their poor functional capacity or severe health problems and found the questionnaire too demanding to be filled in and returned. Questions in the short phone interview were chosen from the key questions and were identical to those in Questionnaire 1 (except for the minor differences adapting the self-administered questions to an interview form). The short interview covered questions on self perceived health, chronic diseases and disabilities, functioning, health behaviour and background. The interview was made by trained staff at the central office. The phone interview was carried out when the invited persons actively contacted the central office or when the staff at the central office called the invited persons to confirm appointments or to contact those who had not participated.

3.7 ICT environment and toll-free telephone service

Katja Borodulin and Katri Sääksjärvi

In the training phase, the team members took in use individual laptops. Each laptop had internet access via internal sim-cards and also via a spare system with two portable 4G USB modems in each team.

The toll-free telephone system was run with the Elisa Ring Service. Each staff member at the central office logged on to the system and handled the calls with their own THL mobile phones. The Elisa Ring System was also used to type in personalized SMS messages. These were used for example when trying to reach the participants who had not confirmed their health examination appointment two weeks before the suggested appointment time. The attempted contacts, both phone calls and SMS messages, were registered in the logistics service (see Chapter 5.6). In

addition, an automatic SMS reminder was sent two days before the appointment time for those who had a mobile telephone number available in the logistics service, whether or not the appointment time was confirmed. These messages were sent by an automated Java program every day according to the schedule and included information on participant's name, reserved appointment time and location with detailed address.

3.8 Communications

Katja Borodulin, Johanna Leinonen, Heli Tapanainen, Hanna Tolonen and Katri Sääksjärvi

The communications team was assigned to help in planning and implementation of communications in the project. The communication plan included activities for both internal and external communication. All efforts were made to motivate the invitees and thus increase participation rate. The aim of the team was to help in finalizing the materials (both those informing the invitees as well as the questionnaires and other study materials), and in preparing material for the media. The team for example reviewed and edited the material to make sure they were user-friendly and clear to all types of readers. Particularly much emphasis was paid to the invitation letter and the information leaflet. A graphic designer was used in designing the layouts for the post cards and information leaflets. Furthermore, FinHealth webpages were created for communication under the THL website.

One of the main aims in the communication strategy was to ensure a high participation rate. The activities to reach this target were, for example:

- design material that was easy to read and understand
- create tailored post cards for different age and language groups
- use social media for information dissemination, such as paid advertisements in Facebook.
- contact local media to increase public awareness about the research project and interest to check personal invitations
- use FinHealth website actively to guide all invited persons
- upload pictures and videos from voluntary participants at the website to encourage others to participate

When the field phase started, a press release was prepared and six kick-off media events were organized all over the country. National and local media attention was abundant and positive. One press release was also prepared later when the Eastern Finland sub-study was started in North Karelia and North Savo. During the field phase in spring 2017, continued efforts to receive publicity were carried out by

contacting local media in the study locations. Contacts were made from THL communications unit, the central office and also by the leading study nurses in the teams.

The communications units in municipalities and health care districts were contacted so they would spread information about the study in the area. The aim was that also local health professionals would engourage their clients and patients to participate.

4 Participation

Katja Borodulin, Anne Juolevi, Harri Rissanen and Katri Sääksjärvi

Participation rates were calculated for several different phases in the study flow; the health examination, questionnaires and sub-studies (Table 4.1). The proportion of those who participated in any of the study phases (Health examination, Questionnaire 1 or Short telephone interview) was 68.8% (n=7050). Women (72.8%, n=3759) participated more often than men (64.8%, n=3291). The original sample size was 10305, but after updating vital status, moves abroad or unknown address information, the corrected sample (hereafter called as eligible sample) size was 10247. Further, there were some individuals who participated in the health examination but cancelled their consent afterwards. These people are considered as non-participants in our analyses. Participation rates are calculated using the eligible sample.

In the recruitment process, people were first invited to the health examination. The examination was undergone by 2733 (53.8%) men and 3219 (62.4%) women (Table 4.1). Of these 5952 men and women, almost all (n=5939) gave blood samples. Those who did not participate in the examination were asked to fill in Questionnaire 1 (n=841, 8.2%) or were interviewed by phone (Short telephone interview, n=257, 2.5%).

Table 4.1. Sample size and participation by gender (FinHealth main sample, adult + young).

	Men		Women		All	
	N	%	N	%	N	%
Sample						
Original sample size	5108	49.6	5197	50.4	10305	100
Eligible sample size[1]	5079	49.6	5168	50.4	10247	99.4
Participated in						
Health examination	2733	53.8	3219	62.4	5952	58.1
Questionnaire 1 only	415	8.2	426	8.2	841	8.2
Short telephone interview	143	2.8	114	2.2	257	2.5
At least one of the above-mentioned phases	3291	64.8	3759	72.8	7050	68.8
Non-participation	1788	35.2	1409	27.2	3197	31.2

[1] Excluding deaths (n=34), moved abroad (n=14) or unknown address (n=10), based on updated information from the population register

Participation rates differed by age group from 53.8% to 81.9% (Table 4.2). The highest participation rate was reached in the age groups of 60–69 and 70–79 years. These age groups had the highest proportions in all the phases of the study, except for the Short telephone interview. The lowest participation rates appeared in the youngest age group of 18–29 years. In the oldest age group of 80 years and above, participation was particularly low in the health examination, but higher regarding Questionnaire 1 and the Short telephone interview.

Table 4.2. Participation by gender and age group in the main data collection phases.

	Eligible sample	Health examination		Questionnaire 1		Short telephone interview		At any phase of data collection	
	N	N	%	N	%	N	%	N	%
18–29	1162	524	45.1	598	51.5	26	2.2	625	53.8
30–39	1752	903	51.5	1014	57.9	29	1.7	1044	59.6
40–49	1673	953	57.0	1057	63.2	21	1.3	1078	64.4
50–59	1825	1134	62.1	1276	69.9	37	2.0	1313	72.0
60–69	1873	1302	69.5	1459	77.9	55	2.9	1514	80.8
70–79	1246	836	67.1	979	78.6	40	3.2	1020	81.9
80+	716	300	41.9	407	56.8	49	6.8	456	63.7
Total	10247	5952	58.1	6790	66.3	257	2.5	7050	68.8

Participation rates were different depending on the native language of the invitees. Native language was based on the information from the population register. Highest participation was reached for people whose native language was Sami (Native language of population in Northern part of Finland) with 78%, followed by Swedish with 72% and by Finnish with 70%. In all other language groups together the participation rate was considerably lower, 54%.

Table 4.3. shows participation rates by educational group and employment status across age groups. When looking at the participation rates by educational groups, the FinHealth participants comprised more highly educated persons (39.9%) than what the general population (31.6%). Lower participation, hence, was seen among the low educated in the FinHealth participants (20.2%) when comparing to the general population (25.8%). Similar systematic difference across educational groups and participation was seen in all age groups except in the 18–24-year-olds. The participation rate differences across employment status where smaller than those found for educational groups. The FinHealth participants were slightly more often employed or retired and less often student or unemployed as compared to the general population. Much of the differences found for employment status appeared at the working aged and particularly in 18–24-year-olds.

Table 4.3. Participation (%) by educational group and employment status compared to the general Finnish population.

	18−24 y		25−44		45−64 y		65+ y		18+ y	
	Participated in the health examination (n=524)	Population	Participated in the health examination (n=524)	Population	Participated in the health examination (n=3626)	Population	Participated in the health examination (n=1802)	Population	Participated in the health examination (n=5952)	Population
	%	%	%	%	%	%	%	%	%	%
Level of education[1]										
Low	27.0	30.0	8.3	15.1	13.3	17.4	40.2	47.5	20.2	25.8
Middle	68.7	65.2	41.4	44.8	44.4	44.0	30.9	29.0	39.9	42.5
High	4.4	4.8	50.4	40.0	42.3	38.6	28.9	23.5	39.9	31.6
Employment status[2]										
Employee[3]	40.9	37.2	79.1	73.3	73.1	70.4	3.3	3.2	53.1	50.4
Student	46.1	42.8	6.6	6.4	0.8	0.9	0.06	0.1	3.2	6.7
Retired	2.6	1.3	1.5	2.6	12.1	13.0	95.8	95.8	34.1	30.0
Unemployed[4]/ Other	10.4	18.7	12.8	17.7	14.0	15.7	0.8	0.9	9.6	12.8

[1] Low: primary school; Middle: Vocational or high school; High: College or university. Information from Statistics Finland, for participants from the years 2014, 2015 and 2016 (the most resent information available selected), and for the population from the year 2016.

[2] Information from Statistics Finland, for participants from the years 2014 and 2015 (the most recent information available selected), and for the population from the year 2015.

[3] Including entrepreneurs and those unemployed for less than six months

[4] Unemployed for six months or more. Most of the FinHealth 2017 participants belonging to the group “Unemployed/Other” were unemployed (84.2%).

Table 4.4. Participation (%) by health status compared to non-participants (sample in the FinHealth 2017, n=10 247).

	18−29 y			30−64 y			65+ y			18+ y		
	Participated in the health examination (n=524)	Participated at any phase of data collection (n=625)	Non-participants (n=537)	Participated in the health examination (n=3626)	Participated at any phase of data collection (n=4183)	Non-participants (n=2024)	Participated in the health examination (n=1802)	Participated at any phase of data collection (n=2242)	Non-participants (n=636)	Participated in the health examination (n=5952)	Participated at any phase of data collection (n=7050)	Non-participants (n=3197)
	%	%	%	%	%	%	%	%	%	%	%	%
Psychiatric diagnosis for hospital or primary care[1]	9.9	10.1	11.4	8.2	8.8	11.1	17.2	18.6	26.3	11.0	12.0	14.1
Has been in inpatient care[2]	2.3	2.9	3.4	3.5	3.9	5.6	9.7	11.9	19.2	5.3	6.4	7.9

[1] Percentage of those who have had a psychiatric diagnosis for hospital or primary care during the past six months from the date when invited to participate in the FinHealth 2017 Study, based on information from the Care Register for Health Care (inpatient care and outpatient visits, diagnoses and operations and other care procedures, relevant ICD codes), and the Register of Primary Health Care Visits (relevant ICPC and ATC codes).

[2] Percentage of those who have been in inpatient care during the past six months from the date when invited to participate in the FinHealth 2017 Study, based on information from the Care Register for Health Care (relevant ICD codes).

Participation rates were compared in the FinHealth sample against information on health status (Table 4.4). Comparisons included those who participated in the health examination, participated in any phase of the study and did not participate in the study. Proportions of those who had had a recent psychiatric diagnosis or who had been in inpatient care were higher among the non-participants (14.1% for diagnoses and 7.9% for inpatient care) than among those participated in the health examination (11.0%, 5.3%) or in any phase of the study (12.0%, 6.4%).

Response rates regarding the different questionnaires given at the health examination are provided in Table 4.5. Here, participation rates are presented both as 1) the proportion of the eligible sample that participated and 2) as the proportion of participants in the health examination who filled in the respective questionnaire. The first figure shows the response rate in the whole sample and the latter how well the participants adhered to the different phases of the study.

Table 4.5. Response rates for the questionnaires that were given at the health examination.

	Eligible sample	Participated in the health examination	Filled in the questionnaire	Participation rate / eligible sample[1]	Participation rate / health examination[2]
	N	N	N	%	%
Questionnaire 2	10247	5952	5337	52.1	89.7
Food frequency questionnaire FFQ	10247	5952	5125	50.0	86.1
Food propensity questionnaire FPQ	3099	1814	1787	57.7	98.5
Questionnaire for person aged 70 years or older	1962	1136	1076	54.8	94.7

[1] Calculated for the entire (sub-)sample, regardless of participation status in the health examination.

[2] Calculated for those who participated in the health examination.

Questionnaires were given at the health examination based on either age or pre-selection to the sub-samples by defined criteria. Questionnaire 2 was filled in by 89.7% of those who attended the health examination and by 52.1% of the entire sample. The corresponding percentages for other questionnaires were: Food frequency questionnaire 86.1% and 50.0%; Food propensity questionnaire 98.5% and 57.7%, and Questionnaire for participants aged 70 years or older 94.7% and 54.8%. The participants had a chance to fill-in either electronic or paper forms. For Questionnaire 1, 80% returned their answers in paper forms and 20% through internet. The corresponding distribution in other questionnaires was 86% and 14% for Questionnaire 2, and 88% and 12% for Food frequency questionnaire, and 98% and 2% for Questionnaire for persons aged 70 years or older.

Participation in the sub-studies is described in Table 4.6. The FinDiet Study obtained acceptable face-to-face and telephone interviews from 91.2% of those who participated in the health examination and 53.4% of the entire sub-sample. The corresponding percentages for the other sub-samples were the following: spot urine participation rate 90.9% and 55.2%, 24-hour urine collection 85.6% and 24.6%, 24-hour urine validation collection 78.4% and 24.3%, Physical activity and sleep 81.8% and 46.9%, Joint function 97.4% and 61.9%, and bioimpedance validation 91.4% and 53.1%.

Table 4.6. Participation in the sub-studies.

	Eligible sample	Participated in the health examination	Participated in the sub-study	Participation rate / eligible sample[1]	Participation rate / health examination[2]
	N	N	N	%	%
FinDiet (face-to-face and telephone interview)	3099	1814	1655	53.4	91.2
Spot urine collection	2802	1699	1546	55.2	90.9
24-hour urine collection	1546	935 (444)[3]	380	24.6	85.6
24-hour urine validation collection	686	400 (213)[3]	167	24.3	78.4
Physical activity and sleep	1991	1140	933	46.9	81.8
Joint function	4771	3034	2954	61.9	97.4
Bioimpedance validation	148	84	65	43.9	77.4

[1] Calculated for the entire sample, regardless of participation status in the health examination.

[2] Calculated for those who participated in the health examination and fulfilled the eligibility criteria.

[3] Number of persons who took the urine collection canister back home for collection.

Participation in the Eastern Finland Study was similar to that of the FinHealth 2017 Study (Table 4.7). Two thirds (68.1%) of the sample participated in at least one phase of the study. Women (73.1%) participated more often than men (63.4%). Proportion of those who participated in the health examination was 53.5% in men and 62.7% in women. Of these 996 men and women who participated in the health examination, almost all (n=982) gave blood samples.

Table 4.7. The Eastern Finland Study: Sample size and participation by gender.

	Men		Women		All	
	N	%	N	%	N	%
Sample						
Original sample size	888	51.3	844	48.7	1732	100
Eligible sample size[1]	878	51.1	840	48.9	1718	99.2
Participated in						
Health examination	470	53.5	527	62.7	996	57.4
Questionnaire 1 only	65	7.4	84	10.0	149	8.7
Short telephone interview	22	2.5	3	0.4	25	1.5
At least one of the above-mentioned phases	557	63.4	614	73.1	1170	68.1
Non-participation	321	36.6	226	26.9	548	31.9

[1] Excluding deaths (n=8), moved abroad (n=2) and unknown address (n=4), based on updated information from the population register

5 Data management

5.1 Identification of the participants

Anne Juolevi, Harri Rissanen and Katja Borodulin

Data managers created identification numbers for each participant that enabled the linkage of all research materials during the data collection and also for later analyses, without using names or birth dates. Each person in the sample received an identification code, personalized bar code numbers for questionnaires, and a password to access the electronic portal for questionnaires. The information on all personalized numbers and password was sent to the invitees in the invitation letter and accompanying questionnaire 1.

For those who participated in the health examination, a bar code sticker series was created. Serial numbers in the bar code series linked the participant with other material that was collected during the health examination. All number series in the data collection were unique and appeared only once. This way the risk of errors in linking the collected information with the right person was minimised.

In the above described ways the data were pseudonymized in line with the General Data Protection Regulation (GDPR 2019), so that the personal data could no longer be attributed to a specific participant without the use of additional information, which is kept separately at THL and available only to a few data managers.

5.2 Descriptions in xml language

Anne Juolevi, Harri Rissanen and Katja Borodulin

Questionnaires were described using xml-language. These descriptions were then used to create:

- an analysis database and the so called LOPA-database which was used to create electronic questionnaires
- a parser that enabled saving the data into electronic form with predefined correct contents and structures
- html-based files of the questionnaires that comprised variable names and response options
- html-based LOPA-files that visualized the electronic questionnaires

5.3 Data collection and saving

Anne Juolevi, Harri Rissanen and Katja Borodulin

The participants filled in the questionnaires (Table 5.3.1) either in paper or electronic format. Filling in electronic questionnaires required the use of the identification code and password that were included in the invitation letter. The participants had access to Questionnaire 1 in three languages upon receiving the invitation letter. The remaining questionnaires, also in three languages, were scheduled to be accessed electronically the day following their health examination visit, after the leading study nurse had saved the daily visits into the database at the end of the day. The participants had a tailored selection of questionnaires to be filled in, depending on the sub-samples and age group they belonged to.

The paper questionnaires were returned to the main office, where the reception of each paper form was recorded in the database and then further delivered to an outsourced company responsible for saving data into electronic format, Tikkurilan Kopiopalvelu (TKP). During the data collection period, questionnaires were regularly sent to TKP in small batches. TKP scanned and saved the questionnaires optically. The scans produced a picture of each page in a png-format. The FinHealth team advised TKP in the saving process, also allowing some corrections to the data. The corrections were marked with a per cent sign (%) or a hashtag sign (#), where the per cent noted a correction by the personnel of TKP and the hashtag an item that did not fall into the predesigned categories of allowed responses and was left to the FinHealth Team to correct. Data were sent from TKP to THL in csv-format and further downloaded into the analysis data base.

Responses collected through electronic questionnaires with the LOPA-service were saved into the LOPA-database and further downloaded in the main analysis database on a daily basis.

In the saving process, the xml-descriptions enabled the creation of a template. A Metaform-tool was created to make sure the saved data followed the right structure. For example, each variable had a predefined variable name and right number of response categories that also followed the right coding options. The xml-descriptions and the Metaform tool were used for saving the questionnaire information both in paper and electronic format.

There were a number of questionnaires and forms that were used by the study personnel to collect and save information during the health examination (Table 5.3.1). The questionnaires included for example the information collected in each examination room (mainly measurement results and notes on deviations from the protocol and explanation for missing results). These were collected using paper forms and generally saved at the end of each day in the LOPA-database.

Table 5.3.1. Questionnaires and forms in the data management process.

Name of the questionnaire or form	Filled in by…	Saved in electronic format by…
Daily visit list	Leading study nurse	Leading study nurse
Daily visit list, double saving process	Leading study nurse	Study personnel in Central office
Consent form	Leading study nurse and participant	Nurse in Examination Room 1A and 1B
Biobank consent form	Leading study nurse and participant	Tikkurilan Kopiopalvelu
Examination Room 1 form	Study nurse in examination room 1A and 1B	Study nurse in examination room 1A and 1B
Examination Room 2 form	Study nurse in examination room 2	Study nurse in examination room 2
Examination Room 3 form	Study nurse in examination room 3	Study nurse in examination room 3
Bioimpedance measurement form	Receipt from the bioimpedance device	Study personnel in Central office
Questionnaire 1, paper format	Participant	Tikkurilan Kopiopalvelu
Questionnaire 1, electronic format	Participant	Participant
Questionnaire 2, paper format	Participant	Tikkurilan Kopiopalvelu
Questionnaire 2, electronic format	Participant	Participant
Food frequency questionnaire, paper format	Participant	Tikkurilan Kopiopalvelu
Food frequency questionnaire, electronic format	Participant	Participant
Food propensity questionnaire, paper format	Participant	Tikkurilan Kopiopalvelu
Food propensity questionnaire, electronic format	Participant	Participant
Questionnaire for persons aged 70 years or older, paper format	Participant	Tikkurilan Kopiopalvelu
Questionnaire for persons aged 70 years or older, electronic format	Participant	Participant
Physical activity and sleep diary	Participant	Study personnel at Central office
Urine collection diary	Participant	Study personnel at Central office
Urine collection validation study diary	Participant	Study personnel at Central office
Short telephone interview	Study personnel at Central office	Study personnel at Central office

The central laboratory at THL analysed blood and urine samples regularly during the data collection period. These results were received in csv-format from the laboratory, and were transformed into a SAS-file by the data manager and further saved in the analytic database.

5.4 Data cleaning

Anne Juolevi, Harri Rissanen and Katja Borodulin

Data cleaning was done at several phases:

1. Hashtag-marks (#) were listed by each question using csv-files and the scanned pictures of the page where the answers were checked and corrected by the FinHealth team.
2. Frequency tables were created to check that all response categories were as expected and no outliers could be seen.
3. Potential double questionnaires were listed. In case duplicates were found, the field coordinator screened the responses with data managers and judged for a higher quality (more complete) version to be included in the final data.
4. Missing information was screened in all response items for potential correction. The corrections were made in some selected instruments where the respondent had systematically checked “yes”-items but left “no” missing. In these cases, the missing information was replaced as “no” option.
5. Zero-values were searched and added for instruments that should logically include a value ”0”, based e.g. on the other responses in the same instrument.
6. Orders to jump over to a new question were checked. If the respondent had not followed the jump advice, the answers were visually checked and a logical decision was made to correct the answers or leave the information missing.
7. Logically meaningful values were checked and corrected when needed. This included an inspection of minimum, maximum, mean or median values.

5.5 Quality assurance

Katja Borodulin, Katri Sääksjärvi and Päivikki Koponen

Quality assurance in the FinHealth 2017 Study followed the principles presented in the European Health Examination Survey manual on planning and preparation of a health examination survey (Tolonen 2016a), including components such as good overall management of the survey, agreement on survey procedures that ensure standardized measurements, training of the survey personnel on using the standard procedures, piloting the fieldwork phase, quality control measures taken to monitor the survey process, and evaluation of the achieved quality.

Fieldwork quality assurance

The study personnel received the full field manual in the training period so that they could check and recap the standards during the fieldwork and find instructions for challenging situations. They also had short check-up lists to make sure all tasks were carried out as instructed.

Quality control of health examinations during the field phase was implemented by an external audit visit to each team. The external auditor concluded in her report that the measurements were satisfactorily carried out as instructed in the field manual. Furthermore, the external auditor visited the central office, and evaluated whether the central office activities were acceptably performed.

In addition to the external audits, the FinHealth field coordination team made more than 40 visits to all teams to ensure high quality and identical measurements across the teams and across the whole field phase. Measurement results on blood pressure, height, weight, and waist and hip circumference were checked several times during the field phase for outliers, means, distributions, and last digits. The information recorded in the health examinations were systematically evaluated during the field to intervene on potential systematic error, such as missing values. If any potential problems were identified in the data, these were discussed with the staff to ensure the standards and accurate recording. In addition to helping to resolve any problems, the field visits by the coordination team were an important source of encouragement and an evaluation tool. During these visits the actual measurements were observed with the consent of the participant, and feedback was immediately given to the study personnel to encourage them to follow the standards or to pay more attention to some details, if needed.

Quality control

Quality control in the FinHealth 2017 Study aimed to obtain high quality data from all teams and all measurers, as well as from all questionnaires. Another aim for data quality was to ensure comparability with data from previous data collection rounds.

Quality control measures were taken to monitor the survey process, so that any problems could be detected at an early stage, and actions were taken to correct the detected problems as soon as possible. A large number of quality control measures were built into the study at different stages of the survey process. Activities by the field coordination team to ensure good quality of the collected data included for example:

- check that a written signed consent was received from all participants
- check the linkage between participant id and the bar code serial number by double saving the daily visit lists
- compare blood pressure, waist and hip circumference, and height and weight measurements (maximum, minimum, mean, last numbers for preference and odd numbers) between the study personnel
- screen the data recorded by the field teams, checking the number of entered forms and if there were missing values
- check that all questionnaires and forms were received and that the data entry was complete for all participants
- screen the quality of data from paper forms entered in the data set at TKP (TKP entered data from a small proportion of questionnaires manually, compared the manual data with the optically entered data and reported these comparisons to the data management team)
- compare the quality of the examination room forms by double entry for some forms at the central office

Further details about the quality control are described in the chapters for each measurement. Quality control was carried out by the field coordination team at the central office, i.e. as internal quality control, except for the field laboratory activities (see Chapter 6.4).

Quality assessment

The quality of the FinHealth 2017 Study data has been assessed on the basis of pre-defined criteria. The survey data was evaluated and documented at the central office. For different data items different issues were checked. More details about data cleaning and check-ups are described in Chapter 5.4.

5.6 Logistics service

Anne Juolevi, Harri Rissanen and Katja Borodulin

The FinHealth 2017 Study used a logistics service, referred as Research and Scheduling Service (tutkimus- ja ajanvarauspalvelu) TAP, to handle the massive field phase. The TAP Service was developed by THL mainly for the use of questionnaire surveys but it included also features needed for the logistics of the field phase of a health examination survey. The TAP Service was an essential part of the survey and included detailed information for each individual in the sample on:

- the sample (name, address, phone numbers, date of birth, sub-sample)
- location of the health examinations (name of health centre / other facility and detailed address)
- health examination time (previous reservations and updates)
- appointment time for dietary telephone survey (previous reservations and updates)
- refusal, death or move
- contact attempts by the study personnel
- scheduled access to questionnaires and information on saved questionnaires

The TAP Service also provided practical tools for daily work during the data collection period. These included:

- printable daily visit list for each field team, with detailed information on participants of the day
- possibility to link daily visits and the series number of the bar code sticker of each participant
- list of non-confirmers for re-contacts
- management of the daily appointment times for the health examinations and telephone interviews
- management of logistics for the blood samples and questionnaires
- SMS messages with information on participant's name, reserved appointment time and location that were sent every day according to the schedule using an automated Java program. The subjects received the SMS message two days prior to the reserved appointment time, if they had a mobile phone number available in the TAP Service.

The TAP Service produced daily automated CSV-files for quality control use. They included the following information: sample, received electronic questionnaires, daily health examination visits and the saved bar code stickers, refusals, confirmed and non-confirmed health examination appointments.

5.7 Data from registers

Päivikki Koponen, Anne Juolevi, Harri Rissanen and Seppo Koskinen

Data obtained for the sample from the National Population Register comprised information on some key characteristics of each person (Table 5.7.1). In addition, administrative register data have been obtained with specific permissions sought from the institutes/organisations responsible for each register, and these can be updated later to enable register-based follow-up of survey participants, and in some cases also follow-up of non-participants. Register linkages were made using the personal registration number assigned to all residents in Finland.

Register data can be used for several purposes e.g. to analyse non-response, and to obtain additional information on sociodemographic characteristics, health status and on the use of health services and benefits before and after the survey. Register data can also be used to study whether the use of health services is adequately based on the needs identified in the survey data. A comparison of the participants' and non-participants' health in the light of register based information also helps to evaluate the accuracy of the results obtained by questionnaires and health examination. Register data were used to assess the characteristics of the non-participants and to construct the survey weights to be used in the analysis (see Chapter 5.9).

Due to changes in data protection rules, all register data obtained for the previous surveys (Health 2000/2011 Surveys and/or the FINRISK Studies) are not available for the FinHealth 2017 Study sample. From Statistics Finland, personal data have been obtained only for participants (those who gave consent for register-linkage). The Social Insurance Institution (KELA) has so far not given the FinHealth 2017 researchers any permission to obtain their data, neither for participants nor the non-participants. In KELA the informed consent was considered to be too general as the participants didn't give detailed consent for specific KELA register data linkage.

Register based follow-up provides incidence data enabling future epidemiologic studies to find out how the survey data predict the development of the participants' health, by linking the cross-sectional survey data with follow-up data on the participants' causes of death and illnesses, as well as use of services and work-force participation (employment).

The record-linkage was designed and carried out in close co-operation between the THL project organisation and the bodies maintaining the registers concerned. The most important register data cover causes of death, hospital treatments and primary care visits (with specific ICD-10 and ICPC codes), births and induced abortions (for women), cancer screening and cancers, as well as employment and pensions.

Table 5.7.1. Register data available for the FinHealth 2017 sample.

Register authority	Topics
Population Register Centre*	Age, sex, date and place of birth, marital status, native language, country of birth
Finnish Institute for Health and Welfare (THL)*	Care Register for Health Care (inpatient care and outpatient visits, diagnoses and operations and other care procedures)
	Register of Primary Health Care Visits
	Cancer Registry (diagnosed cancers)
	Mass Screening Registry (mammography and pap smear)
	Medical Birth Register (year(s) of giving birth, prenatal care and care during births)
	Register of Induced Abortions (year(s) and types of procedures)
	National Infectious Diseases Register (selected diagnosed diseases)
Ministry of Employment and the Economy*	Employment service register data: periods of unemployment and participation in labour market training and work/training trials
Statistics Finland **	Education, occupation and socioeconomic status
	Causes of death
The Social Insurance Institution (KELA)***	Coverage by the social insurance in Finland
	Disability, rehabilitation and sickness allowances
	Reimbursement for medicine expenses
	Purchases of selected medicines
	Allowances for pensioners
Finnish Centre for Pensions*	Earnings related pensions

* Register data available for the total sample

** Register data available for those participating in the health examination

*** Permission to use register data in the FinHealth 2017 Study applied, not (yet) received

5.8 Using the data for research purposes

Anne Juolevi, Harri Rissanen and Katja Borodulin

The data of the FinHealth 2017 Study are available for research purposes in collaboration with the project organization and through THL Biobank. In order to obtain access to the data, researchers must first submit a study proposal to the FinHealth 2017 or the THL Biobank Scientific Board. The forms to apply access to the data are available on the website of the FinHealth 2017 Study and the THL Biobank. The FinHealth 2017 website includes all the forms used during the fieldwork and the corresponding variables. Once access to the data is granted by the Scientific Board, a signed agreement is required and all researchers must confirm to follow the THL data security rules.

5.9 Statistical analyses

Tommi Härkänen and Tarja Palosaari

The sampling design and the guidelines for statistical analyses follow closely those of the Health 2000 and 2011 Surveys, which have been successfully conducted by a large number of researchers over the past decades. Thus, analyses on the FinHealth 2017 data can be conducted in a similar way.

Below an overview is presented of the most important aspects to take into account in practical statistical analyses. Furthermore, background on the weights needed to account for the sampling probabilities and non-response is given.

Practical guidelines for researchers on data analysis

Relevant guidance to statistical analyses of the FinHealth 2017 data can be found at the website of the Health 2011 Survey containing documentation and some examples to analyse the Health 2011 Survey data. These examples can be easily applied for the FinHealth 2017 Study as well by changing the variables corresponding to the sampling design and weights according to Table 5.9.1. These examples cover analytical procedures to produce descriptive statistics and to perform common regression analyses. The analyses are not restricted to cross-sectional analyses, as the survey data have been linked to various population registers with regular updates in the future (see Chapter 5.7), thus prospective (and retrospective) analyses can also be conducted. Access to the data may be granted for research purposes (see Chapter 5.8). An empirical comparison of different statistical

methods to handle missing data in the Health 2011 Survey have been described elsewhere (Härkänen et al. 2016).

Various statistical software packages can be applied to account for the sampling design and the weights for missing data, for example,

- SAS/STAT software, with the Survey procedures (SAS Institute Inc 2019),
- Sudaan (Research Triangle Institute 2008),
- Stata, with the "svy" prefix, see Stata survey data reference manual (StataCorp. 2019)
- R (R Core Team 2019), with package "survey" (Lumley 2004, Lumley 2019) and also
- SPSS, only with the "Complex Samples" module (IBM Corporation 2019).

Background information for statistical analyses

The non-response to population surveys has increased considerably in the 2000's, and researchers should assess the possible mechanisms which cause non-response, and in each analysis perform corrective measures among which commonly applied methods are:

- **Weighting** of observations corrects the distribution of known background factors (age, sex etc.) in the group of participants to match the distribution in the population. Weighting methods are useful in correcting unit non-response. The weight variable should match the analysis variables, e.g. if the analysis involves variables collected in the health examination then the health examination weight should be selected. There are several weights, which are based on participation in different parts of the survey:
    - participation in the health examination
    - participation in any part of the survey (good for questionnaire variables)
    - participation in sub-studies
- **Multiple imputation** is a more advanced and efficient method which can handle item non-response better than weighting, but it requires more experience in conducting analyses. In order to minimize bias, the imputation models must be constructed separately for each research problem. It is advisable to incorporate appropriate register variables, which have been linked also with the non-respondents, in the imputation model, if possible.

Non-participation can depend (directly) on the variables of interest, e.g. healthy individuals participate and individuals with a disease do not. This kind of **missing not at random (MNAR) non-participation** can be very difficult or impossible to correct for by using any statistical methods without additional information such as register data on health status of both non-participants and participants.

The original Health 2000 Survey was based on a complex sampling design, which should be taken into account using proper statistical methods such as the design-based methods.

- The sample is **not a simple random sample** from the population, thus standard statistical methods assuming independence of observations generally underestimate standard errors.
- **Geographical representativeness** of the Health 2000 Survey was limited to continental Finland and the five university hospital districts as well as the biggest cities. In the FinHealth 2017 Study the number of health centre districts (HCD's) in the rural strata was decreased, thus the representativeness is now weaker than in the Health 2000 and 2011 Surveys. Therefore, the sample does not cover small regions, and representative results can be reported only for the university hospital districts and the city of Helsinki. In other cities both the sample size and the number of participants is likely to be too small for meaningful analyses.

The analyses on the FinHealth 2017 data can be conducted using most general-purpose statistical software packages. Multiple imputation can be conducted using, for example, SAS (SAS Institute Inc 2010), Stata (StataCorp 2009) or R (R Core Team 2019) software packages. Design-based analyses can be performed using Sudaan (Research Triangle Institute 2008) as well as using SAS, Stata or R (survey package, Lumley 2004; lme4 package, Bates et al. 2012) software packages. The latter software packages can be utilized also for model-based mixed-effects analyses. Model adjusted estimates based on the predictive margins (Graubard & Korn 1999) can be calculated using Stata and Sudaan software packages. In the examples given for the Health 2011 Survey the variables describing the sampling design and the weights need to be replaced according to Table 5.9.1 for analysing the FinHealth 2017 Study data.

Table 5.9.1. Corresponding variables in the Health 2011 and FinHealth 2017 data sets.

Description	Health 2011 Survey	FinHealth 2017 Study
Strata	OSITE	ft17_otos_osite
Primary Sampling Unit (PSU)	RYVAS	ft17_otos_ryvas
Analysis weight	ALL_ANALYSIS_W	w_perus_kys1_ana
Expansion weight	ALL_EXPANSION_W	w_perus_kys1_exp

Sampling probabilities

The equal probability of selection method (EPSEM) of the Health 2000 Survey yielded equal sampling probabilities in the age group of 18 to 79 years, and in the age group of 80 years or older this probability was chosen to be twice as high in order to obtain oversampling among the oldest age group (Laiho et al. 2008). The EPSEM does not hold after year 2000, because the population sizes have changed. The true population sizes in year 2017 as well as in 2000 based on the boundaries between municipalities in 2000 were obtained from Statistics Finland. The notation needed to calculate the sampling weights is presented in Table 5.9.2.

Table 5.9.2. Notation corresponding to the population and sample sizes, and to the sampling weights. For the 15 largest towns, define $\mathbf{m_s} := \mathbf{N_{s1}^{00}} := \mathbf{N_{s1}^{17}} := \mathbf{1}$.

	Year 2000 Age group 18+	Year 2017 Age group 18+
Sample size in stratum s and health centre district k	n_{sk}^{00}	n_{sk}^{17}
Number of strata	S	S
Population size in stratum s	N_s^{00}	N_s^{17}
Number of health centre districts sampled in stratum s	m_s^{00}	m_s^{17}
Population size in stratum s and health centre district k	N_{sk}^{00}	N_{sk}^{17}
Participation status	R_i^{00}	R_i^{17}
Sampling probability	p_i^{00}	p_i^{17}
Expansion weight	w_i^{00}	w_i^{17}

The inclusion probability of individual sampling unit i, who belonged to stratum $s := s(i)$ and health centre district $k := k(i)$, in year 2000 was written as

$$p_i^{00} := \frac{n_{sk}^{00}}{N_{sk}^{00}} \frac{m_s N_{sk}^{00}}{N_s^{00}} = \frac{m_s n_{sk}^{00}}{N^{00}} \quad \text{(Equation 5.9.1)}$$

The "size" of cluster k was the corresponding population size N_{sk}^{00} of age 18 or older. The sampling weight was defined as $v_i^{00} := 1/p_i^{00}$. Equation 5.9.1 reduced nicely, but in 2017, however, the PPS (probability proportional to size) probabilities were the same as in 2000, thus the inclusion probabilities in 2017 did not reduce similarly. In other words, the sampling design was not self-weighting in 2017, but the sample sizes per HCD were defined proportional to the corresponding population sizes, thus the design in 2017 was close to self-weighted.

$$p_i^{17} := \frac{n_{sk}^{17}}{N_{sk}^{17}} \frac{m_s N_{sk}^{00}}{N_s^{00}} \quad \text{(Equation 5.9.2)}$$

The sampling weight was defined as above: $v_i^{17,*} := 1/p_i^{17}$ using Equation 5.9.2. Note that the sampling probabilities and the sampling weights $v_i^{17,*}$ were equal (within a HCD) in the age group 25 years and older, but in the age group 18–24 years a considerably smaller number of individuals were selected into the sample, thus the sampling weights $v_i^{17,*}$ were larger.

We rescaled the sampling weights in 2017 so that their sum equals the population size in each stratum by

$$w_i^{17,*} := \frac{v_i^{17,*} N_{si}^{17}}{\sum_{i \in s} v_i^{17,*}}. \quad \text{(Equation 5.9.3)}$$

In the rural strata the number of HCDs was only seven, and these HCDs were randomly selected from the HCDs selected into the Health 2000 Survey, thus the sampling probability p_k^{17} of HCD k was smaller in the FinHealth 2017 Study than the original sampling probability p_k^{00} in 2000. The ratio of the HCD sampling probabilities m_s^{17}/m_s^{00} is the same for all HCDs within each stratum, thus it cancels out, when the weights are calibrated with respect to the population size (Equation 5.9.3).

Adjusting the weights for non-response

Weighted statistics, such as a weighted mean and prevalence, provide representative results on the target population (the adult population aged 18 and over of the continental Finland, or some subgroups).

First, define some notation. Let $R_i^{17} := 1$ for the participants of the FinHealth 2017 Study and $R_i^{17} := 0$ for all others. Let X_i denote register-based data, which were associated with the participation R_i^{17} in year 2017.

The sampling weights were updated to account for differences in the participation probabilities based on the *inverse probability weighting* method (Robins et al. 1994) as follows.

The participation ($R_i^{17} = 1$) probability $\mathbb{P}_\beta\{R_i^{17} = 1|X_i\}$ was modelled here using the random forest method (Liaw & Wiener 2002), and the probability estimates were produced using the corresponding 'predict' function of the randomForest package in R (R Core Team 2019). The inverse of the probability is the non-response weight.

$$v_i^{17} := \frac{1}{\mathbb{P}_\beta\{R_i^{17}=1|X_i\}}. \quad \text{(Equation 5.9.4)}$$

For non-participants $R_i^{17} = 0$ we defined $v_i^{17} := 0$. We assumed that the non-participation can be explained by the observed register-based variables X_i in Equation 5.9.4, that is, the missing data mechanism was assumed to be *missing-at-random* (MAR, Rubin 1987, Molenberghs and Kenward 2007). In reality, the missing data mechanism is likely to be often *not-missing-at-random* (NMAR), in which case the non-participation is likely to depend on unobserved factors possibly including outcome variables of analyses such as the health status at the time of the FinHealth 2017 Study.

The covariate vector X_i contained register variables listed in Table 5.9.3. For the internal use of THL, some additional register variables of Statistics Finland were also used: 3-category urban-rural classification of municipalities, 3-category education (low, middle, high), 7-category socioeconomic status, taxable income, net income and main occupation.

Table 5.9.3. Register variables in the weighting model.

Register	Variable	Details
Population Register Centre	Age	
	Gender	
	Language	Finnish, Swedish or other
	Marital status	Unmarried, Married, Divorced, Widowed
	Area	University hospital region borders in 2000
The Care Register for Health Care 1996-2016		Time since the most recent treatment with the ICD-10 codes…
	Cardiovascular disease diagnoses	I00-I99
	Mental health	F00-F99
	Infections	A00-B99 and J00-J22
	Births and Pregnancy	O00-O00
	Accidents, poisonings and external causes	S00-Y98
Ministry of Economic Affairs and Employment	Last employment	Time since expiry of the last period at work in years
	Last unemployment	Time since the last unemployment period in years

The expansion weights were obtained by calibrating the product of the sampling weights $v_i^{17,*}$ and non-response weights v_i^{17} by stratum and age group $AG_i \in \{$(18-24), (25-54), (55-69), (70-74), (75+)$\}$. The corresponding population sizes were $N_{AG_i s_i}^{17}$. The final, calibrated weight was then

$$w_i^{17} := v_i^{17,*} v_i^{17} \frac{N_{AG_i s_i}^{17}}{\sum_{\ell:(AG_\ell s_\ell)\in(AG_i s_i)} v_\ell^{17,*} v_\ell^{17}}.$$

Other methods to handle effects of missing data

Various methods have been proposed to handle effects of missing data (Molenberghs & Kenward 2007). In addition to the IPW and post-stratification (Lehtonen and Pahkinen 2004) methods described above, there are improved methods based on weighting (e.g. the doubly robust methods, Wirth et al. 2010), and other methods based on augmenting the missing data values.

Generally weighting is most appropriate in cases where the proportion of item-non-response is low. In other cases the missing data values in the few variables can be imputed, and all information contained in the partially observed sampling units can be utilized.

In multiple imputation (MI) the missing data values are imputed using a predictive distribution, which is based on the observed data and possible prior information (Rubin 1987, Schafer 1999). This imputation model can differ from the analysis model, which is applied on the imputed data containing no missing values. The imputation model should be at least as complex (variables and interactions) as the analysis model. Generally there is considerable uncertainty in the imputed values, thus a single imputation would underestimate the uncertainty (variance) of the results. Therefore in MI several copies of the original dataset are created, both the imputation procedure and the statistical analyses are performed separately on each of them, and finally the results based on the imputed datasets are combined.

In a typical item-non-response case the analysis variables cannot be ordered to form a monotonic missing data pattern. This restricts the range of adequate MI methods. In standard statistical software packages the variables, which contain missing values, are assumed to follow a multi-normal distribution, which does not suit well to categorical or other non-Gaussian variables. Binary variables are, however, often approximated by normal distribution in MI. These problems can be avoided by multiple imputation based on chained equations (van Buuren et al. 1999), which is available in many statistical software packages, for example in R (van Buuren & Groothuis-Oudshoorn 2011).

6 Laboratory measurements

Laura Råman, Liisa Valsta, Katja Borodulin and Jouko Sundvall

Two kind of biological samples were collected in the FinHealth 2017 Study. Blood samples were collected from all participants at the health examination, and information on them is presented in this chapter. Urine samples were collected from a sub-sample of participants, thus information on them is presented in Chapter 20.3.

6.1 Blood collection

Samples of whole blood, serum, fluoride-citrate plasma and EDTA plasma were collected from all participants at the health examination (Figure 6.1.1). The samples were divided into aliquot tubes as illustrated in Figure 6.1.2.

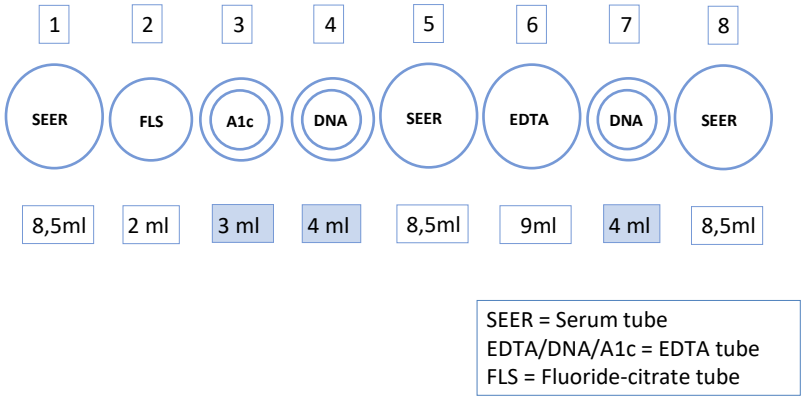


Figure 6.1.1. Blood tube chart.

All the necessary supplies were delivered in advance to each field Team. Teams had their local storage room at their central home town. If there was lack of some equipment, it was ordered from THL and delivered to the sites. The field laboratory personnel estimated the amount of the supplies needed and delivered them to different study sites. All the required equipment, including a field centrifuge and a chest freezer, were moved with the laboratory. Electrical and manual pipettes were used to aliquot the samples.

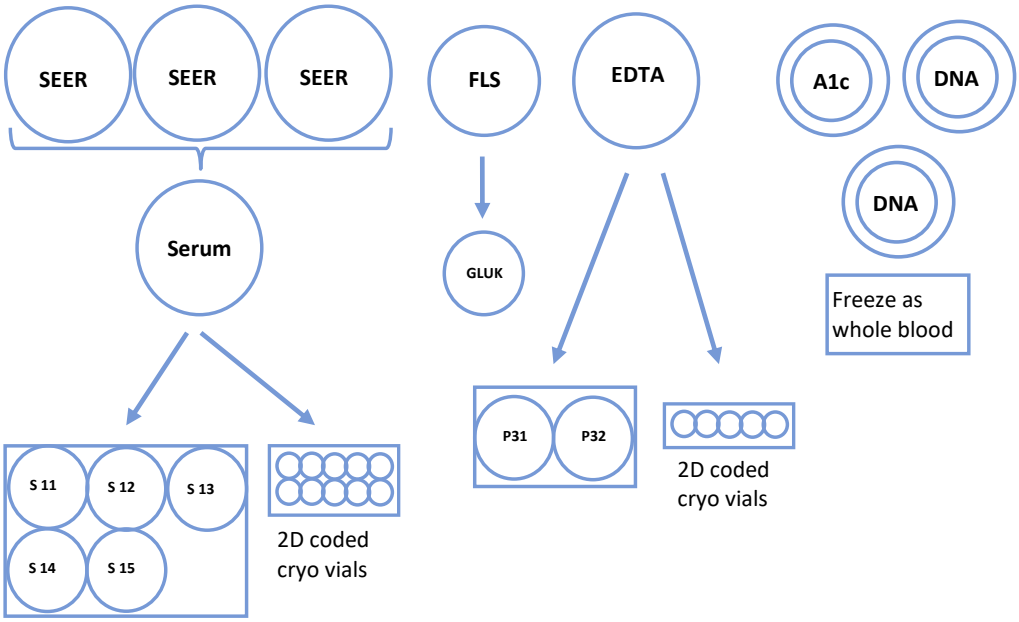


Figure 6.1.2. Aliquot tube chart.

Eight tubes of blood were drawn from each participant (5 to 10 ml plastic-walled, evacuated Becton Dickinson tubes for all other except Vacuette fluoride-citrate tubes, gel tubes for serum). The sampling order was determined by the purpose of the samples, where high priority was set to the first serum tube to enable the basic analyses. If difficulties were met with drawing the samples, three attempts were made with the participant's approval, to get at least one serum tube.

Venous blood samples were collected from a vein in the arm, with the participant in a sitting position. Blood sampling was taken, preferably, from the left arm. To prevent hemolysis the tourniquet was released as soon as the blood began to flow. If a sample could not be obtained from the arm, it was drawn from the back of the hand using a wing or open needle. Serum and EDTA tubes were carefully inverted at least six times against the plugs. Fluoride-citrate plasma tubes were inverted at least 10 times. Usually a tube rocker was used to mix the samples.

After sampling, the study personnel affixed labels (also called bar code stickers) on the tubes. Labels contained only a random number that was linked to the subject in the first study room. After the sample collection, the serum samples were allowed to clot for at least 30 minutes in a vertical position after the final tube had been collected. The maximum storage time allowed at room temperature before centrifugation was 60 minutes. The plasma samples were kept at room temperature for the same time as serum samples so that they could be centrifuged together.

Participants were asked to fast for at least four hours before their scheduled health examination time. The last time the participant had eaten or had drunk anything but water was asked and recorded. Furthermore, the participants were asked if they had used any antibiotics during the past 14 days.

6.2 Blood sample processing and management

The samples were processed according to Figure 6.1.2. Two DNA samples and the HbA1c sample of EDTA whole blood were frozen as such. The sample was frozen without opening the cap. The serum, EDTA and fluoride-citrate plasma tubes were centrifuged at 2200 G for 11 minutes. The sera from three centrifuged gel serum tubes were collected into one large pooling tube. The pooled serum was mixed by carefully inverting the tube five times and aliquoted into 1 ml cryo-tubes and 0.5 ml 2D-coded cryo-tubes. If one of the serum tubes was haemolysed, it was not added to the pool but pipetted into separate aliquot tubes. EDTA plasma tube was centrifuged and pipetted into 1 ml aliquots on cryo-vials and 0.5 ml 2D-coded cryo-tubes. Fluoride-citrate plasma was separated and pipetted to a polypropylene tube. All the samples were frozen at –20°C immediately after handling.

The date and time of sample handling, the ID code of the study personnel, the number and type of samples obtained, and the volume of all serum and plasma aliquots were entered into the laboratory form. Any deviations in sampling or in sample processing were also recorded on the laboratory form.

The participants handed their folder to the study personnel. The folder included labels for sample tubes, arranged in the order the samples were to be drawn. Each label in the sheet carried the same recurring secondary key for that particular set of labels. Storage tube labels also included an unequivocal primary key in both barcode and alphabetical format and a code describing the type of sample. The laboratory form was also labelled with a special label designed for this purpose. 2D-coded cryo-vials were linked to the blood sample collecting tube in THL's sample logistics system, SamWise. The 2D codes of the vial were linked either to the barcoded sample collecting tube or the sera pooling tube which was also labelled with barcode label.

6.3 Storage and shipment of blood samples

Serum, plasma and whole blood samples were immediately frozen at –20°C on the site, normally within 45–60 minutes, but not later than 120 minutes after sampling. If the samples were left at room temperature for longer than the maximum time (60 minutes) after the centrifugation, it was recorded in the laboratory form. The

samples were stored in fibreboard boxes that had been labelled before or to the 2D-sample racks that contained pre-printed barcode by the manufacturer. The storage boxes were filled with tubes according to a pre-planned box chart. All the samples were kept frozen at -20°C throughout the storage at the field (collecting) sites. The temperature of the freezer was followed with a calibrated temperature gauge and the daily minimum and maximum temperatures were recorded.

The samples in the boxes were packed in dry ice and transferred from the field storage points to their final storage location at THL no later than 1–2 weeks after sampling. The sample boxes were shipped via a door to door carrier. The sample boxes were read to the logistics programme at the field laboratory before shipment to keep track of the boxes sent. A mechanical thermometer was also included in the transport container to monitor the temperature during transport.

When the sample shipment arrived at THL, the temperature and the overall condition of the shipment were checked. The content of the shipment was read into the logistics programme to make sure that all sample boxes that were sent from the field had also been received at THL. The serum, plasma and whole blood sample aliquots were sorted on the basis of the aliquot type and transferred to storage at –70°C. DNA samples were stored at –20°C. HbA1c and fluoride-citrate plasma samples were also stored in –20 °C after the analysis.

6.4 Field laboratory quality assurance

Laboratory work followed strictly the field manual that was specifically prepared for the FinHealth 2017 Study. Procedures for sampling and sample processing were tested during two pilot phases. The field laboratory personnel were trained in advance during a 2-week training period. The sampling and sample handling sites were audited once by an external auditor. Also the person responsible for the laboratory work audited the sites one or two times during the field examinations.

One of the major concerns during planning was how to minimize the risk of errors during sampling and sample handling. Therefore all the samples from each participant were processed at the same time. In the event of problems, the field laboratory personnel contacted the person in charge at THL by e-mail or phone. A job rotation scheme was operated with personnel responsible for sample collection and sample processing, exchanging jobs at about one-week intervals.

6.5 Basic laboratory measurements

The basic laboratory measurements were performed at the biochemistry laboratory of the Genomics and Biomarker Unit at THL, Helsinki. The laboratory measurements were carried out for alanine aminotransferase, albumin, apolipoproteins A-I and B, aspartate aminotransferase, calcium, cholesterol, creatinine, glutamyltransferase, HDL-cholesterol, high sensitive CRP, triglycerides and uric acid measurements from serum samples, glucose measurements from fluoride citrate plasma samples and glycated haemoglobin A1c measurements from EDTA blood samples. LDL cholesterol was calculated using the Friedewald formula (Friedewald et al. 1972). All measurements were performed on a clinical chemistry analyser Architect ci8200 (Abbott Laboratories, Abbott Park, IL, USA). The biochemistry laboratory (T077) is accredited by the Finnish Accreditation Service, FINAS and it fulfils the requirements of the standard SFS-EN ISO/IEC 17025:2005. The scope of accreditation covers all analyses except albumin, aspartate aminotransferase and uric acid. The determinations were carried out on frozen samples within one month after sampling. Table 6.5.1 provides more detailed information concerning the methods used.

For standardizing the measurements, the laboratory has taken part in the Lipid Standardization Program organized by CDC, Atlanta, USA and External Quality Assessment Schemes organized by Labquality, Helsinki, Finland. The quality of the results of the series of analysis was ascertained by using controls, which were used to determine interassay coefficients of variation (CVs). During the course of the study comprising four months in 2017, the precision between series expressed as coefficients of variation (CV%), the accuracy of the methods (mean bias% ± SD) and the traceability of the methods are demonstrated in the Table 6.5.1. The bias indicates the difference between the laboratory's own result and the target value of the quality assessment sample and describes the laboratory's systematic error.

Table 6.5.1. The precision between series, the accuracy of the methods and the traceability of the methods.

Assay	Method	CV% ± SD, (N)[1]	Bias% ± SD, (N)[2]	Traceability
Alanine Aminotransferase	NADH (with P-5'-P), IFCC, Abbott	5.3 % ± 3.9 (5)	- 3.4 % ± 4.1 (6)	IFCC
Albumin	Photometric, Bromcresol Purple, Abbott	2.0 % ± 0.3 (5)	- 1.1 % ± 2.0 (6)	ERM-DA470/IFCC
Aspartate Aminotransferase	NADH (with P-5'-P), IFCC, Abbott	2.3 % ± 1.0 (5)	+ 2.7 % ± 2.7 (6)	IFCC
Calcium	Photometric, arsenazo III, Abbott	1.3 % ± 0.2 (5)	- 0.5 % ± 1.2 (6)	NIST SRM 956
Cholesterol, total	Enzymatic, Abbott	0.8 % ± 0.4 (6)	- 0.3% ± 0.9 (18)	Abell-Kendall verification, CDC
Cholesterol, HDL	Enzymatic, homogenous direct, Abbott	1.9 % ± 0.6 (6)	+ 2.7 % ± 1.9 (18)	Abell-Kendall verification, CDC
Creatinine	Enzymatic, Abbott	1.7 % ± 0.2 (5)	+ 1.0 % ± 2.5 (6)	NIST SRM 967
C-Reactive Protein, High Sensitivity	Immunoturbidimetric, Abbott	2.0 % ± 0.3 (5)	+ 5.9 % ± 4.9 (3)	ERM-DA472/IFCC
Glucose	Enzymatic, hexokinase, Abbott	2.2 % ± 0.2 (5)	+ 4.7 % ± 3.5 (6)	NIST SRM 956
Gamma-Glutamyl Transferase	Photometric, kinetic (IFCC), Abbott	2.2 % ± 0.5 (5)	- 3.7 % ± 3.8 (6)	IFCC
Haemoglobin A1c, glycated	Enzymatic, Abbott	1.2 % ± 0.2 (3)	- 1.7 % ± 2.1 (4)	IFCC Monitoring Program Reference Samples
Lipoprotein, apo A1	Immunoturbidimetric, Abbott	1.6 % ± 0.3 (6)	+ 2.1 % ± 2.5 (18)	WHO/IFCC/CDC Standard SP1-01
Lipoprotein, apo B	Immunoturbidimetric, Abbott	1.2 % ± 0.3 (6)	- 4.2 % ± 1.2 (18)	WHO/IFCC/CDC Standard SP3-08
Triglycerides	Enzymatic, Abbott	2.6 % ± 1.1 (6)	- 5.2 % ± 3.5 (18)	ACS Grade Glycerol
Uric Acid	Enzymatic, Abbott	0.9 % ± 0.3 (5)	+ 1.3 % ± 1.1 (6)	NIST SRM 913

CV = interassay coefficient of variation; SD = standard deviation; (N)[1] = number of different control; (N)[2] = number of quality assessment sample

7 Anthropometric measurements

Katja Borodulin and Laura Råman

7.1 Height

Height was measured using a portable, stand-alone (Seca 213) stadiometer. On assembly and every day a carpenter's level was used to verify the correct vertical and horizontal placement of the stadiometer. After measuring the correct placement of the stadiometer was marked with tape. A thin non-slip mat/carpet was placed under the stadiometer to stabilize its place on the floor.

Height was measured with light socks or barefoot (Tolonen 2016b). Hair ornaments interfering with the measurement were removed. Participants were instructed to stand upright with feet together on the stadiometer´s platform with the back of the head, back, buttocks and heels against the measuring rod. The head was positioned so that the top of the external auditory meatus (ear canal) and the bony orbit (cheek bone) were in a straight line. The reading was read at eye level of the measurer, when a small ladder was used when needed. Height was recorded to an accuracy of 0.1 cm.

Height was not measured if the participant was unable to stand upright or if the participant exceeded the maximum height of the stadiometer (205 cm). In these cases self-reported height was asked and recorded. For quality control central office staff followed the last digits and means of the height measurements by each study personnel.

7.2 Weight and body composition

Bioelectrical impedance analysis was carried out to measure body composition. This included weight, basal metabolic rate and amounts and proportions of fat, muscle, bone and water masses. Tanita DC-430-MA with four electrodes at the platform and a remote display was used. Horizontal placement of the platform of the scale was checked daily with a carpenter's level and the device was cleaned with antiseptic fluid after every subject.

For the bioimpedance measurement, the electrodes of the platform were cleaned and moistened. The study personnel typed in the participant's data (age, gender, height) on the display. The participants were asked to take off heavy outer garments and to empty their pockets. An automatic reduction of 0.5 kg for clothing was made.

The participant stepped on the platform with bare feet and in light clothing. The study personnel checked the position of the feet and posture. The measurement took no more than 30 seconds and the results were printed out. The study personnel checked the readings and recorded them. All results were recorded to an accuracy of one decimal point (e.g. 0.1 kg for weight).

The bioimpedance analysis was not carried out if the participant had a cardiac pacemaker or another electronic device in the body, was pregnant or had metal parts in their body. Weight was measured as a part of the bioimpedance measurement, but if not possible due to the exclusion criteria, or if the participant refused the bioimpedance measurement, weight was measured using a digital floor scale (Seca 877). Neither weight nor bioimpedance were measured if the participant had difficulty in standing steady or if the participant's weight exceeded the maximum of the scale (Tanita 270 kg, Seca 200 kg). In these cases the participant's self-reported weight was asked and recorded.

For a small validation sub-study, an older model, Tanita TBF-300MA, was used in the Helsinki region. In the validation, each participant had their body composition analysis carried out twice using both Tanita devices. This information was collected to compare the results between the two devices. For the additional Eastern Finland sub-sample, only the older model, Tanita TBF-300MA, was used in all body composition measurements.

Weight and body composition devices were calibrated before the field work started.

7.3 Waist and hip circumference

Waist and hip circumferences were measured (Tolonen 2016b) using a plastic measuring tape. The tape had a push button to lock the tape at the target level, allowing the study nurse to adjust the right place and tightness for a precise measurement. A longer 3-meter tape was also available if the standard tape (max 150 cm) was too short. For the measurement, the participants were asked to undress jackets, pullovers and other clothing that hid the waist-hip area. The circumferences were measured preferably on bare skin or wearing light underwear. The participants were asked to stand with their weight evenly balanced on both feet, a small gap between the feet and hands hanging loosely beside the body. The study nurse was seated in front of the participant and checked that the measuring tape was in a horizontal position also in the back side and that the tape was not twisted.

Waist circumference was measured at the midway between the lower rib margin and the iliac crest with the tape all around the body in horizontal position. Hip circumference was measured 2.5 cm above the pubic bone. The measuring tape was fastened firmly but so that the measurer was able to fit a finger between the subject's

body and the tape. The participant was instructed to breathe normally and the reading was taken during light expiration. The readings were recorded to the nearest millimetre.

For quality control, the length of the measuring tape was checked against a stiff metallic tape measure. The study nurses checked the length of the tape on every Monday and recorded this. In case the measuring tape had stretched, it was immediately replaced with a new one. All measuring tapes were replaced once a month with new ones. Further, for quality control the central office staff followed the last digits and means of the measurements by each study nurse.

Waist and hip measurements were not done if the participant was pregnant (pregnancy week above 20) or could not stand in upright position during the measurement.

8 Blood pressure measurements

Tiina Laatikainen, Pekka Jousilahti and Katja Borodulin

Blood pressure was measured before any other measurements. In the invitation the participants were requested to refrain from heavy exercise prior to the examination and to avoid eating and drinking for at least four hours before the examination. Blood pressure was measured by a trained study nurse in a room carefully selected to meet the requirements of privacy, silence and adequate temperature. The room temperature was recorded.

The measurements were done in a sitting position from the right arm of the participant using a mercury sphygmomanometer. There were four different sizes of cuffs available: small, medium, large, and extra large. The cuff was selected based on measured arm circumference so that a small cuff was used when the arm circumference was less than 24 cm, a medium cuff when the circumference was 24–32 cm, a large cuff when the circumference was 32–48 cm and an extra large cuff when the arm circumference was more than 48 cm. Before the measurement the participants sat at least five minutes with the cuff set ready around their arm. Measurements were repeated three times with at least one minute between measurements. After the first blood pressure measurement, pulse was measured by palpating the wrist artery and counting the number of pulses from the artery for 60 seconds.

The measurement technique followed the recommendations of the European Health Examination Surveys (Tolonen 2016b). For each participant the following possible exceptions were recorded, if relevant: irregular rhythm, measurement performed from the left arm, measurement performed on supine position, or Korotkoff IV phase recorded as diastolic pressure. If the blood pressure measurement was not performed at all the reason for that was also recorded.

The study protocol included several quality management procedures regarding blood pressure measurements as this measurement, especially when using sphygmomanometers, is prone to measurement error by the measurers. First of all the study nurses measuring blood pressure were provided a 9-day training on the measurement techniques including practicing and final assessment. All the measurers also passed a hearing test. During the field work, all study nurses who carried out these measurements circulated between the teams in one week intervals from February 20th until March 31st. Inter-individual variability of recorded blood pressure levels and possible zero (or other last digit) preference was followed at the central office during the data collection. The field protocols were also audited by internal and external visits

.

9 Sociodemographic factors

Seppo Koskinen and Katri Sääksjärvi

Demographic factors

Information on age, sex, date and place of birth, marital status, place of residence and mother tongue was obtained for the whole sample (participants and non-participants) from the Population Register Centre. Furthermore, information on marital status and education were inquired with Questionnaire 1.

Socioeconomic status

Register data were acquired from Statistics Finland concerning level of education, occupation and socioeconomic position for those individuals who participated in the health examination. Furthermore, the Ministry of Employment and Economy provided information on unemployment for all individuals included in the sample.

In Questionnaire 1, the participants were asked about their main activity, with the following six response alternatives: employed or self-employed (includes unpaid employment in a family-owned business, apprenticeship, and paid internship); unemployed; student, further education, or unpaid internship; retired; on family leave, or a stay-at-home mother/father; other.

Questionnaire 1 included a question “How large was your household’s income last year (before tax deduction)?”, with ten response alternatives ranging from less than 15 000 euros to more than 90 000 euros. Furthermore, the questionnaires collected information on the financial situation of the respondents by posing the questions “How satisfied are you with your economic situation?” with five response alternatives (very satisfied; satisfied; somewhat satisfied; unsatisfied; very unsatisfied) (Questionnaire 1), and “Do you have enough money to meet your needs?” with five response alternatives (not at all; a little; moderately; mostly; completely) (Questionnaire 2).

10 Quality of life

Seppo Koskinen and Katri Sääksjärvi

Quality of life (QOL) refers to a broad, multidimensional concept that usually includes subjective evaluations of both positive and negative aspects of life while health related quality of life (HRQOL) aims to capture the aspects of QOL that can be influenced by health and health care. These include domains related to physical, mental, emotional, and social functioning. Several methods to assess QOL and HRQOL exist.

In the FinHealth 2017 Study, the EUROHIS-QOL 8-item index (Power 2003, Schmidt et al. 2006) was included in Questionnaire 2. The EUROHIS-QOL 8-item index is composed of eight items (overall QOL, general health, daily activities, self-esteem, relationships, home, energy, and financial situation) taken from the WHOQOL-BREF. Each item has a five-point response scale and is scored positively. The overall QOL score is formed by a simple summation of scores on the eight items, with higher scores indicating better QOL.

In addition, Questionnaire 1 included one question on each of the three dimensions of wellbeing outlined by Allardt (Allardt 1976), i.e. having, loving and being. The questions were “How satisfied are you with your economic situation?”, “How satisfied are you with your family life?”, and “How satisfied are you with your accomplishments in life?”, with five response alternatives (very satisfied; satisfied; somewhat satisfied; unsatisfied; very unsatisfied).

Finally, self-rated quality of life was assessed in Questionnaire 2 with a global question “How would you rate your quality of life?”, with five response alternatives ranging from very poor to very good. This question is one of the eight items included in the EUROHIS-QOL index, but it is also often used as a separate indicator of quality of life.

11 Health behaviours

11.1 Smoking

Otto Ruokolainen

In Questionnaire 1, smoking, snuff use, electronic cigarette use, nicotine replacement therapy and exposure to environmental tobacco smoke were assessed.

For all participants, a question: "Have you ever smoked?" (no; yes) was presented in the Questionnaire 1. For those, who answered 'yes', a follow-up question was asked: "Have you during your life smoked at least 100 times (cigarettes, cigars or pipefuls)" (no; yes). The rest of the questions on smoking were put to those who had smoked at least 100 times. A five-category variable for smoking status was generated using, in addition to these two questions, the following questions (and the corresponding answer options): "Have you ever smoked regularly (almost every day for at least a year)? How many years altogether?" (I have never smoked regularly; I have smoked regularly for __ years [an open ended question]), "When was the last time you smoked?" (yesterday or today; 2 days–1 month ago; between 1 and 6 months ago; 6 months–1 year ago; 1–5 years ago; 6–10 years ago; over 10 years ago).

The classes for smoking status were: Daily smoker; Occasional smoker; Quitter 1–12 months ago; Quitter over 1 year ago; Non-smoker. The respondents' current smoking was enquired with the question: "Do you smoke nowadays (cigarettes, cigars, pipefuls)?" (yes, daily; yes, occasionally; not at all). The initiation age of smoking was assessed with the question "How old were you when you started smoking", with years as the open-ended answer option. Nicotine addiction was measured using a two-question version of the Fagerström Test for Nicotine Dependence (Heatherton 1991), also known as Heaviness of Smoking Index, HSI. The first question was "How soon after waking up do you smoke your first cigarette?" (in 5 minutes; in 6–30 minutes; in 31–60 minutes; more than 60 minutes after waking up). Second, an open-ended question was asked: "On average, how much do you smoke or did smoke before you quit?" (manufactured cigarettes; self-rolled cigarettes; pipefuls; cigars).

Snuff use was assessed with a question "Do you use snuff?" with answer options being: yes, __ portions a day (an open-ended question); sometimes; not at all. Nicotine replacement therapy use was asked as follows: "Have you during the last 12 months used nicotine replacement therapy (gum, patches, pills, lozenge, sublingual tablet, inhaler) or prescription drugs that can help you quit smoking?" (no, I have not; yes, to help me stop smoking; yes, for other reason). Current electronic

cigarette use was assessed with the question: “Are you currently using electronic cigarettes with nicotine?” (daily; sometimes; never). Exposure to environmental tobacco smoke was asked with a question: “How many hours do you daily spend in indoor spaces where you have to inhale other people’s smoke?”. The open-ended answer options were: at home; at work; other places.

In questionnaire 2, the remaining four questions comprising the full Fagerström Test for Nicotine Dependence (Heatherton 1991) were addressed to ever smokers (current smoker or former smoker): “Is it difficult for you to refrain from smoking in places where smoking is banned?” (yes; no), “Which cigarette is the most difficult for you to give up?” (the first of the morning; some other cigarette), “Do you usually have a habit of smoking more frequently in the first hours after waking than at other times of day?” (yes; no), and “Do you smoke even when you are so ill that you have to stay in bed for most of the day?” (yes; no; I can’t say). Also, two questions for only current smokers were posed: “Would you be willing to quit smoking?” and “If you were to try to quit smoking, do you believe that you could completely give up smoking?”. The answer options for these questions ranged from 1 (not at all willing / not at all confident) to 10 (very willing / very confident).

11.2 Alcohol consumption

Janne Härkönen and Pia Mäkelä

The information concerning alcohol consumption was collected by Questionnaire 1 The respondents were first asked to define, whether they were a) lifetime abstainers (or have only tasted an alcohol beverage maximum of 10 times during their lifetime), b) former drinkers (from which year, until which year) or, c) current drinkers (from which year).

Next the respondents completed the first three questions of the Alcohol Use Disorders Identification Test (AUDIT-C): the frequency of drinking, quantity of alcohol typically consumed, and the frequency of drinking six or more drinks on one occasion. The definition of a standard drink was given (one 330 ml standard bottle of medium strength beer, a small 12 cl glass of wine, or one 4 cl shot of spirits; and a 50 cl pint of beer/cider equaling 1.5 standard drinks). Each AUDIT-C question had five answer choices, which were rated from zero to four, thus resulting in a total score of 0 – 12 points (scores of zero reflect no alcohol use in the past year). Following the Current Care Guidelines, a score of six or more was considered positive in men for hazardous or problem drinking; in women, a score of five or more was considered positive (Working group set up by the Finnish Medical Society Duodecim and the Finnish Society of Addiction Medicine, 2015).

Lastly, using the standard drink measurement, the respondents were asked how many drinks of the following beverages they had consumed during the last week: 1. medium beer or similar strength cider/alcopops, 2. strong beer or similar strength cider/alcopops, 3. wine, 4. spirits.

11.3 Dietary habits

Satu Männistö, Niina Kaartinen, Mirkka Maukonen, Heli Tapanainen, Heikki Pakkala, Anne Juolevi, Harri Rissanen, Katja Borodulin and Liisa Valsta

Questionnaire 1 contained questions on dietary habits including frequency of meals and snacks consumed during weekdays, most commonly used fat spread, cooking fat, milk type, and consumption frequency of vegetables, fruits and berries during the past week. In addition, Questionnaire 2 contained questions on importance of different claims related to food choices as well as perception of saltiness of food, and salt consumption.

Food Frequency Questionnaire (FFQ)

Information on habitual diet was collected by a food frequency questionnaire (FFQ) developed and validated at THL. The FFQ is the primary method in epidemiological studies concerned with the association of diet and the risk of diseases (Willett 2013), as it provides information on diet over a long period. The main aim of FFQ is to rank participants according to their food or nutrient intakes, not to measure the absolute intakes. The FFQ is easy for participants to complete and the answers are straightforward digitized, which makes it quite inexpensive to use in large population-based studies. The development of the questionnaire itself, however, is a time-consuming exercise and it is always necessary to ascertain the validity of the FFQ compared to food records or recalls.

The THL's semi-quantitative FFQ was initially developed for the Kuopio Breast Cancer Study (Männistö et al. 1996). The questionnaire has been updated every five years since 2000, and it is widely used in many studies. While the food rows/physical appearance of the FFQ have remained largely unchanged (approximately 130 -items), the updates have concerned the sex-specific portion sizes associated with each food row, and the food composition database codes composing each of the food rows (information needed for dietary calculations, and not visible for the subjects). The updates made for the FFQ used in the FinHealth 2017 Study were based on data from the FinDiet 2017 Study (two non-consecutive 24-hour dietary recalls).

In general, the participants were asked to describe their habitual diet over the past 12 months. The questionnaire listed 134 foods, mixed dishes and alcoholic beverages commonly used in Finland, grouped in the following categories: dairy products; grain products; fat spreads; vegetables; potatoes, rice and pasta; meat; fish; chicken, turkey and eggs; fruit and berries; desserts; sweet and snacks; and beverages. The average use of 134 foods was recorded by ten frequency categories ranging from never to at least six times a day. Participants can adjust the reported frequency for a food item if their own portion size differs from the predefined size on the questionnaire. The questionnaire also included additional questions on special diets and dietary supplements.

The FFQ was given to all participants in the health examination and they were asked to complete it later at home. The questionnaire was introduced to each participant and the filling instructions were reviewed together with them. Of these participants 89% returned the FFQ. Exclusions were made due to blank or incompletely filled FFQs (n=110), duplicate answers (n=9), withdrawal of the written consent to participate (n=7) and daily energy intake cut-off points corresponding to 0.5 per cent at both ends of the daily energy intake distributions for men and women separately (n=51). Eventually, intake of food and nutrients was calculated for 5125 (86%) participants.

The average daily intakes of ingredient groups (e.g. wheat, fish and berries), food groups (e.g. fish soups) and nutrients (e.g. energy-yielding nutrients, fibre and vitamin C) were calculated using the National Food Composition Database (FINELI®) and the FINESSI software of THL (Reinivuo et al. 2010). The final dietary dataset comprises around 80 ingredient groups, 80 food groups and 100 nutrients that can be used for research purposes.

The reproducibility of the FFQ versions has been measured twice (Männistö et al. 1996, Paalanen et al. 2006) and the validity compared with dietary records three times (Männistö et al. 1996, Paalanen et al. 2006, Kaartinen et al. 2012). In those validation studies, the first evaluation of FFQ included diet as a whole, the second one concentrated more on the differences between sex, age and BMI groups, and the third one focused on carbohydrate fractions, dietary glycaemic index (GI) and the glycaemic load (GL). The reproducibility and validity results were similar compared to large internationally well-known studies (e.g., Pietinen et al. 1988, Willett 2013). As a consequence, the FFQ is reasonably accurate when the cautions concerning some foods and nutrients are taken into account.

11.4 Physical activity and sedentary behaviour

Katja Borodulin

Physical activity refers to movement that results in energy expenditure and comprises elements such as type, frequency, duration, and intensity. Information on physical activity was collected in Questionnaire 1 and in Questionnaire 2. Objective measurements of physical activity and sedentary behaviour by accelerometers are described under Chapter 20.2.

Questionnaire 1 included questions on occupational, commuting, and leisure time physical activity as well as on time spent sitting in different contexts. The question on occupational physical activity was formulated as "How demanding is your work physically? Please choose the option that best applies to your situation", with response options 1) I do not work or my work is mainly done sitting down and I do not walk much during my working hours, 2) I walk quite much in my work, but I do not have to lift or carry heavy objects, 3) I have to walk and lift much or to take the stairs or go uphill, and 4) My work is heavy manual labor in which I have to lift or carry heavy objects, to dig, shovel or chop, etc.

Commuting physical activity was assessed with the question: "On your way to work or school, how many minutes do you travel on foot, by bicycle or similar? Add up the journeys to and from work/school". The six response options were the following: 1) I do not work or I work at home, 2) I use a motor vehicle for the entire trip, 3) less than 15 minutes daily, 4) 15–29 minutes daily, 5) 30–60 minutes daily, and 6) over an hour daily.

For leisure time physical activity, the question was stated as: "How much do you exercise and stress yourself physically in your leisure time?" The response categories were: 1) In my leisure time I read, watch TV and do other activities in which I do not move much and which do not strain me physically, 2) In my leisure time I walk, cycle and move in other ways several hours a week. This includes walking, fishing and hunting, and light home gardening, 3) In my leisure time I exercise several hours a week. This includes running, jogging, cross country skiing, fitness training, swimming, ball games, and strenuous garden work, and 4) In my leisure time I practice regularly strenuous sport several times per week. This includes competitive sports such as running, orienteering, cross country skiing, swimming and ball games.

For time spent sitting, the question was: "How many hours on average do you sit in a weekday? Mark 0 if not at all." The participant was asked to estimate the hours and minutes for each location or context: During the workday in office or equivalent; At home, in front of the TV, computer, or mobile device; In a vehicle; and other sitting.

Questionnaire 2 included two additional sets of questions on physical activity. The other was an instrument for volume of total physical activity per week that also allowed an estimation of reaching the current recommendation of physical activity. This instrument included four activity levels by their intensity, frequency and duration, as well as the frequency of muscle strengthening activities. The second instrument in questionnaire 2 was the physical activity frequency questionnaire that assessed weekly frequency of more than ten types of activities across winter and summer time.

11.5 Sleep and sleeping

Timo Partonen

In the self-administered Questionnaire 1, the habitual duration of sleep was assessed with a single question asking "How many hours do you sleep in 24 hours?" The answer was requested to be given as on average in hours and minutes. Sleep satisfaction (insufficient sleep) was assessed with the question asking "Do you think you sleep enough?" The participants were also asked, how often over the past month they "have felt excessively tired or sleepy during the daytime", "have had nightmares", and "have had trouble sleeping". These items concerned the frequency of common symptoms of insomnia.

In the self-administered Questionnaire 2, there were the following questions on sleeping and disturbances of sleep. The habitual schedule for sleep was assessed by the two items asking "What time do you usually go to bed (to prepare to sleep)?" and "What time do you usually get up from bed (without going back again)?" The responses were asked separately for "On workdays or weekdays" as well as "On days off or weekends". The habitual duration of sleep was calculated on the basis of these answers separately for working days as well as free days. Further, the social jetlag was calculated on the basis of these two durations of sleep. The behavioural trait of morningness-eveningness (chronotype) was assessed with a single question asking "There are so-called 'morning people' (early to rise, early to bed) and 'evening people' (late to rise, late to bed). Which are you?" Participants were also asked "Do you snore when sleeping? (Ask others if you are not sure)", "Have you noticed (or have others noticed) respiratory arrests when you sleep?", and "How many times a night do you need to get up to urinate?" These items concerned the frequency of common symptoms of sleep apnea.

Some questions which are related to sleep were also presented in other parts of the survey protocol. These include the questions asking "Has a doctor diagnosed or treated you for sleep apnea during the past 12 months?" (as one of the 10 medical conditions listed), "When was the last time you used sleeping pills?" (as one of the

11 medications listed), “How much does the duration of sleep change for you according to different seasons?” (as part of the Global Seasonality Score, GSS), and “Have you recently lost much sleep over worry?” (as part of the General Health Questionnaire, GHQ).

In addition, to a random sample attending the health examination, an accelerometer (Actigraph GT9X Link) was given to be worn on the non-dominant wrist continuously as well as a sleep diary to be kept for seven days, measuring the rest-activity cycles. See Chapter 20.2 for more information.

12 Self-rated health and long-term illnesses

Katja Borodulin, Seppo Koskinen and Päivikki Koponen

The global measure of self-rated health has consistently been identified as a predictor of several health problems and mortality (Baćak & Ólafsdóttir 2017). It has been assumed that people take into account a more comprehensive set of physical and psychological conditions when rating their health than what would be possible to measure in any one survey. While the question on self-rated health is widely used, the exact wordings and response options of questions on self-rated health vary. Thus the levels and distributions are not directly comparable between different surveys (Jylhä 2009). The question is also sensitive to cultural factors and differences in data collection modes.

Self-rated health was measured in Questionnaire 1 by a standard question used in previous national health surveys in Finland: "Is your present state of health…", with response options 'good', 'rather good', 'moderate', 'rather poor', and 'poor'. This wording differs from the European (Eurostat 2019) and most international standards (Jylhä 2009), but was chosen for the FinHealth 2017 Study to follow national trends.

Longstanding illnesses or health problems were assessed with the Minimum European Health Module question: "Do you have any longstanding illness or health problem?" and the response options were 'no' or 'yes' (Eurostat 2019). This question differs from the wording used in previous national health surveys in Finland. It was chosen because of the simplicity of the question and problems identified with the previously used national questions on longstanding illnesses and health problems.

13 Diseases and risk factors

13.1 Cardiovascular diseases and diabetes

Tiina Laatikainen and Pekka Jousilahti

In the FinHealth 2017 Study, questions on cardiovascular diseases and diabetes were included in the self-administered questionnaires as in the previous FINRISK Studies. Thus, the comparability with the corresponding Health 2000/2011 interview questions is low. Questionnaire 1 included previous FINRISK questions concerning these diseases.

First, the list of diseases diagnosed or *treated by a doctor during the past 12 months* included cardiac insuffiency and coronary heart disease. The questions on hypertension covered *last time when the respondent's blood pressure had been measured* (with five response options ranging from 'during the last six months' to 'never'), and having ever been diagnosed for high or elevated blood pressure, and having ever used medicine for blood pressure. For medication, the last time when the respondent had taken the medicine was asked (with six response options ranging from 'today or yesterday' to 'over 5 years ago'). The frequency of using a blood pressure monitor at home (with six response options ranging from 'daily' to 'never') was also asked.

Further, questions were asked about *having ever been diagnosed by a doctor*, first with myocardial infarction, and second with stroke, cerebral haemorrhage or cerebral thrombosis. There were also questions for having ever had coronary bypass surgery, or angioplasty (balloon distension). If the answer was yes to any of these, the subject was asked to specify what year was the last one. The question on medication included use of 'Acetylsalicylic acid to prevent myocardial infarction or cerebral infarction (e.g. Aspirin, Disperin, Primaspan)' and 'Blood thinner medications, anticoagulants (Marevan, Pradaxa, Xarelto or Eliquis)' with five answer options from 'during the past week' to 'never'.

Information on diabetes covered *the last time the respondent had his/her blood sugar level measured* (with response options from 'during the last six months' to 'never', and 'do not know'). They were asked about having ever been diagnosed with diabetes with the answer options covering the type (elevated blood glucose levels or prediabetes); type 1diabetes (childhood-onset diabetes), type 2 diabetes (adult-onset diabetes), gestational diabetes, or not knowing which type. The year of diagnosis was also asked. When diagnosed with diabetes the respondents were asked about the treatments: lifestyle counselling only, tablet or insulin treatment or none of

these. Current use of medicines for diabetes was also asked (nothing, insulin, tablets or both).

Blood pressure was measured (Chapter 8) and blood lipids, glycated hemoglobin and fasting glucose were analysed among those who participated in the health examination (Chapter 6).

13.2 Respiratory diseases and allergies

Tiina Laatikainen and Pekka Jousilahti

In the FinHealth 2017 Study, questions on respiratory diseases and allergies were included in the self-administered questionnaires as in the previous FINRISK Studies. Thus, the comparability with the corresponding Health 2000/2011 interview questions is low. In Questionnaire 1, the subjects were asked whether *a doctor had ever diagnosed* them with asthma, chronic obstructive pulmonary disease (COPD) or chronic bronchitis. The following symptoms were also asked (with reference to usually and answer options yes or no): coughing phlegm when waking up on winter mornings, during the day or at night during winter, or on most days or nights for at least 3 months yearly.

The FinHealth Questionnaire 2 included additional questions on respiratory symptoms, i.e. *having noticed over the past 12 months*: ‘a wheezing or hissing sound when breathing’, experiencing ‘while wheezing shortness of breath (dyspnea) at the same time’ and noticing ‘a wheezing sound when you breathe even though you are not suffering from a common cold or a respiratory infection’. In addition, the respondents were asked if, over the past 12 months, they had ever been awakened ‘because your breathing became laboured’, ‘because of shortness of breath‘ or ‘because of a coughing fit’. After these questions the respondents were asked if they currently take any asthma medications (nebulizer, inhaler or pills).

Questions on allergies in Questionnaire 1 inquired if the respondent *had ever ha*d hay fever or other allergic nasal symptoms, allergic eye symptoms or an itching rash which was called milk crust (infantile eczema), or atopic rash (atopic eczema). The answer options were ‘no’, ‘yes, *during the last 12 months*’ and ‘yes, the last time was *over a year ago*’.

The question on medication included use of ‘Asthma medication’ and ‘Hay fever medication’ with five answer options from ‘during the past week’ to ‘never’.

No measurements concerning respiratory function were included in the health examination, but serum samples were taken and stored for possible future analyses of specific IgE and other biological markers.

13.3 Infectious diseases

Kirsi Liitsola and Jussi Sane

Infectious diseases are caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi. The diseases can be spread, directly or indirectly, from one person to another. Infectious diseases can cause conditions ranging from mild to fatal. Antibiotics are used to prevent and treat bacterial infections. Because of the overuse of antibiotics, antibiotic resistance has become a public health threat. Many infections can be prevented by vaccines. Despite the existing control methods, the burden of infectious diseases remains high.

In the FinHealth 2017 Study, Questionnaire 1 included three questions concerning the use of antibiotics. The question "When was the last time you used the following medication?" included antibiotics as well as several other drugs. In addition, there were two antibiotic-specific questions. The *reason for the last antibiotic treatment* was asked, with answer options: respiratory tract infection, stomach problems including diarrhea and vomiting, urinary tract infection, skin or wound infection, some other reason. Also a question on *where the recent antibiotic treatment had been started* was presented, with the answer options: inpatient ward, at home.

Questionnaire 2 included two questions concerning the burden of common infections in sickness absences: *absences from work/study during the last 30 days because of respiratory infections* (a common cold, influenza, tonsillitis, maxillary sinusitis, pneumonia, etc.), or *because of stomach problems including diarrhoea and vomiting*.

Since the national vaccination register currently only includes vaccinations given in public primary health care, a question of self-paid vaccinations was included in Questionnaire 2. The question was "Have you ever taken any of the following vaccinations, and paid for them yourself?", with the answer options: tick-borne encephalitis, combined hepatitis A and B, hepatitis A, pneumonia, varicella, shingles, influenza, other.

13.4 Symptoms on indoor air quality

Juha Pekkanen, Pekka Jousilahti and Tiina Laatikainen

Symptoms related to indoor air quality were asked in the FinHealth 2017 Study in Questionnaire 2. Three questions were presented: 1) "Have you ever experienced symptoms related to poor indoor air quality at your home?", 2) "Have you ever experienced symptoms related to poor indoor air quality at your workplace?" and 3)

“Have you ever attended a medical doctor or received medical care due to symptoms or illness, which were suspected to be mainly caused by poor indoor air quality?“ The response options for all these questions were: “no”, “yes, during the past 12 months” or “yes, over a year ago”.

14 Mental health

Jaana Suvisaari, Timo Partonen and Pia Solin

Mental health and substance use-related problems were assessed with questionnaires (Questionnaire 1, Questionnaire 2), which assessed mood and anxiety symptoms, psychological distress, and mental well-being (positive mental health). In addition, there were a few questions on treatment.

The instruments used for the assessment of mental health in the study questionnaires and interviews are presented in Table 14.1.

Table 14.1.The instruments used for the assessment of mental health.

	Questionnaire 1	Questionnaire 2
Treatment	x	x
BDI-6		x
GHQ-12		x
MHI-5	x	
Depression symptoms	x	
SPAQ		x
WEMWBS		x

Current psychological distress was assessed with two sets of questions. The first was the 12-item version of the General Health Questionnaire (GHQ-12, Goldberg 1972). GHQ-12 includes 12 questions assessing symptoms commonly related to depression as well as general functioning, e.g. ability to face problems and make decisions. All items have a 4-point scoring system ranging from a “better/healthier than normal” option, through a “same as usual” and a “worse/more than usual' to a “much worse/more than usual” option. These are scored using a 0-0-1-1- scoring, so that “better” and “usual” responses are scored as 0, and “worse” and “much worse” responses are scored as 1. The responses to individual items are added to give a total score which varies from 0 to 12. The cut-off for current psychological distress was a total score above 3.

The second set of questions for assessing current psychological distress was the Mental Health Inventory (MHI-5) derived from the SF-36 scale (McHorney & Ware 1995). MHI-5 includes five questions covering the past four weeks: (1) Have you been a very nervous person? (2) Have you felt so down in the dumps that nothing could cheer you up? (3) Have you felt calm and peaceful? (4) Have you felt

downhearted and blue? (5) Have you been a happy person? All items have a 6-point scoring system ranging from "All of the time" to "None of the time". When the total score is calculated, the answers to two items (the third and fifth) are reversed. The raw scores are then transformed to a scale ranging from zero to 100 (Aalto et al. 1995). The cut-off for current psychological distress was a total score of 52 or below.

Current depressive symptoms were screened using the 6-item version of the Beck Depression Inventory (BDI-6) (Aalto et al. 2012). The scoring of each of the BDI-6 questions in the version that was used in the study is described in Table 14.2. The scores of individual items are added to give the total score which varies from 0 to 18.

Table 14.2. Scoring of the Beck Depression Inventory-6 (BDI-6).

Question 1	1=0	2=1	3=2	4=2	5=3
Question 2:	1=0	2=1	3=2	4=2	5=3
Question 3:	1=0	2=1	3=2	4=2	5=3
Question 4:	1=0	2=1	3=2	4=2	5=3
Question 5:	1=0	2=1	3=2	4=2	5=3
Question 6:	1=0	2=1	3=2	4=3	

Seasonal variations in mood and behaviour were assessed with seven items derived and adapted from the Seasonal Pattern Assessment Questionnaire (SPAQ, Rosenthal et al. 1984), including the six seasonal variations in sleep duration, social activity, mood, weight, appetite, and energy level. Two modifications were made to the original scoring as follows. Each item was scored from zero to three (none, slight, moderate or marked), not from zero to four, with the sum or global seasonality score (GSS) ranging from 0 to 18. The psychometric properties of this modified questionnaire have been tested and been shown to be good (Rintamäki et al. 2008). The 7/8 cut-off score was applied for the two GSS categories (0–7 vs. 8–18). In addition, there was a question: "If you experience changes by seasons, do you feel that these are a problem for you?" The first part of this item was scored from zero to one (no variations, variations but no problem), and if there was a problem, the second part of this item was scored from two to five (variations of mild, moderate, marked or severe problem).

Positive mental health was measured with Warwick Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al. 2007). The scale consists of 14 positively worded items covering positive affect (feelings of optimism, cheerfulness, relaxation), satisfying interpersonal relationships and positive functioning (energy, clear thinking, self-acceptance, personal development, competence and autonomy). The questions are: I've been feeling optimistic about the future 2) I've been feeling useful, 3) I've been feeling relaxed, 4) I've been feeling interested in other people, 5) I've had energy to spare, 6) I've been dealing with problems well, 7) I've been

thinking clearly, 8) I've been feeling good about myself, 9) I've been feeling close to other people, 10) I've been feeling confident, 11) I've been able to make up my own mind about things, 12) I've been feeling loved, 13) I've been interested in new things and 14) I've been feeling cheerful. The respondents are asked to rate their experience over the past two weeks; 1 (none of the time), 2 (rarely), 3 (some of the time), 4 (often) and 5 (all of the time). The total score ranges from 14 to 70 points.

In addition to the aforementioned questionnaires, there were single items on mental health and its treatment as follows. In Questionnaire 1, as part of the 10-item list (Question 5) asking "Has a doctor diagnosed or treated you for any of the following diseases during the past last 12 months?", the participant was asked about "depression" as well as "other psychological or mental illness", and to answer either "no" or "yes". Later (Question 36), the participant was asked "Have you during the last 12 months had a period of at least two weeks when, for most of the time you have been low-spirited or depressed?" and "Have you during the last 12 months had a period of at least two weeks when, for most of the time you have lost interest in most things, such as hobbies, work or other things that usually give you pleasure?", to both of which the participant was asked to answer either "no" or "yes". Later, as part of the 11-item list (Question 38) asking "When was the last time you used the following medication?", the participant was asked to choose the correct alternative of "during the past week", "1–4 weeks ago", "1–12 months ago", "over a year ago" or "never" for "sleeping pills", "tranquillizers" and "antidepressants". In Questionnaire 2, there was one question on health service use during the past 12 months due to mental health problems. In addition, Questionnaire 2 had a list of questions on family history of different health problems (mother, father), including mental health problems.

15 Oral health

Liisa Suominen and Eero Raittio

Information on oral health was collected in Questionnaire 1 and Questionnaire 2 and in the Questionnaire for persons aged 70 years or older. The questions covered the aspects of self-reported oral health and symptoms, oral self-care, and use of services. The questions were largely the same that were used in the Health 2011 Survey (Lundqvist & Mäki-Opas 2016), in the Health 2000 Survey (Suominen-Taipale et al. 2008) and in the Mini-Finland Study (Vehkalahti et al. 1991) but included also some new or slightly modified questions.

In Questionnaire 1, information on self-reported oral health was collected by asking the participants 'Is the condition of your teeth and the health of your mouth at present' good, rather good, moderate, rather poor or poor. Oral self-care was inquired by two questions: 'How often you usually brush your teeth' with answer options 'more often than twice a day', 'two times per day', 'once a day', 'less frequently than daily' or 'never', and 'How often do you use for cleaning and caring for your mouth and teeth dental floss or interdental brush?' with answer options 'daily', 'weekly', 'less frequently' or 'not at all'.

Questions on toothache or other oral health-related trouble and symptoms were included in Questionnaire 2. Participants were asked 'Have you during the past 12 months had toothache or other trouble related to your teeth or dentures' with answer options 'yes' or 'no'. Questions on bad breath (halitosis or malodor) and dry mouth were new and were inquired with a question 'Have you during the last month (past 30 days) had the symptoms or problems?' with answer options 'daily', 'less frequently' or 'not at all'.

Questions on use of oral health care services were also included in Questionnaire 2. Participants were first asked about their habitual use of dentist's services by a question 'Do you usually go to a dentist' with answer options 'regularly for a check-up', 'only when having toothache or some other trouble' or 'never'. They were also asked 'When was the last time you visited a dentist' with answer options 'less than 1 year ago', '1 to 2 years ago', '3 to 5 years ago', 'over 5 years ago' or 'have never visited a dentist'. Number of visits to any oral health care was asked by the question 'Over the past 12 months, how many times have you visited...' and the answers were requested separately for a dentist working at public dental services (a health centre), a private practice, or other place (the Finnish Student Health Services, military, university, hospital etc.), a dental technician, a dental hygienist working at a health centre or at a private clinic, or other oral health care. Barriers for not having received care were inquired by the question 'Have the following factors prevented you from

getting the dentist's treatment you wanted?' with answer options 'queuing to access to care', 'poor commuting to treatment place' or 'too high service charges or prices'.

Questionnaire for persons aged 70 years or older included questions concerning presence of natural teeth and/or dentures and denture cleaning. Participants were asked whether they had 'full dentures and no natural teeth or tooth remnants', 'dentures and natural teeth', 'no dentures but natural teeth' or 'neither dentures nor natural teeth'. Those having dentures were asked how often they cleaned their dentures with answer options 'more often than twice a day', 'twice a day', 'once a day', 'less frequently than daily' or 'never'.

16 Accidents

Anne Lounamaa and Persephone Doupi

An accident is an unexpected event in which a person is injured or killed. The common hallmark of an accident is bodily injury of varying degrees. The prevention of accidental injuries begins with the identification of hazards: the better the different hazards are recognized, the more effectively prevention addresses them, reducing the risk of accidents and reducing accidents.

In the FinHealth 2017 Study, there were two questions related to accidental injuries (Questions 12 and 13), incorporated in the section of Questionnaire 2 where survey respondents provide a self-assessment of their health status.

The first question aimed at collecting information regarding the type and partly the circumstances of accidental injuries the respondent had sustained during the year prior to participation in the survey. Only injuries which had required medical care were included.

Respondents could tick 'yes' or 'no' boxes for a selection of options:

- traffic accidents (distinguishing between those involving motor vehicles and others, incl. bicycles),
- work injuries,
- injuries during on the to or from work (if not a road traffic accident),
- home and leisure time injuries (separately indoors and outdoors) and
- sport injuries (separately indoors and outdoors).

The second question aimed to gauge the impact of injuries on the functional ability of the respondents. They were requested to give the number of days – in the course of 12 months prior to the survey – normal activities of daily living were impossible or very difficult to them as a result of their injuries.

The data collected on injuries during the FinHealth 2017 Study are not directly comparable to those from the Health 2000 (Heistaro 2008) and 2011 Surveys (Lundqvist & Mäki-Opas 2016), due to changes in the focus and structuring of the pertinent questions, as well as the method of data collection.

Data collection approaches over the different studies have strengths and weaknesses, since they focus on different aspects of injury and its impact on functional ability and daily living. In earlier studies, the role of injury as a permanent disability factor was emphasized. Thus the survey identified more severe injuries, but did not provide information on the circumstances in which they occurred. The current FinHealth 2017 question setting combines information on the impact of the injury on functional ability of respondents, with basic data on the

circumstance (type) of injury, which in turn is essential background for targeting of injury prevention activities.

17 Sexual and reproductive health

Päivikki Koponen, Reija Klemetti and Kirsi Liitsola

Most questions on reproductive and sexual health were based on questions included in previous Finnish surveys, in the Health 2000/2011 and/or the FINRISK surveys. A few questions were adapted and specified, e.g. due to changes in hormone therapy for women and most frequently used contraceptive methods. The Health 2000/2011 interview questions were also adapted to the self-administered questionnaires. Due to these adaptations comparability with the previous survey questions on reproductive health is limited. In addition, three new questions on sexual behaviour were included.

Questions on reproductive health were at the end of Questionnaire 1 and these were targeted to women. First, there were questions on hormonal contraception: using contraceptive pills, intrauterine devices (IUD) or other hormonal contraceptives currently, not now but before, and never. The total number of years the contraceptives had been used was also specified. Second, use of hormone therapy (other than contraceptives) in the form of tablets, gel, vaginal suppository, vaginal cream, or patch was asked with the options of using these by prescription or over the counter (without prescription) or not having used any. Women were also asked to specify for how many years they had been using the hormone therapy. There was also a question on having periods nowadays, and if yes, whether the periods were regular and if not, why (due to hormone medication or IUD, periods ended naturally with menopause, because of pregnancy, or due to other reasons such as e.g. no uterus or other disease).

The questions also specified breastfeeding currently, never, in total less than one month or the total years and months having breastfed. Questions on births, abortions, miscarriages, and extrauterine pregnancies had answer options of “no” or “yes, how many”. The women were also asked if they had ever had high blood pressure during pregnancy and how often they examine their own breasts by themselves (more often than once a month, about once a month, occasionally or never).

Further questions on sexual and reproductive health were included at the end of Questionnaire 2. It was specified that these questions apply to both men and women. First these questions addressed experiences of infertility, seeking examinations and treatments due to infertility, and the success of these treatments (having a child). The respondents were also asked if they wish to have (more) children in the future.

The questions on sexual behaviour in the past 12 months were related to sexual activity including the gender of the sex partners, the types of sex (vaginal

intercourse, anal intercourse, oral sex, or none of these) and the number of partners. Additionally, contraceptive methods used in the past 12 months were asked. Questions on screening and health examinations also comprised items related to reproductive and sexual health (e.g. mammography and cervical cancer screening, and HIV testing, see Chapter 19).

18 Functioning

Päivi Sainio, Sari Stenholm, Heli Valkeinen, Mariitta Vaara, Markku Heliövaara and Seppo Koskinen

WHO's International Classification of Functioning, Disability and Health (ICF, WHO 2001) is a biopsychosocial approach to describe and structure functioning and disability. It portrays functioning and disability as a dynamic interaction between the health conditions and personal factors of the individual and the contextual factors of the environment. The ICF framework classifies human functioning on three levels: functioning at the level of body or body part (body functions), the whole person (activities), and the whole person in a social context (participation, WHO 2002). The ICF has also been accepted as a framework for the definition and operationalization of functioning and disability in population surveys by e.g. Eurostat, WHO and Washington Group on Disability statistics. The FinHealth 2017 Study included measurements on physical, psychological, cognitive and social functioning, work ability and usual and basic activities of daily living. Information was also gathered on various environmental and personal factors as well as on the health conditions. The topics of functioning in the FinHealth 2017 Study quite comprehensively cover the various components of ICF. The majority of the methods applied to measure functioning in the FinHealth 2017 Study are described in this chapter (Table 18.1).

Table 18.1. Measures of functioning in the FinHealth 2017 Study and the chapters in this report where the methods are described.

Physical functioning	Chapter 18.1
Vision, hearing	Chapter 18.2
Cognitive functioning	Chapter 18.3
Psychological functioning	Chapters 14 and 12
Social functioning	Chapter 18.4
Basic and usual activities of daily living	Chapter 18.7
Quality of life	Chapter 10
Work ability and working conditions	Chapter 18.6
Living environment and housing	Chapter 18.8
Use of assistive devices, use and need of help	Chapter 18.9
Activity limitations (based on the global activity limitation indicator, GALI)	Chapter 18.5

Some of the methods have also been used in previous national surveys in 1978–80, 2000 and 2011 (see Aromaa et al. 1989, Sievers et al. 1985, Heistaro 2008, Lundqvist & Mäki-Opas 2016).

18.1 Physical functioning

Päivi Sainio, Sari Stenholm, Heli Valkeinen, Mariitta Vaara, Markku Heliövaara and Seppo Koskinen

The assessment of physical functioning was based on self-reports and performance tests (Table 18.1.1). The methods are well-established and have been widely used in population surveys and clinical studies (McWhinnie 1981, Sievers et al. 1985, Guralnik et al. 1994, Guralnik et al. 1995, Curb et al. 2006).

Table 18.1.1. Methods for assessing mobility and physical functioning for adults aged 30 years or older in the Finnish national health examination surveys.

	Mini-Finland 1978–80[1)]	Health 2000[2)]	Health 2011[2)]	FinHealth 2017[3)]
Self-reported items				
Walking 500 m	interview (400m), questionnaire	interview	interview	questionnaire
Walking 2 km	-	interview	interview	
Walking about in the apartment	interview	interview	interview	questionnaire[5)]
Going out of home	-	-		questionnaire[5)]
Climbing stairs for one flight	interview, questionnaire	interview	interview	questionnaire
Climbing stairs for several flights	interview, questionnaire	interview	interview	-
Running a short distance (100 m)	questionnaire	interview	interview	questionnaire
Running a long distance (500 m)	questionnaire	interview	interview	-
Walking difficulties due to knee pain	interview	interview	questionnaire	questionnaire
Walking difficulties due to hip pain	interview	interview	questionnaire	questionnaire
Mobility status	questionnaire	interview, questionnaire	interview, questionnaire	-
Preclinical questions on	-	-	interview	-

mobility				
Using public transport	questionnaire	interview	interview	-
Driving a bicycle	-	interview	-	-
Driving a car	-	interview	interview	-
Performance tests				
Chair stand	-	1 and 5 times[4)]	1, 5, 10 times	1, 5, 10 times
Walking test	-	6,1 m[4)]	6,1 m/4 m	-
Joint function test	10 tests for legs and arms	10 tests[4)]	only shoulder (abduction, internal and external rotation) and squatting[4)]	only shoulder (abduction, external rotation) and squatting[4)]
Grip strength	both hands (dynamometer: self-constructed) [4)]	dominating hand (dynamometer: Good Strength, Metitur)	dominating hand (dynamometer: Jamar/Saehan)	dominating hand (dynamometer: Jamar/Saehan)
Standing balance	-	performance test: Guralnik's protocol; postural sway: Good Balance, Metitur	performance test: Guralnik's protocol[5)]	-

[1)] Mini-Finland
[2)] Health 2000 and Health 2011 Surveys
[3)] FinHealth 2017 Study
[4)] Only age group 55+
[5)] Only age group 70+

Self-reported physical functioning

Assessment of self-reported physical functioning focused on mobility (Questionnaire 1). The questions gathered information about ability to run a short distance (about 100 meters), ability to climb up one flight of stairs and ability to walk 0.5 km (Rosow & Breslau 1966, McWhinnie 1981, Aromaa et al. 1989, see Table 18.1.1). Questions on ability to move about from one room to another and ability to go out from the apartment were asked from participants aged 70 years or older (Questionnaire for persons aged 70 years or older). The core question in all items was phrased *"Are you able to …?"* The response options were: without difficulties, with minor difficulties, with major difficulties, not at all. In addition, two questions about difficulties in walking or limping due to hip or knee problems were also asked (with response options yes/no).

Performance tests for physical functioning

Performance tests measuring mobility, strength, and joint functions were conducted by the study nurse and performed in a standard order, following written instructions. Before each test the study nurse ensured that the test could be safely administered. If the test was not conducted (e.g. due to severe disability), the reason for this was recorded in the data collection sheet. The study nurse explained and showed the test movements to the subject prior to each test.

Hand grip strength

The hand grip strength was measured with a Jamar/Saehan dynamometer (Sammong Preston Rolyan 2003) from the dominating hand, which was defined as the writing hand. If the subject could not use the dominating hand due to severe injury or disorder (e.g. cast due to fracture, hemiplegia), the measurement was conducted with the non-dominating hand. The size of the grip handle was adjusted according to the size of the subject's hand. The width of the grip was appropriate, when the middle joint of the index finger was in a 90 degree angle. The subjects were asked whether they felt comfortable with the width of the grip. The subjects sat straight in a chair, feet slightly apart on the floor. They held the dynamometer with wrist in a neutral position (i.e. in slight dorsal flexion) and elbow in 90 degrees. The opposite upper limb was resting on the lap. The subjects were asked to grip the handle as hard as they could for 3–5 seconds; throughout this time the study nurse urged the subjects to do their best. The second measurement was conducted 30 seconds later. More information on the test can be found in the TOIMIA-database (in Finnish).

The chair stand test

The chair stand test (Csuka & McCarty 1985, Guralnik et al. 1994) was conducted with a standard chair with no arm rests, seat height 43–45 cm from the floor and seat depth 39–43 cm. The back of the chair was placed against a firm table or wall. The subjects were asked to sit on the chair, with arms crossed in front of the chest and feet on the floor and slightly apart. From this position, they were asked to stand up once. If this did not succeed or the subjects had to use their hands to support the rising, the test was ended and the performance recorded. If the subjects managed to get up without using hands, they were asked to get up and sit down 10 times as quickly as possible. A split time was taken at five stands and timekeeping was ended after 10 stands. The test was discontinued if it was not completed in 120 seconds, or if it posed any risk to the subject's safety. Contraindications for the 10 times repetitive test were myocardial or cerebral infarction within 3 months, or blood pressure higher than 200/120 (or 180/110 if accompanied with coronary heart

disease, other cardiac disease or transient ischemic attack). More information on the test can be found in the TOIMIA-database (in Finnish).

The joint functions tests

From the original joint function test protocol (Sievers et al. 1985) only two tests were used, squatting and abduction of the upper arms. In addition, internal rotation of the shoulder joints was added. The tests were conducted for persons aged 55 years or older.

Squatting. The subjects were asked to squat and stand up. Light support for balance from a table edge was allowed. Performance was rated as 1) normal, if squatting down (thighs at horizontal level, or thighs and calfs touching) and getting up without support was successful; 2) restricted, if some support was needed or if the squat was not full (thighs not reaching horizontal level); 3) failed, if the subject could not stand up without using notable support or knees were flexed less than 45 degrees (Sievers et al. 1985).

Abduction of the upper arms. The subjects were asked to abduct both arms towards the ceiling. Each arm was rated separately: 1) normal, if the arm was raised up (near the head, 30 degrees short of vertical line was accepted); 2) restricted, if the abduction was above horizontal level but not all the way up; 3) failed, if the abduction remained below horizontal level (Sievers et al. 1985).

Internal rotation of the shoulder joints. The subjects were asked to rotate one arm at a time behind the back to reach with fingers the lower corner of the opposite scapula. The performance was rated as 1) normal, if scapula was reached; 2) restricted, if the fingers reached only the waist level; 3) failed, if the movement was less (Hoppenfeld 1976).

18.2 Vision and hearing

Hannu Uusitalo, Alexandra Mikhailova, Päivi Sainio and Seppo Koskinen

Vision was assessed on the basis of self-report and with vision charts and hearing on the basis of self-report only.

Self-reported vision and hearing

Vision and hearing were assessed in Questionnaire 1 by the question: *"How do you manage the following activities nowadays? ..."*, with four response categories (without difficulties, with minor difficulties, with major difficulties, not at all). For vision the question continues as "*... to read an ordinary newspaper print (with or*

without glasses)", and for hearing as "*… to hear what is said in a conversation between several people (with or without a hearing aid)*".

Visual acuity tests

Binocular visual acuity was measured using well illuminated distant and near vision charts (Oriola). Eye glasses or contact lenses were allowed if normally worn by the subject. Illumination was adjusted using the lights at each examination site and an additional spotlight. If the test was not performed the reason was recorded in the data collection form, e.g. refusal. The same tests were conducted in the Health 2000 Survey (Rudanko and Koskinen 2008) and in the Health 2011 Survey (Sainio 2016).

Before the tests, all subjects were asked the following questions (yes/no): Have you had refractive surgery (to improve eyesight)? Have you had cataract surgery? Do you usually use spectacles or contact lenses when reading? In addition, information on whether the subjects were wearing their own spectacles during the near and/or distant vision examination was recorded.

For the examination of near vision, the subjects held the chart at the distance where they could see it best. The subjects were asked to indicate the last line that they could still easily read. Testing was started on the line above by asking the subjects to read the letters on that line. If the subjects correctly identified all those letters or at least four letters of five, they were asked to move one line down towards smaller letters. The result was the lowest line on which the subject correctly identified at least four letters. If the subject was unable to see even the biggest letters, the result was entered in the data collection form as "*did not see any of the lines*".

For the examination of distant vision, the subject sat in a chair at four meters' distance from the chart, with eyes at the level of the chart. As in the near vision test, the result was entered as the lowest line on which the subject correctly identified at least four letters. If the subject was unable to see even the biggest letters, the result was entered in the data collection form as "*did not see any of the lines*".

If the result (visus value) in the distant vision examination was $\leq$0.50, the test was carried out again using a pin hole test for both eyes separately. In the pin hole test the subjects were first asked to look through a pinhole and identify the letters on the line with the smallest letters that they could recognize in the previous phase. If they identified at least four letters on that line they were asked to move one line down towards smaller letters. If the vision improved in either eye compared to the distant vision test, the result of the pin hole test was entered as the lowest line on which the subject correctly identified at least four letters. Furthermore, the subjects were asked whether they had had their eyesight examined within the last year. Subjects with visual acuity values of 0.40 or less for near vision or 0.80 or less for distant vision were urged to contact an optician or eye specialist. If distant vision acuity was 0.25 or lower, the subjects were asked about rehabilitation services for

the visually impaired and recommended to visit an ophthalmologist or contact the Federation of the Visually Impaired.

18.3 Cognitive functioning

Annamari Tuulio-Henriksson and Päivi Sainio

In the health examination, cognitive functioning was assessed with selected tasks from the CERAD neuropsychological test battery, originally developed for screening early phases of dementia and memory disturbances (Morris et al. 1989, Hänninen et al. 1999, Pulliainen et al. 1999, Hänninen et al. 2010). The cognitive functions assessed were verbal fluency, and encoding and retaining verbal material. Furthermore, the subjects were asked to self-evaluate their memory, ability to concentrate and ability to learn new things.

Cognitive tests

The tests were not performed if the subject's native language was other than Finnish or Swedish, or if the subject had severe cognitive dysfunction that hindered the testing. The reason for not performing the test or refusing from it was recorded in the data collection form. The same tests were conducted in the Health 2000 (Suutama et al. 2008) and Health 2011 (Tuulio-Henriksson & Sainio 2016) surveys as well.

Verbal fluency

In the test of verbal fluency, the subject was asked to say aloud as many animals as possible in one minute. The study nurse measured the time with a stopwatch and kept a tally to count the number of correctly and incorrectly cited animals, as well as any repetitions of the same animal, which all were recorded separately in the data collection form.

Word list memory and word list recall

The subjects were shown 10 words one after another that they were to read aloud and memorize. After this, the subjects were given 90 seconds to say aloud the words they were able to recall. Then, they read the words again, in a different order, and this was repeated also a third time. After each round the subjects said aloud the words they recalled in 90 seconds. The number of words correctly and incorrectly recalled after each showing was recorded in the data collection form. If the subject

was unable to read aloud the words, the study nurse read them out loud. The delayed recall of the words was assessed by asking the subjects to repeat the same words about five minutes later, after the grip strength test and chair stand test had been conducted.

Self-evaluation of memory, concentration and learning new things

Self-evaluation of memory, concentration and learning new things was enquired in Questionnaire 1. The respondents were asked to evaluate their ability in these functions using a 5-point response scale (very well, well, adequately, poorly, very poorly). The same questions were used previously in the Regional Health and Wellbeing Study (ATH, Murto et al. 2017). It was also used in the interview of the Health 2011 Survey in a slightly different form (Tuulio-Henriksson & Sainio 2016).

18.4 Social functioning

Tuija Martelin, Tarja Nieminen, Päivi Sainio, Seppo Koskinen and Pirjo Tiikkainen

Social functioning can be defined as ability to act in close relationships and in different communities. For example, a person is able to interact with social networks, to participate and to experience social inclusion. The concept of social functioning has not been fully established. Due to this, it has been assessed using proxy indicators which have been used in measuring other related concepts, such as social capital and social inclusion. In general, measures are classified into two categories: those describing interpersonal relationships and those indicating social participation. (Tiikkainen & Pynnönen 2018).

The FinHealth 2017 Study includes several questions that can be used to map both dimensions of social functioning. The first mentioned dimension is measured by questions of communication with relatives and friends, the existence of a close friend and feelings of loneliness as well as the availability of social support. In addition, interpersonal trust and trust in reciprocity are connected with the functioning of social networks. Moreover, they are usually considered to be the key elements of social capital, along with social participation. Living alone, helping others (see Chapter 18.9) and satisfaction with one's personal relationships (part of the EUROHIS-Qol 8-item index measuring quality of life, see Chapter 10) are also related to interpersonal relationships. Activity in hobbies and recreation describe social participation. Most of the questions measuring social functioning were also included in the Health 2011 Survey.

Communication with friends and relatives was asked with a question "How often are you in contact with your friends and relatives who do not live in the same

household with you?". Both face-to-face contacts and contacts by phone or internet were asked. The five options were 'Daily or almost daily', '1–3 times a week', '1–3 times a month', 'less than once a month' or 'never' (Questionnaire 2). In addition, the existence of close friends was asked "Do you currently have a close friend with whom you can talk confidentially about almost any issues concerning yourself?" with answer options 'I don't have any close friends', 'I have one close friend', 'I have two close friends' and 'I have several close friends' (Questionnaire 2). Loneliness was examined with a question "Do you ever feel lonely?" The response options were 'Never', 'Very rarely', 'Sometimes', 'Fairly often' or 'All the time' (Questionnaire 1).

Social support was measured in Questionnaire 2 by means of two questions, based on the more extensive Social Support Questionnaire developed by Sarason et al. (1983). The respondents were asked to estimate their possibilities to get help from people close to them when in need of help or support. Several sources of help were listed (husband, wife or partner; other relative; friend etc.), and the respondent could choose several options or tick "no one". The two items were: 1) "Who do you think really cares about you no matter what happened to you?", and 2) "From whom do you get practical help when needed?".

Trust is an essential part of social communication and connectedness. It was measured with indicators of interpersonal trust and trust in reciprocity. Trust in other people was examined with a statement "It is better not to trust anyone", which could be answered either 'Absolutely agree', 'Somewhat agree', 'Somewhat disagree' or 'Absolutely disagree'. Trust in reciprocity was examined with a statement "Most people would not want to go through the trouble to help other people" with the same answer options. Both statements were included in Questionnaire 2, and they were selected to the FinHealth 2017 form among the eight items of the short version of the Cook–Medley hostility scale (Cook & Medley 1954, Greenglass & Julkunen 1989).

Social participation was inquired in Questionnaire 1 by asking "Do you participate in the activities of any club, association, hobby group or religious or spiritual community (e.g. sports club, residents' association, political party, choir, parish)?" The options were 'No', 'Yes, occasionally' or 'Yes, actively'. Moreover, Questionnaire 2 included a question concerning leisure time activities: "How often do you practice the following activities on an average?" with the response options 'Every day or during most days', 'Once or twice a week', 'Once or twice a month', 'Once or a few times a year', 'Less frequently or never'. This battery of questions included six items, all more or less relevant from the point of view of social participation: club or society activities (including posts of trust in society); theatre, movies, concerts, art exhibitions, sport competitions etc.; studying; church or other religious activities; exercise, hunting, fishing, gardening or other outdoor activity; and handicrafts, playing music, singing, photo-graphing, painting, collecting (e.g.

stamps). A corresponding set of questions has been included in several earlier Finnish health surveys (e.g. Aromaa et al. 1989).

18.5 Global Activity Limitation Indicator

Päivi Sainio

Global Activity Limitation Indicator (GALI) is a comprehensive survey instrument which is used by EU and its member states as a measure of participation restrictions (Robine & Jagger 2003, Bogaert et al. 2018). It is also the measure underlying the European indicator Healthy Life Years (HLY). Originally GALI was a single question, but due to its complexity a routed version (comprising two questions) is currently recommended. A recent review has shown the concurrent and predictive validity as well as reliability of GALI to be good (van Oyen et al. 2018). However, its comparability between countries and translation validity have been questioned (Sihvonen et al. 2017), and it has not yet been validated in the Finnish population.

GALI is included as a measure of disability in many European surveys, such as the European Health Interview Survey (EHIS), Survey on Income and Living Conditions (SILC) and the Survey of Health, Ageing and Retirement in Europe (SHARE). In Finland, it has been added to the National FinSote Survey and the FinHealth 2017 Study.

The two-part GALI question was included in Questionnaire 1, after the questions on self-perceived health and longstanding illness or health problem. The first part of the question was "Are you limited because of a health problem in activities people usually do? Would you say you are…" with three response alternatives (severely limited, limited but not severely or, not limited at all). If the respondent indicated being limited, the question continued as "Have you been limited for at least the past 6 months?" (yes/no). Those having any limitations (first question's options 1 and 2) that had lasted at least 6 months (second question, option 1) are classified as having longstanding activity limitation. This is also the basis for counting Healthy Life Years.

18.6 Work ability

Päivi Sainio and Seppo Koskinen

The questions concerning work ability were presented in the Questionnaire 1 and Questionnaire 2. Some of the instruments are described in more detail by Gould et al. (2008) in the report *"Dimensions of Work Ability"*, and in the TOIMIA-database (in Finnish, Gould et al. 2015). The questions were presented to all respondents

regardless of age or employment status (with instructions to answer according to the most recent job if not employed at present). Most of the questions were included also in the Health 2000 and Health 2011 surveys (Aromaa 2008; Gould et al. 2016).

Work ability estimate

In the three-level assessment of work ability, the participants were asked to assess their current work ability regardless of whether they worked or not (Questionnaire 1). The options were 1=completely fit for work, 2=partially unable to work, and 3=completely unable to work. The question originates from the Mini-Finland Survey (Aromaa et al. 1989) and it has thereafter been included in many health surveys, e.g. Health 2000 and Health 2011.

Work ability score

In Questionnaire 1, the respondents were asked to compare their current work ability to their best lifetime work ability on a scale from 0 to 10, where a score of 0 represented full work disability and a score of 10 indicated work ability at its best. This question was also included in the Heath 2000 and Health 2011 Surveys, and it is part of the Work Ability Index (WAI, Tuomi et al. 2006); however, not all questions in the WAI were included in the FinHealth 2017 Study.

Other questions on work ability and working conditions

Questionnaire 2 included four questions on work ability. Sickness absence was inquired with a question “Over the past 12 months, how many whole days have you been absent from work or unable to do your chores due to illness?”. Furthermore, the respondents were asked to assess their current work ability in relation of the physical as well as psychological demands of their job with a 5-point response scale ranging from “very good” to “very poor”. These three questions are also part of the Work ability index. The fourth question in this section was “In terms of your health, do you feel that you will be able to work in your current profession until retirement age? If you are not employed at present, please answer as for your most recent job”, with five response alternatives (I am already retired, no, probably no, probably yes, and yes). The three first questions were also included in the Health 2000 and Health 2011 Surveys.

Working conditions were inquired with the following propositions, "I can make many independent decisions in my job" and "I don’t have enough time to get my work done", with a 5-point response scale ranging from “completely agree” to “completely disagree” (Karasek 1985). Modified versions of these two questions were also included in the Health 2000 and Health 2011 Surveys.

18.7 Basic and usual activities of daily living

Päivi Sainio

The questions on basic and usual activities were presented to persons aged 70 years and older (Questionnaire for persons aged 70 years or older). Some changes and reductions of the items were made compared to the Health 2011 Survey. The items were modified from the Katz index of ADL and the Lawton IADL scale (Katz et al. 1963, Katz et al. 1970, Lawton and Brody 1969), and some of them were already used in Mini-Finland Survey in 1978–80 (Aromaa et al. 1989). The ADL (activities of daily living) items were dressing and undressing, cleaning teeth and mouth, and moving in the apartment from one room to another. The IADL (instrumental activities of daily living) items were: cooking or heating meals; heavy cleaning, e.g. carrying and beating carpets or washing windows; getting out of one's apartment (to run errands, to get some fresh air); and shopping. The response categories were: without difficulties, with minor difficulties, with major difficulties, not able. Furthermore, the respondents were asked about the use of internet by themselves or with assistance by others.

18.8 Living environment and housing

Päivi Sainio

Information on living environment and housing was obtained through the Questionnaire for persons aged 70 years or older. There were questions on the place of residence (a regular private residence; a sheltered housing unit, etc.), and on various features of the living environment and apartment of the respondent, and whether these features were experienced as hindering. Questions on facilitating factors and safety equipment at home were also asked from persons aged 70 years or older. Two questions concerned the respondent's future plans on living arrangements and factors affecting the decisions regarding the living arrangements.

18.9 Need and use of assistance and helping others, use of assistive devices

Päivi Sainio

In Questionnaire 2, the need of help was inquired with a single question "Do you need and do you get help for your everyday activities due to your impaired

functional capacity?" with five response alternatives (I do not need help and do not get it; I would need help but do not get it; I get help, but not enough; I get enough help; I get more help than I need). Corresponding information was collected in the Health 2000 and Health 2011 Surveys, using more detailed questions.

More specific questions on need and use of assistance or help in everyday activities (for example household work, bathing, shopping etc.) were placed in the Questionnaire for persons aged 70 years or older. For each activity it was inquired if the respondent received help, and from whom they received it. Also unmet needs for help were inquired. The last question inquired how often the respondents received help.

Information on helping others was obtained through Questionnaire 2. First the respondents were inquired if they provided regular help for people not living in their household. Those helping such persons were then asked in what activities they provided assistance, and to whom (parents, grandparents, children, etc.), and how often. In addition, they were asked if they were a formally appointed caregiver of a person who is not a member of their own household.

Secondly, questions about helping a person living in the same household were presented. These questions gathered information on who was helped, how much, and whether the respondent was a formally appointed caregiver for this person, or if she/he in general had ever been an informal caregiver.

The use of assistive devices was assessed in the Questionnaire for persons aged 70 years or older. The questions concerned assistive devices for vision, hearing, and mobility.

19 Use of health and social services and experiences from primary care

Päivikki Koponen and Anna-Mari Aalto

Most questions on health services in the FinHealth 2017 questionnaires were modified versions of questions included in previous Finnish surveys (Health 2000, Health 2011, FINRISK). Many of these questions were modified to meet the needs of evaluating the social and health care reform in Finland and also to simplify the original Health 2000/2011 interview questions for the self-administered Questionnaire 1 and Questionnaire 2. A few questions were in the same format as in the previous FINRISK Studies. Questions on social services were limited to one question on services related to alcohol use and questions for those aged 70 and over (Questionnaire for persons aged 70 years or older).

In Questionnaire 2 the respondents were first asked about the number of ambulatory visits to a doctor due to illness during the past 12 months. A corresponding question was presented on clinic or home visits by a nurse (a public health nurse or other). Questions on health service utilization concerned also the organization where the respondent primarily seeks medical services: health centre, occupational or student health care, hospital outpatient clinic or other. The respondents were also asked about their experiences on this primary care facility (e.g. access, communication, participation in decision making regarding own care). There was one question on having been to physiotherapy on a doctor's referral during the past 12 months with options "no" or "yes".

A series of questions on the use of dental care during the past 12 months was also included in Questionnaire 2 (see Chapter 15). The questions on health service use because of mental health problems as well as the questions on health or social services related to alcohol use were cut down compared to the previous Health 2000/2011 Surveys due to less focus on mental health in the FinHealth 2017 Study compared to the previous surveys. The respondents were only asked if they had used any such services in the past 12 months or not. The question on services related to alcohol use specified the use of services because of own problems or somebody else's problems.

Questions on preventive services were also modified to integrate the Health 2000/2011 and FINRISK questions. The respondents were asked about their participation in any health examinations (for example in occupational health care, to get a driving license, or at maternity clinic): the five answer options ranged from

during the last 6 months to never. There were also questions if the respondent's risk for diabetes or risk for heart disease had been assessed during the past 12 months with risk tests or risk calculators.

The questions on screening examinations were included in Questionnaire 1 in the context of the questions on chronic diseases, as in the previous FINRISK Studies and the comparability of these questions to the previous questions in the Health 2000/2011 Surveys is very limited. The respondents were asked if they had ever had their blood sugar level measured and when was the last time, with six answer options ranging from during the last 6 months to never or "I do not know". Similar questions were presented about having cholesterol levels checked and having blood pressure measured.

Questions on infectious disease screening (HIV and chlamydia tests) and on cancer screening were presented at the end of Questionnaire 2 after questions on sexual and reproductive health. The slight changes in wording and the fact that the questions were asked in a different context, limit the comparability with the Heath 2000/2011 questions on screening. Questions targeted to women covered mammography (X-ray of the breasts), ultrasonic examinations of the breasts and cervix cancer screening (PAP smear). A question on PSA blood test to screen prostate cancer or enlargement of the prostate was targeted to men. These questions on screening participation were not specified to organized screening, i.e. they include sporadic tests. The answer options for the questions on screening ranged from "yes, in the past 12 months" to "never".

The Questionnaire for persons aged 70 years or older also included questions on receiving help from a municipal or private service provider, non-governmental organization, etc. over the past 12 months in eight different activities of living, and the frequency of receiving such help. This questionnaire also included questions inquiring if the respondent had been adequately provided with services such as home care, rehabilitation, support for informal care and support in getting and using assistive devices, services for the disabled, transport services, and evaluation of needs for services. The answer options included no need, would have needed but did not receive, has received but the service was not adequate and has received and it was adequate.

20 Contents of sub-studies in the FinHealth 2017 Study

20.1 The National FinDiet 2017 Study

Niina Kaartinen, Heli Tapanainen, Heli Reinivuo, Heikki Pakkala, Sanni Aalto, Susanna Raulio, Satu Männistö, Tommi Korhonen, Suvi Virtanen and Liisa Valsta

The National FinDiet Studies conducted by the Finnish Institute for Health and Welfare have monitored the dietary habits and nutrient intake of the adult population in Finland since 1982. In the year 2017, the FinDiet Study was also part of the pan-European EU Menu food consumption data collection effort of the European Food Safety Authority (EFSA) among adults, EFSA contract OC/EFSA/DATA/2015/03 CT 1_EU Menu Finland_Adults (Valsta et al. 2018, European Food Safety Authority 2014).

The methodology of the FinDiet 2017 Study is described in detail by Valsta et al. (2018). The methodology followed the recommendations and protocols of the EFSA Guidance Document on the EU Menu Methodology (European Food Safety Authority, 2014). The data collection was carried out at individual level on two non-consecutive days using an open-ended, 24-hour computer-assisted dietary recall interview method. The first interview was administered as a computer assisted personal interview (CAPI) at the study site, and the second interview as a telephone administered 24-hour dietary recall (CATI) from the central office. The entire survey methodology, including the newly developed CATI protocol was piloted in August-September 2016. The pilot sample comprised 200 subjects living in the city of Helsinki.

The sampling of the survey subjects is described in Chapter 2.3. The FinDiet Study sample (n= 3099) was a 30% sub-sample of the FinHealth 2017 Study sample. The age range of the participants in the FinDiet Study was 18–74 years. Of the eligible sample, 59% attended the field survey, and 57% provided an acceptable first 24-hour recall interview. Eventually, 53% of the invited subjects (n=1655) provided both interviews acceptably (Valsta et al. 2018).

A group of 10 trained dietary interviewers with a minimum of B.Sc. degree in Human Nutrition served as interviewers in the data collection. Of the interviewers, 6 carried out the CAPI interviews during the field survey and 4 carried out the CATI interviews. In addition, 3 trained replacements were available as needed. The interviewers were recruited during autumn 2016 and underwent uniform two-week training on the interview methodology in January 2017. Eventually, the data

collection for the CAPI interview took place from January 30 until May 19, 2017 and for the second, the CATI interview from February 8 until October 9, 2017, so they covered all the four different seasons.

The two 24-hour dietary recall interviews took place at a minimum of 8 days apart. The survey calendar was organized to be representative for weekdays (proportion of 5/7) and weekend days (2/7 proportion). In addition to dietary interviews, questionnaire data about food habits were collected, through a food propensity questionnaire (FPQ). The FPQ questionnaire was compiled to include consumption information of less commonly eaten foods to differentiate consumers from non-consumers of selected foods. The list of less commonly eaten foods was part of the EU Menu Methodology (EFSA 2014) requested by EFSA and relevant for risk assessment. It was compiled in collaboration with the Finnish Food Authority (Ruokavirasto). The FPQ also included a question on food supplement use based on the EU Menu Methodology. Also additional questions on selected dietary indicators for domestic monitoring purposes and information on food allergies, based on the request of EFSA, were included in the FPQ questionnaire. All questionnaires were available in three languages (Finnish, Swedish and English).

During the CAPI interviews, portion size assessment was based on a validated country-specific and age-appropriate picture book with 170 portion size picture series (Paturi et al. 2006, Ovaskainen et al. 2008). During the CATI interviews, a shortened picture book with 23 picture series was used. Other portion size assessment aids included household measures, standard portions and commonly used utensils. During the interviews, food identification was facilitated with pictures shown from product catalogues or product web sites.

The dietary software used for processing the 24-hour dietary recall interviews was an updated version of the in-house dietary software FINESSI (Reinivuo et al 2010) utilizing the Release 19 of the National Food Composition Database FINELI®. During the data collection, codes of 1721 basic foods, 3222 recipe-based foods and 1025 dietary supplements were available in the database. The dietary interviewer performed the coding of the food entries immediately during the interview.

The quality assurance of the survey was based on detailed study protocols, regular meetings of the survey management group and the survey planning group, provision and action plan for exceptional occurrences, high quality training of the dietary interviewers, quality checks of the questionnaire data, automatic quality checks and alerts included in the dietary software procedures, monitoring of performed interviews throughout the study (including standardization of interviews), as well as on a careful cross-checking of the data collected.

The reporting of the food consumption was based on 13 main food groups and 81 sub-groups of foods as consumed and 14 main ingredient groups and 28 sub-groups of ingredients (Valsta et al. 2018). Nutrient intakes were reported for 39 nutrient variables. The food consumption data collection method applied, i.e. two non-consecutive 24-hour dietary recalls, enabled modelling of usual food and nutrient

intakes. Usual food and nutrient intake distributions are necessary for reliable comparison of intakes with the dietary recommendations.

20.2 Physical activity and sleep

Heini Wennman, Arto Pietilä, Harri Rissanen, Tomi Mäki-Opas and Katja Borodulin

The current development in measuring physical activity and sedentary behaviours emphasizes the role of objective measurements of movement over 24 hours, obtained by accelerometers, for example. By 24-hour assessment important aspects of the circadian variation in movement behaviours, including sleep can be obtained. The use of objective devices in large-scale population studies has become easier and especially wrist-worn devices have shown great potential in increasing the compliance to measurements. Regardless of technological development, there is still a need for supplementing the information collected by objective measurements using questionnaires.

Global recommendations of physical activity for health date to 2010 and encourage to at least moderate intensity physical activity in 10 minute-bouts for at least 150 minutes a week (WHO 2010). The guidelines are to be updated in the near future as device-based measurements enable more detailed information about physical activity intensity, volume and bout length, as well as sedentary behaviours and sleep.

As part of the FinHealth 2017 Study, a sub-sample of individuals was invited to the Physical Activity and Sleep sub-study. At the end of the health examination participants were offered a wrist-worn accelerometer to be used for 24 hours during seven consecutive days beginning from the health examination. There were a limited number of accelerometers available for the study, and thus the participants were only offered a device if there was one available at site. Those participants who belonged to the sub-sample but for whom there was no wrist-accelerometer available at the time of their health examination were contacted after their study visit and offered a device (see section Postal invitations).

Objectively measured physical activity

Participants were instructed to use a tri-axial, wrist-worn accelerometer (Actigraph GT9X Link, Actigraphcorp, Pensacola, USA) during 24 hours on seven consecutive days beginning from the health examination. The accelerometer was attached to a wrist-band and placed on the non-dominant wrist by the study personnel at the health examination site. The accelerometer had a display showing the time and

battery life of the device. The study personnel also gave oral and written information on the use of the accelerometer, and marked the starting time for the measurement in the diary. The participants were advised not to remove the device except for swimming, having a sauna or taking a bath. After seven days of use, the accelerometer and diary (see below) were mailed to the Finnish Institute for Health and Welfare (THL) where the accelerometer was downloaded.

Non-wear and sleep diary

Together with the accelerometer the participants received a diary, where they were asked to report the times when they had removed the accelerometer during the measurement days, and the bedtimes and wake-up times for their longest sleep period each day. Participants were instructed to check the times from the accelerometer display. Participants were also asked to rate the quality of their sleep and report the number of awakenings for their sleep period. Those who received an accelerometer by post (see section Postal invitations) were to write down the starting date and time when they took the device in use.

Postal invitations

Participants who belonged to the sub-study, but for whom there were no accelerometers available at the health examination site, were contacted afterwards by phone and offered an accelerometer. The protocol for the measurements was explained to the participant on the phone, and instructions on the use of the device were briefly given. Those who agreed to participate were sent an accelerometer attached in a wrist-band by post, together with a non-wear and sleep diary, written instructions and a prepaid envelope for returning the device. The participant was instructed to take on the device as soon as it arrived, and to wear it on the non-dominant wrist for 24 hours during 7 consecutive days. On the 7th morning the device and the diary were instructed to be sent back to THL where the accelerometer data was analysed.

Accelerometer initialization

The accelerometers were initialized by trained personnel at THL. Accelerometers were initialized by the ActiLife software version 6.3.3. and set to measure at 100Hz without any restrictions (sleep mode disabled). The accelerometers were set to start recording 06:00 in the morning, without any stop time for the measurements. The starting date was chosen to be 2 to 4 days after the initialization day, to account for the time it took to deliver the device to the health examination sites or to the participants mailing address.

Accelerometer downloading

Accelerometers were returned to THL by post. Upon arrival, the accelerometers were downloaded using ActiLife software 6.3.3. The downloading included a gt3x file and an agd file as explained below. Downloaded data files were named by subject ID that was verified on the diary. In cases when a diary was not returned with the accelerometer, the subject ID was checked from the health examination participation list, by comparing the device's serial number to the serial number for the device given to the participant.

The accelerometer data are primarily stored in gt3x data files that are a compressed data format including the raw acceleration data in binary format and the metadata for the device. The Gt3x files can be read by the ActiLife software or by a package for the statistical software R (read.gt3x). The agd files are count-based data representing 60 second intervals (epochs). The agd files can only be used in the ActiLife software for analysis. For each participant the information about the starting and ending times for their measurement period was linked from the diary to the agd-file in ActiLife.

Non-wear and sleep diary

The information in the diaries was manually entered into an electronic data portal designed for data collection at THL. The subject ID, accelerometer serial number and the bar code were entered to secure the coupling of the diary information to the right participant. Diary data entering was done continuously during the data collection phase and data were regularly stored as SAS data files and checked for abnormalities and storing errors.

20.3 Urine samples

Laura Råman, Liisa Valsta, Katja Borodulin, Iris Erlund, Petra Arohonka and Jouko Sundvall

Spot urine collection

A random spot urine sample was collected from subjects aged 25–74 years who belonged to the FinDiet sub-study (n=1546, participation rate 55.2% of the eligible sample, 90.9% of those who participated in the health examination). No specific collection instructions were given to the participants and the previous urination time was not recorded. Samples were carefully mixed and transferred into 1 ml aliquots

in cryo-tubes at the study site. Sample tubes were frozen to -20 °C immediately after handling.

24-hour urine collection

In preselected study sites (Table 20.3.1), a 24-hour urine sample collection was carried out in a sub-set of the FinDiet participants aged 25–74 years (n=380, participation rate 24.6% of the eligible sample, 40.6% of those who participated in the health examination, 85.6% for those who agreed to take the urine collection canister home for later collection at home). Subjects were asked to perform the urine sample collection on Sundays and the sample was returned to the study site on Monday morning. Subjects received two urine sample collection canisters as part of laboratory routine and were instructed on how the sample should be collected. Subjects were also given written instructions and a form where the details and possible deviations of the sample collection protocol were recorded (i.e. time and volume of sample collection, as well as information on abundant perspiration, sick days, menstruation and medication use during the sample collection day and in long-term). Subjects were asked to keep the urine collection canisters in a cold place, e.g. in the fridge, but to avoid freezing of the sample.

When the subjects returned the urine samples to the study site, the amount of urine was measured and the sample was carefully mixed before the storage samples were collected. A total of four sample aliquots were divided each containing approximately 1.5 ml of urine. All the samples were stored in -20° C immediately after the handling.

Table 20.3.1. Study sites (cities and towns) for the urine sample collection.

	Locations	Dates for 24-h urine sub-sampling*
Team 1	**Helsinki**	
	Helsinki	31.1.-22.3., 23.3.
	Espoo	24.3.-13.4.
	Vantaa	18.4.-5.5.
Team 2	**Lahti**	
	Lahti	31.1. - 8.2.
	Riihimäki	16.2.-27.2.
	Heinola	28.2.-9.3.
	Luumäki	5.4.-12.4.
	Hamina	13.4., 18.4.-25.4.
Team 3	**Tampere**	
	Tampere	31.1-17.2.
	Seinäjoki	17.3.-29.3.
Team 4	**Turku**	
	Turku	31.1-16.2.
	Kaarina	2.5.-8.5.
Team 5	**Oulu**	
	Oulu	31.1. -10.2.
	Raahe	13.2.-20.2.
	Haukipudas	21.3.-27.3.
	Utsjoki	5.4.-13.4.
Team 6	**Kuopio**	
	Joensuu	31.1-6.2.
	Kuopio	23.2.-2.3.
	Siilinjärvi	3.3.-13.3.
	Iisalmi	14.3.-21.3.
	Polvijärvi	27.3.-3.4.

* Participants who belonged to the sub-sample and had their health examination on these dates were given instructions. Return of the collected urine was made on the next two subsequent Monday mornings at the study site

Spot and 24-hour urine collection validation

Together with the 24-hour urine sample collection, a small validation sub-study was conducted (n=167, participation rate 24.3% of the eligible sample, 41.8% of those who participated in the health examination, 78.4% for those who agreed to take the urine collection canister home for later collection at home). Subjects in preselected study sites (Table 20.3.1), were asked to collect a random spot sample, as part of their 24-hour collection, to a separate collection container and return this sample with the rest of the collected urine in another container. The subjects were asked to record the time of the random spot sample collection. The volume of these random spot samples was measured in the laboratory and handled separately. Separated aliquots were pipetted and frozen immediately (in -20°C) after the handling.

Storage, shipment and quality assurance of urine samples

The storage and shipment of the urine samples followed the same protocol and principles as for the blood samples (see Chapter 6.3). Further, similar quality assurance protocol was applied with urine samples as described in Chapter 6.4 for blood samples.

Laboratory measurements

The laboratory measurements were performed at the biochemistry laboratory of the Genomics and Biomarker Unit at THL, Helsinki. The laboratory measurements carried out for urine samples were iodine, sodium, potassium, chloride, microalbumin and creatinine concentrations. Sodium, potassium, chloride, microalbumin and creatinine measurements were performed on a clinical chemistry analyser Architect ci8200 (Abbott Laboratories, Abbott Park, IL, USA). Urinary iodine concentration measurements were determined by inductively coupled plasma - mass spectrometry (ICP-MS) using an Agilent 7800 ICP-MS system (Agilent Technologies Inc., Santa Clara, CA, USA).The biochemistry laboratory (T077) is accredited by the Finnish Accreditation Service, FINAS and it fulfils the requirements of the standard SFS-EN ISO/IEC 17025:2005. Urinary iodine concentration method has been added to the scope of accreditation on 12/2017. The determinations for urine samples were carried out from frozen samples at the end of 2017. Table 20.3.2 provides more detailed information concerning the methods used.

For standardizing the measurements, the laboratory has taken part in the Ensuring the Quality of Urinary Iodine Procedures Program (EQUIP) organized by the Centers for Disease Control and Prevention CDC, Atlanta, USA and External Quality Assessment Schemes organized by Labquality, Helsinki, Finland. The quality of the results of the series of analysis was ascertained by using controls, which were used to determine inter assay coefficients of variation (CVs). During the

course of the measurements in 2017, the precision between series expressed as coefficients of variation (CV%), the accuracy of the methods (mean bias% ± SD) and the traceability of the methods are demonstrated in the Table 20.3.2. The bias indicates the difference between the laboratory's own result and the target value of the quality assessment sample and describes the laboratory's systematic error.

Table 20.3.2. The precision between series, the accuracy of the methods and the traceability of the urine methods.

Assay	Method	CV% ± SD, $(N)^1$	Bias% ± SD, $(N)^2$	Traceability
Microalbumin	Immunoturbidimetric, Abbott	2.7 % ± 1.4 (2)	+ 3.4% ±2.5 (2)	ERM-DA470/IFCC
Chloride	Ion-selective electrode diluted, Indirect, Abbott	0.6 % ± 0.1 (2)	- 1.0 (1)	NIST SRM 918 NIST SRM 919
Creatinine	Enzymatic, Abbott	1.1 % ± 0.1 (2)	+ 2.5% ±0.3 (2)	NIST SRM 914
Iodine	ICP-MS	3,6 % ± 0.1 (3)	- 7,6% ±2,2 (4)	NIST SRM 2670a NIST SRM 3668 Level 1 and Level 2
Potassium	Ion-selective electrode diluted, Indirect, Abbott	1.2 % ± 0.4 (6)	- 0.4 (1)	NIST SRM 918 NIST SRM 919
Sodium	Ion-selective electrode diluted, Indirect, Abbott	0.6 % ± 0.0 (2)	- 1.7 (1)	NIST SRM 918 NIST SRM 919

CV = interassay coefficient of variation; SD = standard deviation; $(N)^1$ = number of different controls; $(N)^2$ = number of quality assessment samples

20.4 Eastern Finland Study

Katja Borodulin, Laura Råman and Tiina Laatikainen

The Eastern Finland Study was carried out as an additional sample to increase the sample size in the regions of North Karelia and North Savo. Larger sample size enabled better local representation. The history of risk factor surveys in North Karelia and North Savo goes as far back as to year 1972 and the increased sample size enables us to analyse the longer trends utilizing also the National FINRISK 1972–2012 Studies (Borodulin et al. 2018). The original FinHealth sample comprised 618 subjects in North Karelia and 515 in North Savo and the additional sample 1400 subjects in North Karelia and 332 in North Savo (Table 20.4.1). The additional sample covered men and women aged 25 to 74 years of age in the same locations as in the FinHealth 2017 Study. One additional town of Kitee was included to improve regional representation. The Chapter 2.3 for sampling provides more detailed information on this sample.

Table 20.4.1. Sample sizes by study locations in the Eastern Finland Study that was part of the FinHealth 2017 Study.

Study locations	Health examinatio dates	FinHealth 2017 sample size (n)	Additional Eastern Finland sample size (n	Combined FinHealt and Eastern Finlan sample size (n)
North Karelia		618	1400	2018
Joensuu	21.4.-9.5.	102	534	636
Juuka	18.5.-24.5.	172	228	400
Kitee	7.6.-13.6	0	182	182
Lieksa	30.5.-6.6.	172	228	400
Polvijärvi	10.5.-17.5.	172	228	400
North Savo		515	332	847
Iisalmi	14.6.-16.6.	172	107	279
Kuopio	11.4.-20.4.	171	118	289
Siilinjärvi	11.4.-20.4.	172	107	279

The study design followed closely the FinHealth 2017 Study design (Figure 20.4.1), including also the recruitment procedure and data collection. Core measurements were anthropometric measurements (height, weight, body composition), blood pressure measurements, and blood draws. The blood draw tubes (Figure 20.4.2.) and aliquote tubes (Figure 20.4.3.) were slightly different from the main FinHealth 2017 Study. Self-reported information was collected through Questionnaire 1 and Questionnaire 2 and the FFQ. The contents of these questionnaires were identical to those collected in the FinHealth 2017 Study. There were no sub-studies included in this additional data collection. The two study nurses (Examination Room 1 and 2) were the same persons as in the FinHealth 2017 Study and the bioanalyst (Examination Room 3) was recruited and trained separately. Training for the Eastern Finland Study was organized on April 10, 2017 by the study coordinators from the central office. There were also trained substitution personnel available for acute sick leaves, similarly as organized in the FinHealth Study.

The participants were reminded if they had not confirmed their examination time beforehand. Health examination took on average 40 to 45 minutes for the participant. There were examination times available starting from 7.30 a.m. until 18 p.m. The participant could switch the time online or by phone. The participants arrived in a fasting state (minimum 4 h) and visited all examination rooms during the visit. The Participants were instructed to fill in Questionnaire 1 before arriving at the examination and Questionnaire 2 and FFQ were taken back home to be filled in later and mailed back to the central office. The central office sent reminding letters for those participants who had not filled in the questionnaires in time. Participation rates

were similar to those in the FinHealth participants. See Chapter 4 (Table 4.7) on participation for detailed information.

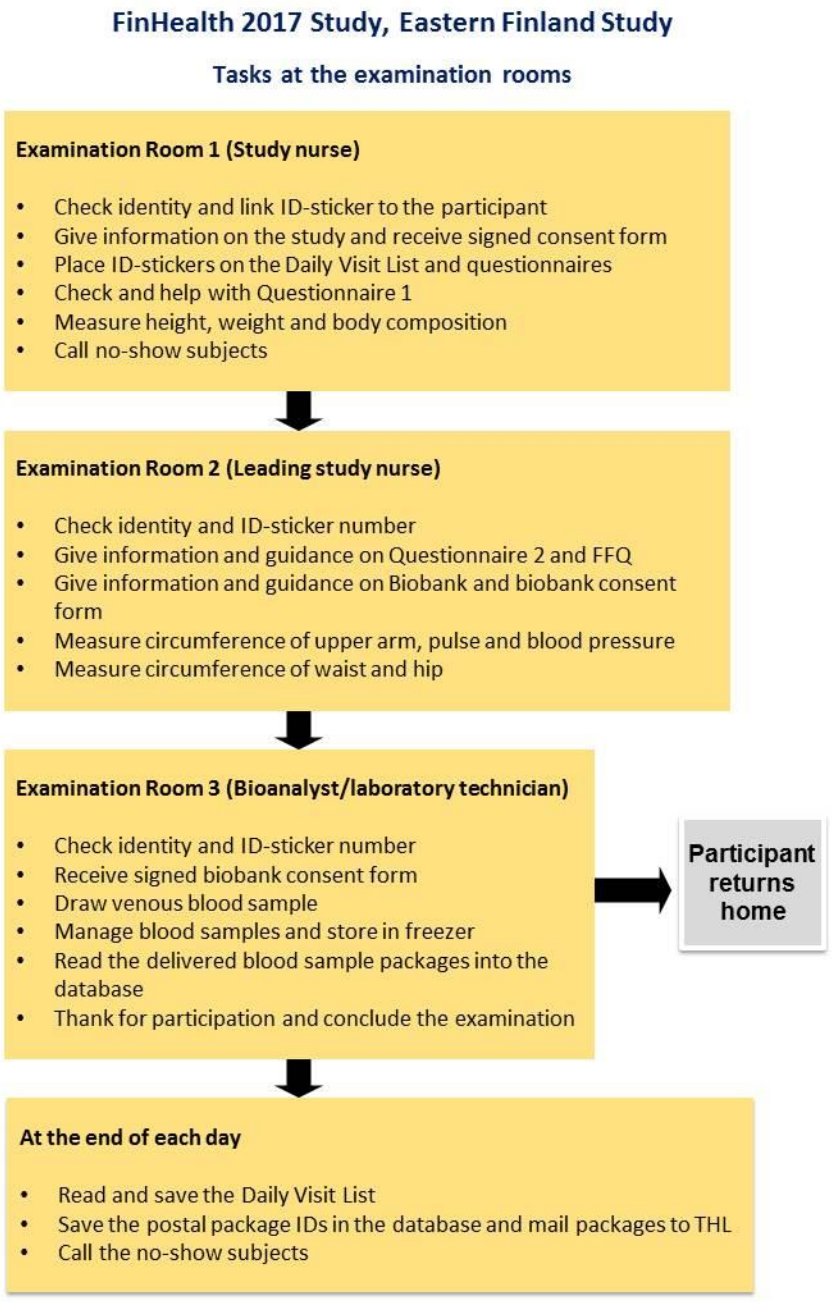
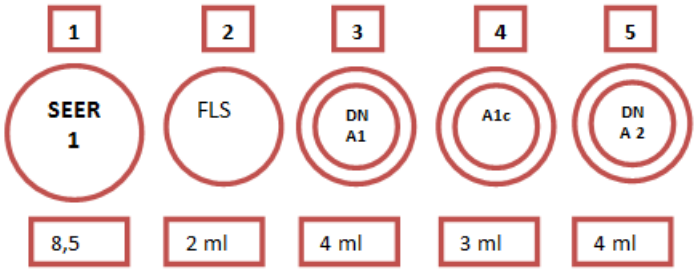


Figure 20.4.1. Study protocol of the Eastern Finland Study.



SEER1: Serum tube
FLS: Fluoride-citrate tube
DNA1/A1c/DNA2: EDTA tube

Figure 20.4.2. Blood tube chart in the Eastern Finland Study in the FinHealth 2017 Study

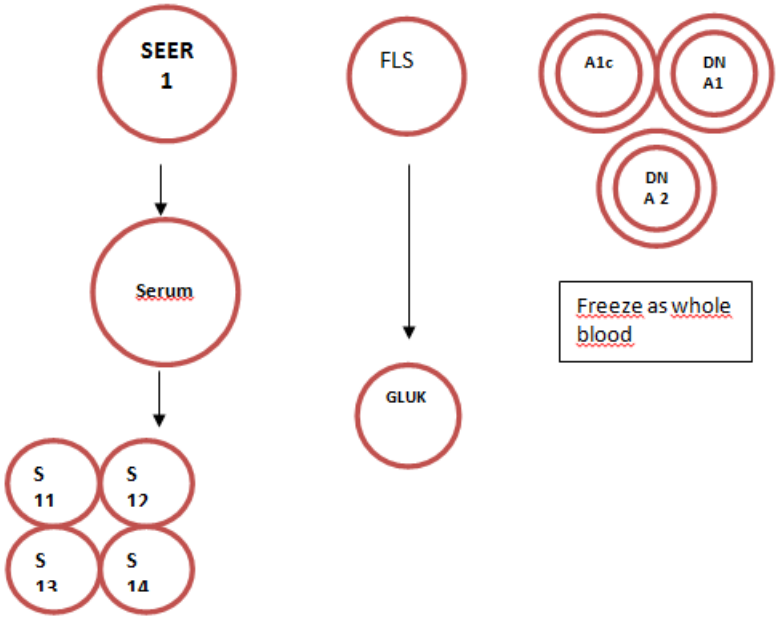


Figure 20.4.3. Aliquote tube chart in the Eastern Finland Study in the FinHealth 2017 Study

21 Feedback and experiences

21.1 Feedback to the participants on their personal results

Katri Sääksjärvi, Katja Borodulin, Liisa Valsta, Niina Kaartinen and Päivikki Koponen

At the health examination site, study personnel gave feedback to participants orally and using a feedback form where they recorded the participant's own results regarding their blood pressure, visual acuity, waist circumference, height, weight, BMI, body fat percentage, hand grip strength, and the chair stand test. The feedback form included reference values and recommendations. Advice for health promotion and follow-up was also given. This feedback form was available in three languages (Finnish, Swedish and English).

Laboratory results were mailed on average six weeks after the health examination (available in three languages). The letter included reference and target values, and it was clearly marked if the participant's personal results differed from these. Participants with laboratory results considered as requiring rapid feedback were contacted by phone by a study nurse or phycisian from THL as soon as the results were available, before the mailed letters. The letter included results on cholesterol values (total, HDL and LDL), triglyserides, lipoproteins (apoA-1 and apoB), blood glucose values (fP-Gluc), liver function tests (S-GT, -ALAT, -ASAT), inflammation levels (CRP), calcium, uric acid (S-Uraat) and kidney function (S-Krea) tests. Following the personal results, the laboratory feedback letter included a short explanation about each test/value as well as advice for healthy lifestyle, follow-up and contacting the local health centre or occupational health service, if needed.

A comprehensive personalized Health Profile was mailed to all participants between January and February 2018. In the Health Profile, the participants received a summary of the results they had already received at the examination or in the letter with their laboratory results, as well as some additional feedback about their own results based on the health examination as well as the information they had given in the questionnaires. The Health Profile focused on factors that can be controlled with health behaviour and personal choices.

The profile leaflets included average results at the population level for persons of the same sex and 10-year age-group as the participants themselves, as well as reference or target values. The participants were adviced to compare their results with their own age and gender group as well as with the reference and target values. The Health Profile also included general advice on health promotion and advice to

contact the local health centre or occupational health service to seek follow-up or advice or care, if needed. The participants were encouraged to evaluate how the general advice could apply to their personal situation and to discuss these with a health professional when needed.

The Health Profile included information about the most common chronic diseases and different dimensions of functioning as well as the most significant factors impacting these. Results of risk tests such as the FINRISK calculator, and the test for type 2 diabetes (or https://www.stopdia.fi/) and test for memory disorders were also included. The Health Profile focused on factors that can be controlled with personal choices. The Health Profile also included new feedback on body composition (fat mass, muscle mass and fat-free mass), information processing (memory tests) and mental health. Furthermore, core results on the use of accelerometry in the sub-sample on physical activity and sleep was given as part of the Health Profile.

All the feedback forms, letters and the Health Profile included contact details for the study nurses and researchers at THL, who gave more information or personal advice if needed. The number of participants who contacted the study nurse regarding their personal results or for additional information was rather low. If needed, the participants were adviced to contact their own physician or a local nurse.

A personalized letter about the results from the FinDiet was sent in July-August 2018. The dietary feedback was based on the two non-consecutive 24-hour dietary recalls, and included results of selected nutrients such as intake of energy nutrients, sugar, dietary fiber, vitamin C, calcium and salt. Regarding food consumption, the intake of vegetables, fruit and berries was reported. The feedback letter also included advice for health promoting dietary choices.

The effort to give feedback to participants was important as giving feedback was used as an incentive when participants were recruited. The possibility to get personal laboratory test results and a Health Profile was mentioned already in the invitation letter, as well as on the internet pages of the FinHealth 2017 Study. In addition, the central office personnel were trained to motivate participation to the health examination when interacting with invitees. The information, that each participant would receive a personal Health Profile and other personal feedback on test results after the survey, was an important motivator in the recruitment of participants.

21.2 Feedback on the Health Profile from the participants

Päivikki Koponen, Katri Sääksjärvi, Katja Borodulin and Minttu Marttila

We were able to receive feedback on the Health Profile from the FinHealth 2017 Study participants. All health examination participants who gave the biobank

consent were invited to a subsequent, new study (the P5 study) that aims to find out whether the study participants benefit from getting access to information related to their genome and metabolism. The P5 study evaluates how the participants perceive the individual information they are provided with and how the received information affects their lifestyles and health behaviour. The P5 study questionnaire included a few feedback questions concerning the Health Profile. Feedback from the P5 study participants can be somewhat positively biased as these persons may be those who are most interested in getting information about their own health. A little more than half of the FinHealth 2017 Study health examination participants returned the P5 questionnaire (n=3437).

The response options for the questions on opinions and experiences (Likert scale statements) concerning the Health Profile ranged from "fully agree" to "fully disagree". The majority of the respondents fully agreed that the Health Profile was interesting and useful, and gave new information about their health. A minority agreed (fully or partly) that the profile was difficult to understand. About a fifth of the respondents agreed that the Health Profile had caused some worries or concern. More than a third of the respondents agreed that the profile had changed their own conceptions or opinions about their health, and/or that the profile encouraged making changes in their lifestyle. In the responses to an open ended question about the most useful and important results, the results of blood tests, measurements of functional capacity and body composition, and the risk tests were frequently mentioned. Many respondents also mentioned the comprehensive description of their health as the most important and useful aspect of the profile.

In another open ended question the respondents were asked to list topics on which they would have preferred to receive more information. Among these, the diabetes and cardiovascular risk tests, memory function and dementia risks, body composition, sleep, vitamins (e.g. vitamin D-levels) or other blood test results (e.g. liver function, blood lipids), were frequently mentioned. Many respondents also told that they had nothing to add, as the profile was so comprehensive and included good explanations of the results. Some participants also told that comparing their own results with those from their age group in general was very interesting. While most of the respondents gave only positive feedback, very few respondents considered that the Health Profile was quite inaccurate, too brief or too limited.

21.3 Feedback from the fieldwork personnel

Päivikki Koponen, Katri Sääksjärvi and Katja Borodulin

An anonymous web-based feedback questionnaire was addressed at the end of the fieldwork period to all staff members at the central office who were in contact with

the invitees and participants, as well as to all personnel and nutritionists in the field teams. Nearly everybody responded and gave feedback (central office staff n=14, fieldwork team staff n=35). A feedback seminar for the fiedwork staff was also organized.

Most telephone service staff members at the central office considered that they had received sufficient feedback, support and guidance on their tasks during the fieldwork. A few considered that it was challenging to balace their other tasks with the telephone service tasks. All staff members at the central office considered that interaction with the invitees and participants was mainly easy when confirming or changing survey appointments. However, contacting those who had not confirmed their appointment was more challenging, as it was sometimes hard to motivate the subjects to participate. A few persons were even unfriendly and rude as they didn't want to be bothered by any surveys. Nearly everyone had experienced some difficulties with the IT programmes, as some of them were only half-finished when the fieldwork was started. All respondents had positive experiences on collaboration in the central office team even though the work load was sometimes very heavy. Some would have expected more active leadership and coordination at the central office and more staff for the telephone service. Some respondents suggested that home visits to those invitees with major problems in health and functional capacity would have been needed and some suggested more incentives for the participants in the future surveys.

At the end of the fieldwork phase, some of the study personnel told that more practical training would have been needed with volunteer participants. Most field team members told that they had received sufficient feedback, support and guidance on their tasks during the fieldwork. Problems were mainly faced due to unexpected absences of field team members, or in arrangements for travel and accomodation. In a few locations the rooms reserved for the examinations were far from ideal, e.g. difficult access for participants or problems in indoor quality or ergonomics. Everyone considered the interaction with participants and giving feebcak to them as easy. A few had experiences on challenging situations, e.g. when elderly participants would have needed more time for the measurements and feedback, or when a few participants were very critical about the aims and purposes of the survey. Nearly all had faced some difficulties with the IT programmes and Internet connections. In all teams there had been days when the work load was considered too heavy, but they had also easier days, when many invitees did not attend as expected. There had also been some difficulties in the collaboration between the field work team and the central office as the coordinators at the central office were also very busy.

For the future surveys the fieldwrk staff suggested more resources for coordination and better preparation so that all materials and IT programmes would be fully finalized and tested before the training. They also suggested that all study

locations and rooms would need to be checked before the teams arrived at new locations, and that the timetables should be more flexible.

To motivate participation, the fieldwork staff members suggested e.g. longer study periods at each location, more incentives to the participants, better travel arrangements and subsidised travel for participants with a long distance between their home and the examination site, opportunities for home visits when needed and more publicity in media, especially social media and local newspapers, as well as better support from the local health service staff.

22 Discussion and conclusions

Katja Borodulin, Seppo Koskinen and Päivikki Koponen

This report describes in detail the planning, implementation and methods of the FinHealth 2017 Study. The study covered a large variety of topics related to health and wellbeing, measured by both clinical measurements in the health examination and by self-administered questionnaires. The data collection was implemented between January and June 2017.

Strengths of the FinHealth 2017 Study are many, such as:

- Relatively good participation rate that enables reasonable generalizability of the findings to the entire adult population.
- Use of individual-level register-based data to correct for non-participation, improving the generalizability of the findings.
- Continued and systematic use of standardized measurements that allow monitoring of changes in health and wellbeing.
- Broad network of acknowledged experts who participated in planning the survey as well as in quality assessment, analyzing and reporting of the data.
- THL organization (previously KTL) with nearly 50 years of expertise in management of population-based health examination surveys.

The FinHealth 2017 Study was implemented the first time as a merger of the preceding health examination study traditions, the National FINRISK Studies and the Health 2000/2011 and the Mini-Finland Surveys. Both of the preceding series of health examination studies comprised elements that were also included in the FinHealth 2017 Study, with the aim of maximizing comparability with the earlier results. Due to the limited resources available and the tight schedule, some essential elements of the previous surveys were discarded, such as home visits for those who were unable to attend the health examination otherwise. This may have caused some bias, as persons with severely restricted functioning had poorer possibilities to participate.

The number of study locations was narrowed down to 50 locations, whereas the earlier Health 2011 Survey was carried out in 60 locations, leading to potentially slightly poorer national representativeness of the data. The selection of the 50 locations led also to somewhat poorer regional representativeness for the FINRISK Study regions, which was why these were complemented with an additional sample.

It is clear that narrowing down the study topics, instruments and measurements as well as the limited resources available for recruitment of participants affect the quality and comparability of the data and the findings. In some topics the data is

mainly comparable only with the previous FINRISK Studies, in others with the Health 2000/2011 Surveys. In addition some new topics and items were introduced. Comparability with European EHIS questionnaires and EHES measurements as well as with other international standards was ensured, where feasible. In some topics ensuring national trends was considered more important than international comparability. When making any international comparisons or analyzing time trends, all researchers utilizing the FinHealth 2017 Study data need to check in detail the possible limitations in comparability. The trend of declining response rates was halted through several actions, but some limitations in comparability arise also from the lower response rates, especially among the youngest and eldest age groups.

The study protocol was developed during a careful planning phase with much emphasis on being able to collect up-to-date, high quality information on the total adult population in Finland. All decisions in the field phase were made based on the aim to secure the quality of the data. Thus, we believe that the FinHealth 2017 Study stands again as another rich and policy-relevant data set to be used by a large group of researchers and other stakeholders in Finland and internationally.

As earlier (Kilpeläinen et al. 2019), the FinHealth 2017 Study results can be widely utilized for developing evidence based health strategies, care guidelines prevention interventions, and legislation needed to support promoting health and wellbeing. Projections for key health problems as well as for functional capacity are needed to support evidence based development of health and social services. The FinHealth 2017 Study data needs to be utilized to provide information on the social and health care needs of the growing aging population, and how their demanding service needs can be postponed and reduced. Information is also needed on changes in the working capacity among the working aged population, how longer and healthier working careers can be promoted, and which conditions promote employment opportunities among younger age cohorts. It is also imperative to evaluate how social inequalities in health and health behaviours as well as health and social welfare costs can be diminished. The FinHealth 2017 Study provides abundant, valuable and valid data for health monitoring and multidisciplinary public health and epidemiologic research. Register based follow-up also enhances the possibilities for scientific research.

In addition, the results can be used in food industry and other fields to develop new heath promoting product concepts. To support clinical practice, the previously developed risk scores/calculators could be updated and verified with new data, and new risk scores can be developed, as well as reference values for clinical measurements can be developed based on the survey data. Examples of the further use of the FinHealth 2017 Study data include also e.g. estimates for the global burden of diseases (GBD), and evaluation of how the WHO targets for NCD prevention have been met in Finland.

There is need for further development to make sure that the study results are utilized in their full potential. New data portals and dissemination strategies need to be

developed to promote open access to the fully pseudonymized data. While the coverage and quality of national registers is improving and new opportunities for health monitoring and scientific research may arise with big data from patient record systems, we need to evaluate the comparability of data from different sources. However, it is clear that registers and patient record systems will unlikely, at least in the near future, cover representative population level data on risk factors and many other key topics (e.g. functional capacity). To obtain more comprehensive health information and to enable full research potentials, possibilities for register linkages should be secured and the continuity of the long series of nationally representative health interview and health examination surveys needs to be secured. Regional level data are also needed to inform regional decisions on health promotion and development of the regional level health and social services. Thus, future health surveys need to be developed in collaboration with the regional authorities.

References

Aalto, A., Aro, S., Aro, A. & Mähönen, M. (1995). Rand 36-item health survey 1,0: Suomenkielinen versio terveyteen liittyvän elämänlaadun kyselystä: Kyselylomake ja käyttöohjeet. Stakes Aiheita 1995/2. Helsinki. (in Finnish).

Aalto, A. M., Elovainio, M., Kivimäki, M., Uutela, A. & Pirkola, S. (2012). The Beck Depression Inventory and General Health Questionnaire as measures of depression in the general population: a validation study using the Composite International Diagnostic Interview as the gold standard. Psychiatry Res. 197:163-71.

Allardt, E. (1976). Hyvinvoinnin ulottuvuuksia. WSOY. Porvoo.

Aromaa, A., Heliövaara, M., Impivaara, O., Knekt, P. & Maatela, J. (1989). Tavoitteet, menetelmät ja aineistot. Osa 1. in: Aromaa A, Heliövaara M, Impivaara O, Knekt P, Maatela J, (eds.). Mini‑Suomi‑terveystutkimuksen toteutus. Publications of the National Public Health Institute ML:88. Helsinki and Turku. url: http://hdl.handle.net/10138/162731. (in Finnish).

Aromaa, A. Content of the home-visit interview. (2008) In: Heistaro, S. (ed.). Methodology Report. Health 2000 Survey. Publications of the National Public Health Institute B26/2008, p. 39–45. Helsinki. url: http://urn.fi/URN:NBN:fi-fe201204193320.

Aromaa, A., Heliövaara, M., Knekt, P. & Koskinen, S. (2019) National Health Examination Surveys in Research: From the Mobile Clinic Health Examination Survey to the Health Studies of the 2000s. National Institute for Health and Welfare, Report 8/2019. Helsinki. url: http://www.julkari.fi/handle/10024/137959.

Baćak, V. & Ólafsdóttir, S. (2017). Gender and validity of self-rated health in nineteen European countries. Scand J Public Health. 45;6:647-53.

Bates, D., Maechler, M. & Bolker, B. (2012). lme4: Linear mixed-effects models using S4 classes. url: http://CRAN.R-project.org/package=lme4.

Bogaert, P., Van Oyen, H., Beluche, I., Cambois, E. & Robine, J–M. (2018). The use of the global activity limitation Indicator and healthy life years by member states and the European Commission. Archives of Public Health. 76:30. url: https://doi.org/10.1186/s13690-018-0279-z.

Borodulin, K., Tolonen, H., Jousilahti, P., Jula, A., Juolevi, A., Koskinen, S., Kuulasmaa, K., Laatikainen, T., Männistö, S., Peltonen, M., Perola, M., Puska, P., Salomaa, V., Sundvall, J., Virtanen, S. M. & Vartiainen, E. (2018). Cohort Profile: The National FINRISK Study. Int J Epidemiol. 47;3:696–696i. url: https://doi.org/10.1093/ije/dyx239.

Cook, W. W. & Medley, D. M. (1954). Proposed hostility and pharisaic-virtue scales for the MMPI. J App Psychol. 38:414–18.

Csuka, M. & McCarty, D. (1985). Simple method for measurement of lower extremity muscle strength. Am J Med. 78: 77-81.

Curb, J. D., Ceria-Ulep, C. D., Rodriguez, B. L., Grove, J., Guralnik, J., Willcox, B. J., Donlon, T. A., Masaki, K. H. & Chen, R. (2006). Performance-based measures of physical function for high-function populations. J Am Geriatr Soc. 54:737–42.

Djerf, K., Laiho, J., Lehtonen, R., Härkänen, T. & Knekt, P. (2008). Weighting and statistical analysis. In: Heistaro, S. (ed.). Methodology Report. Health 2000 Survey. Publications of the National Public Health Institute B26/2008, p. 182-200. Helsinki. url: http://urn.fi/URN:NBN:fi-fe201204193320.

European Food Safety Authority (EFSA). (2014). Guidance on the EU Menu methodology. EFSA Journal. 12;12:3944. url: https://www.efsa.europa.eu/en/efsajournal/pub/3944.

Eurostat (referred March 4, 2019). url: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Minimum_European_Health_Module_(MEHM).

Friedewald, W.T., Levy, R. I. & Fredrickson, D. S. (1972) Estimation of the concentration of lowdensity lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem 1972;18:499–502.

Goldberg, D. P. (1972). The Detection of Psychiatric Illness by Questionnaire. Oxford University Press. London.

Gould, R., Ilmarinen, J., Järvisalo, J. & Koskinen, S., (eds.). (2008) Dimensions of work ability. Finnish Centre for Pensions, The Social Insurance Institution, National Public Health Institute, Finnish Institute of Occupational Health. Helsinki.

Gould, R., Härkäpää, K. & Koskinen, S. (2015). Työkyvyn arviointi väestötutkimuksessa. National Institute for Health and Welfare. url: http://www.julkari.fi/handle/10024/132199. (in Finnish)

Gould, R., Sainio, P. & Koskinen, S. (2016) Work ability. In: Lundqvist, A. & Mäki-Opas, T. (eds.). Health 2011 Survey – Methods. National Institute for Health and Welfare, p. 109–11. Helsinki.

Graubard, B. I. & Korn, E. L. (1999). Predictive Margins with Survey Data. Biometrics. 55:652-9.

Greenglass, E. R. & Julkunen, J. (1989). Construct validity and sex differencesin Cook-Medley hostility. Person Ind Diff. 10:209-18.

Guralnik, J. M., Simonsick, E. M., Ferrucci, L., Glynn, R. J., Berkman, L. F., Blazer, D. G., Scherr, P. A. & Wallace, R. B. (1994). A short physical performance battery assessing lower extremity function: association with selfreported disability and prediction of mortality and nursing home admission. J Gerontol, 49:M85–94.

Guralnik, J. M., Ferrucci, L., Simonsick, E. M., Salive, M. E. & Wallace, R. B. (1995). Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med. 332:556-61.

Heatherton, T. F., Kozlowski, L. T., Frecker, R. C. & Fagerström, K.O. (1991) The Fagerström test for nicotine dependence: a revision of the Fagerström Tolerance Questionnaire. Br J Addict. 86:1119-27.

Heistaro, S. (ed.). (2008). Methodology Report. Health 2000 Survey. Publications of the National Public Health Institute B26/2008. Helsinki. url: http://urn.fi/URN:NBN:fi-fe201204193320.

Hoppenfeld, S. (1976). Physical examination of the spine and extremities. Pearson Education. New York.

Hänninen, T., Pulliainen, V., Salo, J., Hokkanen, L., Erkinjuntti, T., Koivisto, K., Viramo, P., Soininen, H. & Suomen muistitutkimusyksiköiden asiantuntijaryhmä. (1999). Kognitiiviset testit muistihäiriöiden ja alkavan dementian varhaisdiagnostiikassa: CERAD-tehtäväsarja. Suomen Lääkärilehti. 15:1967–75. (in Finnish).

Hänninen, T., Pulliainen, V., Sotaniemi, M., Hokkanen, L., Salo, J., Hietanen, M., Pirttilä, T., Pöyhönen, M., Juva, K., Remes, A. & Erkinjuntti, T. (2010) Muistisairauksien tiedonkäsittelymuutosten varhainen toteaminen uudistetulla tehtäväsarjalla. Duodecim. 126:2013-21. (in Finnish).

Härkänen, T., Karvanen, J., Tolonen, H., Lehtonen, R., Djerf, K., Juntunen, T. & Koskinen, S. (2016). Systematic handling of missing data in complex study designs - experiences from the Health 2000 and 2011 Surveys. J Appl Stat. 43;15:2772–90. url: http://urn.fi/URN:NBN:fi-fe201602024534.

IBM Corporation. (2019). IBM SPSS Complex Samples 26. (referred December, 2019) url: ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/26.0/en/client/Manuals/IBM_SPSS_Complex_Samples.pdf.

Jylhä, M. (2009). What is self-rated health and why does it predict mortality? Towards a unified conceptual model. Soc Sci Med. 69;3:307-16.

Jääskeläinen, T., Koponen, P., Lundqvist, A., Borodulin, K., Koskinen, S. & FinTerveys 2017-tutkimuksen johtoryhmä. (2019). Nuorten aikuisten terveys ja elintavat Suomessa – FinTerveys 2017 -tutkimuksen tuloksia. Tutkimuksesta tiiviisti 11. National Institute for Health and Welfare. Helsinki. url: http://urn.fi/URN:ISBN:978-952-343-319-9. (in Finnish).

Kaartinen, N. E., Tapanainen, H., Valsta, L. M., Similä, M. E., Reinivuo, H., Korhonen, T., Harald, K., J.G., E., Peltonen, M. & Männistö, S. (2012). Relative validity of a FFQ in measuring carbohydrate fractions, dietary glycaemic index and load: exploring the effects of subject characteristics. Br J Nutr. 107:1367-75.

Karasek, R. (1985). Job content instrument questionnaire and user's guide, Version 1.1. Department of Industrial and Systems Engineering, University of Southern California. Los Angeles.

Katz, S., Ford, A. B., Moskowitz, R. W., Jackson, B. A. & Jaffe, M. W. (1963). Studies of illness in the aged. The index of ADL: a standardized measure of biologocal and psychosocial function. JAMA. 185:914-19.

Katz, S., Downs, T. D., Cash, H. R. & Grotz, R. C. (1970). Progress in development of the index of ADL. Gerontologist. 10:20-30.

Kilpeläinen, K., Koponen, P., Tolonen, H., Koskinen, S., Borodulin, K. & Gissler, M. (2019). From monitoring to action: utilising health survey data in national policy development and implementation in Finland. Arch Public Health. 77:48 url: https://archpublichealth.biomedcentral.com/track/pdf/10.1186/s13690-019-0374-9.

Koponen, P., Borodulin, K., Lundqvist, A., Sääksjärvi, K. & Koskinen, S. (eds.). (2018). Terveys, toimintakyky ja hyvinvointi Suomessa – FinTerveys 2017 -tutkimus. National Institute for Health and Welfare, Report 4/2018. Helsinki. url: http://urn.fi/URN:ISBN:978-952-343-105-8. (in Finnish).

Laiho, J. (2004). Katoanalyysi. In: Laiho, J. & Nieminen, T. (eds.). Terveys 2000 -tutkimus. Aikuisväestön haastatteluaineiston tilastollinen laatu. Otanta-asetelma, tiedonkeruu, vastauskato ja estimointi- ja analyysiasetelma. Statistics Finland, p 28-47. Helsinki. (in Finnish).

Laiho, J., Djerf, K. & Lehtonen, R. (2008). Sampling design. In: Heistaro, S. (ed.) Methodology report. Health 2000 Survey. Publications of the National Public Health Institute B26/2008, p. 13. Helsinki. url: http://urn.fi/URN:NBN:fi-fe201204193320.

Lawton, M. P. & Brody, E. M. (1969). Assessment of older people: self-maintaining and instrumental activities ofdaily living. Gerontologist. 9:179-86.

Lehtonen, R. & Pahkinen, E. (2004). Practical methods for design and analysis of complex surveys. Revised 2nd Edition. John Wiley & Sons. Chichester.

Liaw, A. & Wiener, M. (2002). Classification and regression by randomForest. R News 2;3:18-22.

Lumley, T. (2004). Analysis of complex survey samples. J Stat Softw. 9;8:1–19.

Lumley, T. (2019). Survey: analysis of complex survey samples. R package version 3.36. url: http://ftp.acc.umu.se/mirror/CRAN/web/packages/survey/survey.pdf.

Lundqvist, A. & Mäki-Opas, T. (eds.) (2016). Health 2011 Survey – Methods. National Institute for Health and Welfare, Report 8/2016. Helsinki. url: http://urn.fi/URN:ISBN:978-952-302-669-8.

McHorney, C. A. & Ware, J. E. Jr. (1995). Construction and validation of an alternate form general mental health scale for the Medical Outcomes Study Short-Form 36-Item Health Survey. Med Care. 33:15-28.

McWhinnie, J. R. (1981). Disability assessment in population surveys: results of the OP.E.C.D. Common Development Effort. Rev Epidemiol Santé Publique. 29:413-19.

Molenberghs, G. & Kenward, M. G. (2007). Missing data in clinical studies. Wiley. Cornwall.

Morris, J. C., Mohs, R., Rogers, H., Fillenbaum, G. & Heyman, A. (1989). The

consortium to establish a registry for Alzheimer's disease (CERAD). Part I. Clinical and neuropsychological assessment of neuropsychological measures. Neurology. 39:1159–65.

Männistö, S., Virtanen, M., Mikkonen, T. & Pietinen, P. (1996). Reproducibility and validity of a food frequency questionnaire in a case-control study on breast cancer. J Clin Epidemiol. 49:401-9.

Murto, J., Kaikkonen, R., Pentala-Nikulainen, O., Koskela, T., Virtala, E., Härkänen, T., Koskenniemi, T., Jussmäki, T., Vartiainen, E. ja Koskinen, S. (2017). Aikuisten terveys-, hyvinvointi- ja palvelututkimus ATH:n perustulokset 2010-2017. National Institute for Health and Welfare. url: www.thl.fi/ath. (in Finnish).

Ovaskainen, M. L., Paturi, M., Reinivuo, H., Hannila, M. L., Sinkko, H., Lehtisalo, J., Pynnönen-Polari, O. & Männistö, S. (2008). Accuracy in the estimation of food servings against the portions in food photographs. Eur J Clin Nutr. 62;5:674-81.

Paalanen, L., Männistö, S., Virtanen, M. J., Knekt, P., Räsänen, L., Montonen, J. & Pietinen, P. (2006). Validity of a food frequency questionnaire varied by age and body mass index. J Clin Epidemiol. 59:994-1001.

Paturi, M., Nieminen, R., Reinivuo, H. & Ovaskainen, M-L. (2006). Ruokien annoskuvakirja. Publications of the National Public Health Institute B 11/2006. Helsinki. (in Finnish).

Pietinen, P., Hartman, A. M., Haapa, E., Räsänen, L., Haapakoski, J., Palmgren, J., Albanes, J., Albanes, D., Virtamo, J. & Huttunen, J. K. (1988). Reproducibility and validity of dietary assessment instruments. I. A self-administered food use questionnaire with a portion size picture booklet. Am J Epidemiol. 128:655-66.

Power, M. (2003). Development of a common instrument for quality of life. In: Nosikov, A. & Gudex, C. (eds.). Eurohis: Developing common instruments for health surveys. Biomedical and Health Research, 57, p. 145-163. Amsterdam.

Pulliainen, V., Hokkanen, L., Salo, J. & Hänninen, T. (1999). CERAD, kognitiivinen tehtäväsarja, käsikirja. Suomen Alzheimer –tutkimusseura. Kuopio. (in Finnish).

R Core Team. (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna. url: https://www.R-project.org/.

Reinivuo, H., Hirvonen, T., Ovaskainen, M. L., Korhonen, T. & Valsta, L. M. (2010). Dietary survey methodology of FINDIET 2007 with a risk assessment perspective. Public Health Nutr. 13:915-9.

Research Triangle Institute. (2008). SUDAAN Language Manual, Release 10.0. Research Triangle Institute. Research Triangle Park, NC.

Rintamäki, R., Grimaldi, S., Englund, A., Haukka, J., Partonen, T., Reunanen, A., Aromaa, A. & Lönnqvist, J. (2008). Seasonal changes in mood and behavior are linked to metabolic syndrome. PLoS One. 3:e1482.

Robine, J. M. & Jagger, C. (2003). Creating a coherent set of indicators to monitor health across Europe: the Euro-REVES 2 project. Eur J Public Health. 13;Suppl 3:6–14.

Robins, J. M., Rotnitzky, A. & Zhao, L. P. (1994). Estimation of regression coefficients when some regressors are not always observed. J Am Stat Assoc. 89:846–66.

Rosenthal, N. E., Bradt, G. H. & Wehr, T. A. (1984). Seasonal Pattern Assessment Questionnaire (SPAQ). National Institute of Mental Health. Bethesda, MD.

Rosow, I. & Breslau, N. (1966). A Guttman health scale for the aged. J Gerontol. 21:556–9.

Rubin, D. B. (1987). Multiple imputation for nonresponse in surveys. Wiley. New York.

Rudanko, S. L. & Koskinen, S. (2008). Study of visual acuity. In: Heistaro, S. (ed.) Methodology report. Health 2000 Survey. Publications of the National Public Health Institute B26/2008, p. 93-94. Helsinki. url: http://urn.fi/URN:NBN:fi-fe201204193320.

Sainio, P. (2016). Vision and hearing. In: Lundqvist, A. & Mäki-Opas, T. (eds.). Health 2011 Survey – Methods. National Institute for Health and Welfare, p. 139-140. Helsinki. url: http://urn.fi/URN:ISBN:978-952-302-669-8.

Sarason, I. G., Levine, H. M., Basham, R. B. & Sarason, B. R. (1983). Assessing social support: The social support questionnaire. J Pers Soc Psychol. 44:127–39.

Sas Institute Inc. (2010). SAS/STAT® 9.22 User's Guide. SAS Institute Inc. Cary, NC.

Sas Institute Inc. (2019). SAS/STAT® 15.1 User's Guide. Introduction to Survey Sampling and Analysis Procedures. (referred December 5, 2019). url: https://documentation.sas.com/?docsetId=statug&docsetTarget=statug_introsamp_sect001.htm&docsetVersion=15.1&locale=en

Schafer, J. L. (1999). Multiple imputation: a primer. Stat Methods Med Res. 8;1:3-15

Schmidt, S., Mühlan, H. & Power, M. (2006). The EUROHIS-QOL 8-item index: psychometric results of a cross-cultural field study. Eur J Public Health 16;4:420–8.

Sievers, K., Melkas, T., Heliövaaraa, M. & Tuki‑ ja liikuntaelinten sairauksien tutkijaryhmä. (1985). Tuki‑ ja liikuntaelinten sairauksien tutkimusmenetelmät. Osa 3. In: Aromaa, A., Heliövaara, M., Impivaara, O., Knekt, P. & Maatela, J. (eds.). Mini‑Suomi‑terveystutkimuksen toteutus. Publications of the National Public Health Institute ML:50. Helsinki and Turku. url: http://hdl.handle.net/10138/162404. (in Finnish).

Sihvonen, A-P., Koponen, P., Martelin, T., Sainio, P., Jylhä, M. & Koskinen, S. (2017). Terveet elinvuodet väestön terveydentilan kuvaajana. Suomen Lääkärilehti. 72;23:1507–11. (in Finnish).

StataCorp. (2009). Stata: Release 11. Statistical Software. StataCorp LP. College Station, TX.

StataCorp. (2019). Stata: Release 16. Statistical Software. StataCorp LLC. College Station, TX. url: https://www.stata.com/manuals/svy.pdf.

Suominen-Taipale, A. L., Nordblad, A., Vehkalahti, M. & Aromaa, A. (eds.) (2008). Oral Health in the Finnish adult population. Health 2000 survey. Publications of the National Public Health Institute B 25/2008. url: http://urn.fi/URN:ISBN:978-951-740-852-3.

Suutama, T., Sulkava, R. & Koskinen, S. (2008). Tests of congnitive functioning. In: Heistaro, S. (ed.). Methodology Report. Health 2000 Survey. Publications of the National Public Health Institute B26/2008, p 95. url: http://urn.fi/URN:NBN:fi-fe201204193320.

Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., Parkinson, J., Secker, J. & Stewart-Brown, S. (2007) The Warwick-Edinburgh mental well-being scale (WEMWBS): development and UK validation. Health Qual Life Outcomes. 5:63.

Tiikkainen, P. & Pynnönen, K. (2018). Sosiaalisen toimintakyvyn mittaaminen väestötutkimuksissa. National Institute for Health and Welfare. url: https://www.julkari.fi/handle/10024/132198. (in Finnish).

Tolonen, H. (ed.) (2016a). EHES Manual: Part A. Planning and preparation of the survey. 2nd ed. National Institute for Health and Welfare. Helsinki. url: http://urn.fi/URN:ISBN:978-952-302-700-8.

Tolonen, H. (ed.) (2016b). EHES Manual : Part B. Fieldwork procedures. 2nd ed. National Institute for Health and Welfare. Helsinki. url: http://urn.fi/URN:ISBN:978-952-302-701-5.

Tolonen, H., Koponen, P., Al-Kerwi, A., Capkova, N., Giampaoli, S., Mindell, J., Paalanen, L., Ruiz-Castell, M., Trichopoulou, A., Kuulasmaa, K. & EHES Network. (2018). European health examination surveys - a tool for collecting objective information about the health of the population. Arch Public Health. 28;76:38.

Tuomi, K., Ilmarinen, J., Jahkola, M., Katajarinne, L. & Tulkki, A. (2006). Work Ability Index. 2nd revised ed. Finnish Institute of Occupational Health. Helsinki.

Tuulio-Henriksson, A. & Sainio, P. (2016). Cognitive functioning. In: Lundqvist, A. & Mäki-Opas, T. (eds.). Health 2011 Survey – Methods. National Institute for Health and Welfare, p. 134–6. Helsinki. url: http://urn.fi/URN:ISBN:978-952-302-669-8.

Valsta, L., Kaartinen, N., Tapanainen, H., Männistö, S. & Sääksjärvi, K. (eds.). (2018). Ravitsemus Suomessa - FinRavinto 2017 –tutkimus. National Institute for Health and Welfare, Report 12/2018. Helsinki. url: http://urn.fi/URN:ISBN:978-952-343-238-3. (in Finnish).

van Buuren, S., Boshuizen, H. C. & Knook, D. L. (1999). Multiple imputation of missing blood pressure covariates in survival analysis. Stat Med. 18:681-94.

van Buuren, S. & Groothuis-Oudshoorn, K. (2011). mice: Multivariate Imputation by Chained Equations in R. J Stat Softw. 45;3:1-67. url: http://www.jstatsoft.org/v45/i03/.

van Oyen, H., Bogaert, P., Yokota, R. & Berger, N. (2018). Measuring disability: a systematic review of the validity and reliability of the Global Activity Limitations Indicator (GALI). Arch Public Health 76:25. url: https://doi.org/10.1186/s13690-018-0270-8.

Vehkalahti, M., Paunio, I., Nyyssönen, V. & Aromaa, A. (eds.). (1991). Suomalaisten aikuisten suunterveys ja siihen vaikuttavat tekijät. Publications of the National Public Health Institute AL: 34. Helsinki and Turku. (in Finnish).

WHO. (2001). International classification of functioning, disability and health: ICF. World Health Organization. Geneva.

WHO. (2002). Towards a Common Language for Functioning, Disability and Health: ICF. World Health Organization. Geneva.

WHO. (2010). Global recommendations on physical activity for health. World Health Organization. Geneva.

Willett, W. (2013). Nutritional Epidemiology. 3rd ed. Oxford University Press. New York.

Wirth, K. E., Tchetgen, E. J. & Murray, M. (2010). Adjustment for Missing Data in Complex Surveys Using Doubly Robust Estimation: Application to Commercial Sexual Contact Among Indian Men. Epidemiology. 21;6:863–71.

Working group set up by the Finnish Medical Society Duodecim and the Finnish Society of Addiction Medicine. (2015) Treatment of alcohol use disorder. Current Care Guidelines. The Finnish Medical Society Duodecim. Helsinki (referred November 23, 2019). url: https://www.kaypahoito.fi/en/.

Appendices

Appendix 1. List of authors contributing to this report

Author	Authored in chapters
Aalto Anna-Mari	19.
Aalto Sanni	20.1.
Arohonka Petra	20.3.
Borodulin Katja	1., 2.1., 2.2., 2.3., 2.4., 3.1., 3.2., 3.3., 3.4., 3.5., 3.6., 3.7., 3.8., 4., 5.1., 5.2., 5.3., 5.4., 5.5., 5.6., 5.8., 6.1., 6.2., 6.3., 6.4., 6.5., 7.1., 7.2., 7.3., 8., 11.3., 11.4., 12., 20.2., 20.3., 20.4., 21.1., 21.2., 21.3., 22.
Doupi Persephone	16.
Erlund Iris	20.3.
Heliövaara Markku	18., 18.1.
Härkänen Tommi	2.3., 5.9.
Härkönen Janne	11.2.
Jousilahti Pekka	8., 13.1., 13.2., 13.4.
Juolevi Anne	2.3., 4., 5.1., 5.2., 5.3., 5.4., 5.6., 5.7., 5.8., 11.3.
Kaartinen Niina	2.4., 3.1., 3.4., 11.3., 20.1., 21.1.
Klemetti Reija	17.
Koponen Päivikki	2.4., 3.1., 3.4., 5.5., 5.7., 12., 17., 19., 21.1., 21.2., 21.3., 22.
Korhonen Tommi	20.1.
Koskinen Seppo	1., 2.1., 2.4., 3.1., 3.4., 5.7., 9., 10., 12., 18., 18.1., 18.2., 18.4., 18.6., 22.
Laatikainen Tiina	8., 13.1., 13.2., 13.4., 20.4.
Leinonen Johanna	3.8.
Liitsola Kirsi	13.3., 17.
Lounamaa Anne	16.
Martelin Tuija	18.4.
Marttila Minttu	21.2.
Maukonen Mirkka	11.3.
Mikhailova Alexandra	18.2.
Mäkelä Pia	11.2.
Mäki-Opas Tomi	20.2.
Männistö Satu	11.3., 20.1.
Nieminen Tarja	18.4.
Pakkala Heikki	11.3., 20.1.
Palosaari Tarja	5.9.
Partonen Timo	11.5., 14.

Pekkanen Juha	13.4.
Pietilä Arto	20.2.
Raittio Eero	15.
Raulio Susanna	20.1.
Reinivuo Heli	20.1.
Rissanen Harri	2.3., 4., 5.1., 5.2., 5.3., 5.4., 5.6., 5.7., 5.8., 11.3., 20.2.
Ruokolainen Otto	11.1.
Råman Laura	2.4., 3.1., 3.4., 6.1., 6.2., 6.3., 6.4., 6.5., 7.1., 7.2., 7.3., 20.3., 20.4.
Sainio Päivi	2.4., 3.1., 3.4., 18., 18.1., 18.2., 18.3., 18.4., 18.5., 18.6., 18.7., 18.8., 18.9.
Sane Jussi	13.3.
Solin Pia	14.
Stenholm Sari	18., 18.1.
Sundvall Jouko	6.1., 6.2., 6.3., 6.4., 6.5., 20.3.
Suominen Liisa	15.
Suvisaari Jaana	14.
Sääksjärvi Katri	1., 2.4., 3.1., 3.2., 3.3., 3.4., 3.7., 3.8., 4., 5.5., 9., 10., 21.1., 21.2., 21.3.
Tapanainen Heli	3.8., 11.3., 20.1.
Tiikkainen Pirjo	18.4.
Tolonen Hanna	2.4., 3.1., 3.4., 3.8.
Tuulio-Henriksson Annamari	18.3.
Uusitalo Hannu	18.2.
Vaara Mariitta	18., 18.1.
Valkeinen Heli	18., 18.1.
Valsta Liisa	2.4., 3.1., 3.4., 6.1., 6.2., 6.3., 6.4., 6.5., 11.3., 20.1., 20.3., 21.1.
Valtonen Hanna	2.4., 3.1., 3.4.
Virtanen Suvi	20.1.
Wennman Heini	20.2.

Appendix 2. Field coordination team of the FinHealth 2017 Study

Responsibility	Member of the team
Principal investigator	Seppo Koskinen
Research coordinator	Katja Borodulin
Field coordinator	Hanna Valtonen
Laboratory coordinator	Laura Råman
Central office coordinator	Katri Sääksjärvi
Person in charge of equipment and samples	Elina Järvensivu
Preparations for field work and training	Päivikki Koponen
Preparations for field work and pilot study	Liisa Saarikoski
Data manager	Anne Juolevi
Data manager	Harri Rissanen
Person in charge of IT-devices	Eija Purkamo
The logistics service (Research and Scheduling Service, TAP)	Pekka Simola
Functional capacity coordinator	Päivi Sainio
Research coordinator (FinDiet)	Liisa Valsta
Field coordinator (FinDiet)	Niina Kaartinen
Data manager (FinDiet)	Heli Tapanainen
Data manager (FinDiet)	Heikki Pakkala
Accelometer coordinator (Physical activity and Sleep)	Heini Wennman
Preparations for questionnaires	Marketta Taimi

Appendix 3. The schedule for each team (study locations and dates)

Team number	Central location of team	Study locations and dates
Team 1	Helsinki	Helsinki 31.1.-23.3. and 16.5.-19.5.
		Espoo 24.3.-13.4.
		Vantaa 18.4.-5.5.
		Karkkila 8.5.-15.5.
Team 2	Lahti	Lahti 31.1.-8.2. and 12.5.-17.5.
		Hämeenlinna 9.2.-15.2.
		Riihimäki 16.2.-27.2.
		Heinola 28.2.-9.3.
		Lappeenranta 10.3.-16.3.
		Ruokolahti 17.3.-24.3.
		Imatra 27.3.-4.4.
		Luumäki 5.4.-13.4.
		Hamina 18.4.-25.4.
		Kotka 26.4.-3.5.
		Loviisa 4.5.-11.5.
Team 3	Tampere	Tampere 31.1.-17.2. and 24.4.-27.4.
		Keuruu 20.2.-28.2.
		Jyväskylä 1.3.-8.3.
		Muurame 9.3.-16.3.
		Seinäjoki 20.3.-29.3.
		Ilmajoki 30.3.-7.4.
		Valkeakoski 11.4.-21.4.
Team 4	Turku	Turku 31.1.-16.2. and 9.5.-12.5.
		Vehmaa 17.2.-22.2.
		Rauma 23.2.-1.3.
		Pori 2.3.-9.3.
		Harjavalta 10.3.-16.3.
		Loimaa 17.3.-23.3.
		Masku 24.3.-30.3.
		Naantali 31.3.-6.4.
		Forssa 7.4.-19.4.
		Lohja 20.4.-28.4.
		Kaarina 2.5.-8.5.
Team 5	Oulu	Oulu 31.1.-10.2. and 5.5.-9.5.
		Raahe 13.2.-20.2.

		Kokkola 21.2.-28.2.
		Vaasa 1.3.-7.3.
		Uusikaarlepyy 8.3.-17.3.
		Haukipudas 20.3.-27.3.
		Rovaniemi 28.3.-4.4.
		Utsjoki 6.4.-12.4.
		Taivalkoski 18.4.-25.4 .
		Kiiminki 26.4.-4.5.
Team 6	Kuopio	Joensuu 31.1.-6.2., 4.4.-6.4 and 24.4.-9.5.
		Lieksa 7.2.-14.2. and 30.5-6.6.
		Juuka 15.2.-22.2. and 18.5.-29.5.
		Kuopio 23.2.-3.3., 22.3.-24.3 and 11.4.-20.4.
		Siilinjärvi 6.3.-13.3. and 11.4.-20.4.
		Iisalmi 14.3.-21.3. and 14.6.-16.6.
		Polvijärvi 27.3.-3.4 and 10.5.-17.5.
		Kitee * 7.6.-13.6.

* Town of Kitee was additionally included in the Eastern Finland sub-study to improve regional representation.

Appendix 4. Example of morning and evening shifts in the daily appointment plans

Coding of the type of slot: 1=normal; 2=diet; 3=normal reserve time; 4=diet reserve.

Normal morning shift

Time	Rank	Type of slot
7:30	1	2
7:40	2	1
7:50	3	1
8:00	4	3
8:10	5	2
8:20	6	1
8:30	7	1
8:40	8	2
8:50	9	1
9:00	BREAK	BREAK
9:10	10	2
9:20	11	3
9:30	12	1
9:40	13	2
9:50	14	1
10:00	15	1
10:10	16	1
10:20	17	4
10:30		LUNCH
10:40		LUNCH
10:50		LUNCH
11:00		LUNCH
11:10	18	1
11:20	19	2
11:30	20	1
11:40	21	1
11:50	22	2
12:00	23	3
12:10	24	1
12:20	25	2
12:30	26	1

Normal evening shift

Time	Rank	Type of slot
11:00	1	2
11:10	2	1
11:20	3	1
11:30	4	1
11:40	5	2
11:50	6	3
12:00	7	1
12:10	8	2
12:20	9	1
12:30	10	1
12:40	11	2
12:50	12	3
13:00	13	1
13:10	14	2
13:20	15	1
13:30	16	1
13:40	17	1
13:50	18	4
14:00		LUNCH
14:10		LUNCH
14:20		LUNCH
14:30		LUNCH
14:40	19	1
14:50	20	2
15:00	21	1
15:10	22	3
15:20	23	2
15:30	24	1
15:40	25	1
15:50	26	2
16:00	27	1

12:40	27	1
12:50	28	4
13:00	29	1
13:10	30	1
13:20	31	2
13:30	32	1
13:40	33	3
13:50	34	2
14:00	35	1
14:10	36	1
14:20	37	1
14:30	38	1

16:10	BREAK	BREAK
16:20	28	4
16:30	29	1
16:40	30	1
16:50	31	2
17:00	32	1
17:10	33	3
17:20	34	2
17:30	35	1
17:40	36	1
17:50	37	1
18:00	38	1