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COHORT PROFILE

Cohort Profile: The Study of Health in Pomerania

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How did the study come about?

Although in the past century mortality in West Germany decreased similarly as in other Western nations, these changes were less pronounced in East Germany.[1,2] After German reunification in 1990, there was a lack of scientifically valid data from East Germany to explain the regional differences in life expectancy and, consequently, a need for population-based research in northeast Germany.

Previous population-based studies focused mainly on specific diseases. Comparatively narrow examination programmes with time-consuming assessments may lead to a poor response. A design is needed that combines a high response with a broad and time-consuming spectrum of different health examinations. One approach might be a cohort design that includes moderately time-consuming health examinations in a first wave and, after compliance has been established, offers more time-demanding examinations in future waves. An alternative approach could be to first establish a population-based study with moderate demands on participating subjects, followed

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by a second cohort study in the same region with a more comprehensive examination programme. In an effort to combine the potential advantages of both approaches we are currently pursuing a dual strategy with two substudies of the population-based project Study of Health in Pomerania (SHIP).

What does the study cover?

The SHIP has two main objectives: (i) to assess prevalence and incidence of common risk factors, subclinical disorders and clinical diseases; and (ii) to investigate the complex associations among risk factors, subclinical disorders and clinical diseases. A particular characteristic of the SHIP is that it does not specifically address one selected disease; it rather attempts to describe health-related conditions with the widest focus possible.

The overall project consists of two studies, the second examination follow-up of the first SHIP cohort (SHIP-2) and baseline examinations of the second SHIP cohort (SHIP-TREND). Both studies have been designed to: (i) investigate the long-term progression of subclinical findings, their determinants and prognostic values (SHIP-2); (ii) analyse the secular trend of subclinical and overt diseases and their determinants in a high-risk population (SHIP-TREND vs SHIP-0); and (iii) assess the prevalence of subclinical findings defined by highly innovative non-invasive methods (SHIP-TREND).

Who are in the sample?

The two independent cohorts SHIP and SHIP-TREND were selected from essentially the same area with minor deviations at the boundaries of the study areas. The study region of the SHIP is West Pomerania, a region in the northeast of Germany. Sampling details for the first cohort are given elsewhere.[3,4] In brief, from the total population of West Pomerania comprising 213 057 inhabitants in 1996, a two-stage stratified cluster sample of adults aged 20–79 years was drawn. The net sample (without migrated or deceased persons) comprised 6265 eligible subjects.

A separate stratified random sample of 8016 adults aged 20–79 years was drawn for SHIP-TREND. Sample selection was facilitated by centralization of local population registries in the Federal State of Mecklenburg/West Pomerania. Stratification variables are age, sex and city/county of residence. The target sample size was chosen to obtain a final sample size similar to that of SHIP-0.

How often is the follow-up?

Baseline examinations of the first cohort were performed between 1997 and 2001 (SHIP-0). Follow-up examinations of the first cohort were conducted between 2002 and 2006 (SHIP-1) and between 2008 and 2012 (SHIP-2). For SHIP-TREND, baseline information is collected between 2008 and 2011 (Table 1).

A mortality follow-up collects information on vital status from population registries at annual intervals. For deceased persons, death certificates are requested from the local health authorities. Two internists independently validate the underlying cause of death and perform joint readings together with a third internist in cases of disagreement.

A morbidity follow-up was conducted between June and December 2006 by postal questionnaires. Non-responders were contacted by telephone. The total response was 88.6%. Incident events from SHIP-1 and the morbidity follow-up were validated by general practitioners. From 357 physicians contacted, 259 (72.5%) provided the requested information.

Since July 2007 the 'Life-Events and Gene-Environment Interaction in Depression' (LEGENDE) study is carried out in the SHIP cohort. A diagnostic interview for mental disorders is performed based on Diagnostic and Statistical Manual for Mental Disorders (IV edition) diagnostic criteria.[5,6] Additional psychometric assessments are evaluated by questionnaires (Table 2) and a newly developed interview on 80 positive and negative life events.

What is being measured?

Interview

Trained and certified interviewers conduct the computer-assisted personal interviews (Table 3). During the data collection phase, all interview data are checked semi-annually for interviewer bias. Independent auditors regularly review a sample of 10% of all interviews.

Laboratory data

Blood and urine samples are obtained according to standardized procedures (Table 4). Aliquots of blood samples are immediately placed on ice. The SHIP laboratories take part in the official German external quality proficiency testing programmes. All assays are calibrated against the international reference preparations, whenever these are available. A bank of dummy samples allows the standardization of different laboratory methods. Serum, ethylenediaminetetraacetic acid and citrate plasma, DNA and urine are stored at –80°C in a biobank. Saliva samples and swaps are taken from mucosa membranes of the nose, throat, tongue and tooth pockets.

In SHIP-0, 4096 samples were genotyped using the Human SNP 6.0 Array (Affymetrix, Santa Clara, CA, USA). The overall genotyping efficiency of the genome-wide data was 98.6%. ^{1}H NMR spectroscopic analysis for metabolomics in spot urine samples was

Table 1 Instruments integrated in the SHIP examination programme

Instrument	SHIP-0	SHIP-1	SHIP-2	SHIP-TREND-0
Somatometric measures	×	×	×	×
Blood pressure	×	×	×	×
ECG	×	×	×	×
OGTT	–	–	–	×
Echocardiography (⩾45 years)	×	×	×	×
Echocardiography (<45 years)	–	×	×	×
Echocardiography, diastolic function	–	×	×	×
Thyroid ultrasound	×	×	×	×
Carotid ultrasound (⩾45 years)	×	×	×	×
Carotid ultrasound (<45 years)	–	×	×	×
Liver ultrasound	×	–	×	×
Gallbladder ultrasound	×	–	×	×
Endothelial function	–	×	×	×
Bodyplethysmography	–	×	×	×
Cardiopulmonary exercise	–	×	×	×
Oral examinations	×	×	×	×
Dermatological examination	–	×	×	×
Bone stiffness	–	–	×	×
Retinal artery-to-vein ratio	–	–	–	×
Handgrip	–	–	×	×
Bioelectrical impedance analysis	–	–	×	×
Liver elastography	–	–	×	–
Pancreas and renal ultrasound	–	–	×	–
Breath gas analysis	–	–	–	×
Sleep monitoring	–	–	–	×
Whole-body magnetic resonance imaging	–	–	×	×
Neurological screening	×	×	×	×
Functional reading ability	–	–	×	–

SHIP-0: baseline examination of the first cohort; SHIP-1: 5-year follow-up of the first cohort; SHIP-2: 11-year follow-up of the first cohort; SHIP-TREND-0: baseline examination of the second cohort. ECG: electrocardiogram; OGTT: oral glucose tolerance test; ×: denotes available; –: denotes not available.

performed in SHIP-0 at a DRX-400 NMR spectrometer (Bruker BioSpin GmbH, Rheinstetten, Germany).

Simple medical examinations

Somatometric measurements include height and weight as well as waist and hip circumferences. After a 5-min rest period, systolic and diastolic blood pressure is measured three times in the right arm of seated subjects (HEM-705CP, Omron Corporation, Tokyo, Japan). Twelve-lead ECGs are recorded (Personal 120LD, Esaote, Genova, Italy). All ECGs are processed at the Erasmus Center Rotterdam, Rotterdam, The Netherlands, by Minnesota coding and the Modular ECG Analysis System (MEANS).[7] In SHIP-1, a Tele-ECG subproject was conducted to assess the prevalence of symptomatic and asymptomatic cardiac arrhythmias.[8]

Oral glucose tolerance test

For the OGTT, fasting venous blood is sampled, and 75 g of anhydrous glucose with blackcurrant flavour (Dextro OGT, Boehringer Mannheim, Mannheim, Germany) is given orally. Two hours later, a second venous blood sample for determination of plasma glucose concentrations is taken.[9]

Ultrasound

Various ultrasound methods are applied to define subclinical disorders. Technicians examine the extracranial carotid arteries and the thyroid gland with B-mode ultrasound (vivid-i, GE Medical Systems, Waukesha, Wisconsin, WI, USA) with an operating frequency of 13 MHz. Focal widening relative to adjacent segments and an area of focal increased thickness (⩾1.3 mm) of the intima-media layer are

Table 2 LEGENDE—self-report questionnaires

Questionnaire	Description
Childhood Trauma Questionnaire[73] (CTQ)	The CTQ is a retrospective 34-item self-report inventory that provides a brief, reliable and valid screening of histories of abuse and neglect. It investigates five types of maltreatment: emotional, physical and sexual abuse, and emotional and physical neglect. Also included is a 3-item minimization/denial scale for detecting false-negative trauma reports.
Beck Depression Inventory II[74] (BDI-II)	The BDI-II is a 21-item self-report instrument intended to assess the presence and severity of symptoms of depression. Each of the 21 items corresponds to a symptom of depression (e.g. changes in sleep and appetite, concentration difficulties, loss of energy), whereas all items are summed to give the score of the BDI-II.
Life Orientation Test-Revised[75] (LOT-R)	The LOT was developed to assess individual differences in generalized optimism vs pessimism. This measure has been used in a good deal of research on the behavioural, affective and health consequences of this personality variable.
Sense of Coherence Scale—Leipzig Short Scale (SOC-L9)[76]	The SOC-L9 is an economic, unidimensional short version of the Sense of Coherence-Scale (SOC). It is a reliable und valid instrument, which allows assessing a person's sense of coherence, conceptualized according to Antonovsky's salutogenetic model.
Resilienzskala[77] (RS-25)	The RS-25 is the German version of the Resilience Scale by Wagnild and Young,[78] which assesses resilience as a global factor. Resilience (psychosocial stress-resistance) is conceptualized as a protective personality factor that is associated with a healthy development of children, adolescents and adults.
14-item short version for the assessment of social support[79] (F-SozU K-14)	F-SozU K-14 assesses three basic factors of social support: emotional support, practical support and social integration. Social support is conceptualized as the perceived or anticipated support from the social network.
30-item short version of the NEO-Five-Factor Model[80] (NEO-FFI-30)	The NEO-FFI-30 is the 30-item short version of NEO-Five-Factor Inventory by Costa and McCrae.[81] This personality assessment measures five personality dimensions including neuroticism, extraversion, openness to experience, agreeableness and conscientiousness.
Toronto Alexithymia Scale – 20[82] (TAS-20)	The TAS-20 is a 20-item assessment of alexithymia. Alexithymia refers to people who have difficulties identifying and describing emotions and who tend to minimize emotional experience and focus attention externally. The TAS-20 has three factors including difficulties in identifying feelings and distinguishing them from bodily sensations, difficulties in describing feelings to others and externally oriented thinking.
Kurzer Fragebogen zur Erfassung von Belastungen[83] (KFB)	The KFB is a 16-item short assessment of daily hassles und uplifts from several causes in daily life. Four sources of hassles and uplifts are covered including workplace, family/partnership, social relations and daily problems. The KFB provides information on daily stresses und strains that are not caused by illness.
Screeningskala zum chronischen Stress[84] (SSCS) adopted from the 'Trierer Inventar zur Erfassung von chronischem Stress' (TICS)	The SSCS from the TICS assesses experienced chronic stress as a global factor.
SF-12[85]	The SF-12 is the 12-item short form of the SF-36 Health Survey, which is an all illness covering measurement in order to assess the health-related quality of life. The SF-12 covers two dimensions: physical health and mental health.
Coping Inventory for Stressful Situations (CISS)[86]	The CISS is a validated German short-version with 24 items of the 'Coping Inventory for Stressful Situations'.[87] It assesses coping on three dimensions: task-orientated, emotional and avoidant coping styles.

Table 3 Instruments integrated in the SHIP interviews

Item	SHIP-0	SHIP-1	SHIP-2	SHIP-TREND
Socio-demographics	×	×	×	×
Cognitive function				
Mini-mental state[88]	×	×	×	–
Stroop word colour test[89]	–	–	–	×
Word list[90]	–	–	–	×
Utilization of medical and dental services	×	×	×	×
Cardiovascular diseases[91]	×	×	×	×
Claudicatio[91]	×	×	×	×
Restless legs syndrome[92]	×	×	×	–
Diabetes	×	×	×	×
Chronic pancreatitis (symptoms and quality of life)[93]	–	–	×	×
Irritable bowel syndrome[94]	–	–	–	×
Oral health impact profile[95]	–	×	×	×
Lung diseases	–	×	×	×
Allergy/asthma	×	×	×	×
Sinusitis	–	–	×	×
Chronic diseases	×	×	×	×
Cancer	–	×	×	×
Thyroid disorders	–	×	×	×
Infectious diseases	×	–	–	×
Immunization	×	–	–	×
Family history	×	–	–	×
Pain	–	×	×	×
Rheumatism	–	–	–	×
Women's health	×	×	×	×
Accidents, injuries	×	×	×	×
Medication	×	×	×	×
Mental Health[96–98]	–	×	×	×
Social contacts, leisure activities[99,100]	×	–	×	–
Nutrition[101]	×	×	×	×
Alcohol consumption[102,103]	×	×	×	×
Tobacco consumption[104]	×	×	×	×
Physical activity[105]	×	×	×	×
Work load, occupational environment[46,57]	×	×	×	×
Sleep[106]	×	–	×	×
Visual functioning[107]	–	–	–	×
Post-traumatic stress disorder[108]	–	×	–	–
Political persecution prior to the German reunification	–	×	–	–
Utilization of dental services, oral care habits, complaints and pain in the craniomandibular system	×	×	×	×
Oral health related quality of life[95]	–	×	×	×
Past and present tanning habits and the extent of erythema afterwards, previous and family history of skin cancers, history of common skin and vein diseases	–	×	×	×

Table 4 Information from laboratory analyses (blood, urine, swabs, saliva, stool[a]) available for SHIP

Material	SHIP-0	SHIP-1	SHIP-2	SHIP-TREND-0
Serum and plasma				
DNA	×	×	×	×
RNA	–	–	–	×
White blood cell count	×	×	×	×
Red blood cell count	×	×	×	×
Haemoglobin	×	×	×	×
Haematocrit	×	×	×	×
Mean corpuscular volume	×	×	×	×
Mean corpuscular haemoglobin	×	×	×	×
Mean corpuscular haemoglobin concentration	×	×	×	×
Red cell distribution width	×	×	×	×
Platelet count	×	×	×	×
Mean platelet volume	×	×	×	×
Reticulocytes	×	×	×	×
International normalized ratio	×	×	×	×
Partial thromboplastin time	×	×	×	×
Fibrinogen	×	×	×	×
Sodium	×	×	×	×
Potassium	×	×	×	×
Calcium	×	×	×	×
Magnesium	×	×	×	×
Creatinine	×	×	×	×
Urea	×	×	×	×
Cystatin C	–	×	×	×
Alanine aminotransferase	×	×	×	×
Aspartate aminotransferase	×	×	×	×
γ glutamyl transferase	×	×	×	×
Lipase	×	×	×	×
Total cholesterol	×	×	×	×
High density lipoprotein cholesterol	×	×	×	×
Low density lipoprotein cholesterol	×	×	×	×
Lipoprotein (a)	×	–	–	–
Triglycerides	×	×	×	×
Apolipoprotein A1	×	–	–	–
Apolipoprotein B	×	–	–	–
Haemoglobin A1c	×	×	×	×
Glucose	×	×	×	×
Insulin-like growth factor-1	×	×	×	×
Insulin-like growth factor binding protein 3	×	×	×	×
Parathormone	×	×	×	×
Vitamin D	×	×	×	×
Aldosterone	–	×	×	×
Renin	–	×	×	×
Pro-renin	–	×	–	–

(continued)

Table 4 Continued

Material	SHIP-0	SHIP-1	SHIP-2	SHIP-TREND-0
Testosterone	×	×	×	×
SHBG	×	×	×	×
Thyrotropin	×	×	×	×
Free triiodthyronine	×	×	×	×
Free thyroxin	×	×	×	×
Antithyroperoxidase antibodies	×	×	×	×
C reactive protein	×	×	×	×
High-sensitivity C reactive protein	×	–	–	–
Interleukin 6	×	–	–	–
Ferritin	×	–	–	–
Carbohydrate-deficient transferrin	×	–	–	–
N-terminal pro-brain-natriuretic peptide	–	×	–	–
Urine				
Iodine	×	×	×	×
Thiocyanate	×	–	×	×
Nitrate	×	–	×	×
Albumin	×	×	×	×
Leukocytes	×	×	×	×
Erythrocytes	×	×	×	×
Glucose	×	×	×	×
Urobilinogen	×	×	×	×
Bilinogen	×	×	×	×
Creatinine	×	×	×	×
Pyridinum cross-links	×	–	–	–
Swabs				
Tongue	–	×	×	×
Nasal	–	–	×	×
Throat	–	–	×	×
Periodontal pockets	–	–	×	×
Stool				
Bacterial DNA	–	–	×	×
Saliva				
Stored at –80°C	–	–	×	×

[a]All materials stored at –80°C.
SHBG = Sex hormone-binding globulin.

considered atherosclerotic plaques. Readers calculate the mean far-wall intima-media thickness from scans of the distal straight portion of both common carotid arteries. Nodular changes of the thyroid >10 mm in diameter are defined as nodules. Autoimmune thyroid disease is defined as the combined presence of a hypoechogenic thyroid pattern and positive anti-thyroperoxidase levels. Thyroid volume is calculated,[10] and goitre defined.[11] Echocardiography is performed by physicians (vivid-i, GE Medical Systems, Waukesha, Wisconsin, WI, USA). Left ventricular dimensions are measured using the leading-edge convention. Left ventricular mass and markers of left ventricular diastolic function are evaluated.[12,13] Aortic valve sclerosis and mitral annulus calcification are assessed. Measurements of endothelial dysfunction are evaluated by flow-mediated dilation of the brachial artery using a 7.5-MHz linear array transducer ultrasound system (Cypress, Siemens AG, Erlangen, Germany). After the resting scan, a

pneumatic cuff is placed around the forearm and inflated above a pressure of 220 mmHg for 5 min. Diameter measurements are repeated 60 s after deflation of the cuff. Physicians perform liver ultrasound using a 7.5-MHz transducer. Hepatic steatosis is defined as a bright liver pattern relative to the renal parenchyma. Cholelithiasis is present if the gallbladder contains echoes that move with gravity. Real time tissue elastography of the liver and pancreas ultrasound are done using an EUB 8500 device (Hitachi, Tokyo, Japan).[14] The liver elasticity score is done on 10 images with compression values of 3–4 on a scale of 1–6. The size of the pancreatic head, neck, tail and duct as well as calcifications and tissue echogenicity are documented. Duplex ultrasound assessment (HDI 3500, Philips, Eindhoven, The Netherlands) of the common femoral, popliteal, long and short saphenous veins is performed in subjects with venous disease. Bone stiffness is evaluated by heel ultrasound (Achilles InSight, GE Lunar, Wisconsin, USA).

Bioelectrical impedance analysis

Bioelectrical impedance analysis is performed using Nutriguard M (Data Input GmbH, Darmstadt, Germany). R (resistance) and Xc (reactance) are measured applying electric currents of 800 μA at 50 kHz. Source and sensor electrodes are placed on the dorsum of hand and foot of the dominant body side.

Dental examinations

The number of present teeth is counted excluding the third molars.[15] Coronal caries is assessed on a half-mouth basis according to the decayed, missing, filled teeth and surfaces index.[16] Root caries is evaluated full-mouth and defined by lesions or softening of the cementum or root dentin and fillings of the root surface. On a half-mouth basis, probing depth, gingival recession and clinical attachment loss are assessed mesiobuccally, midbuccally, distobuccally and midlingually/midpalatinally excluding third molars using periodontal probes PCP11 and PCP UNC15 (Hu-Friedy, Chicago, IL, USA). Type and extent of prosthetic restorations, dental materials, type of anchorage device, number and location of implants and the date of the most recent prosthetic treatment are recorded during a full-mouth examination. Occlusal patterns are examined by interocclusal impression.[17]

Signs and symptoms of craniomandibular disorders are evaluated by pain upon pressure to the masticatory muscles and joints. Deviations, deflections and limitations during mouth opening and the occurrence of pain or discomfort upon defined movements and palpation are checked. Further records meet the Helkimo dysfunction index and axis 1 of the Research Diagnostic Criteria.[18,19]

Dermatological examination

The skin type is visually categorized.[20] Elastosis, erythrosis interfollicularis, cutis rhomboidalis nuchae, the number of lentigines solares, precancerous skin lesions, psoriasis, atopical eczema, common warts, acne, rosacea and dermatomycosis are documented. The number of nevi is counted. The clinical and dermatoscopic asymmetry, border, colour, diameter rule is applied for atypical moles and melanoma.[21] Samples are taken to detect and specify tinea pedis. Oedema, lipodermatosclerosis, varicose veins, hyperpigmentation and healed or open venous leg ulcers are considered venous disease of the legs, which then is classified according to clinical severity, etiology, anatomy and pathophysiology.[22]

Ophthalmological examinations

Funduscopy of the central retina is conducted using a non-mydriatic fundus camera (TRC-NW 200, Topcon Corporation, Tokyo, Japan) with subsequent static vessel analysis (SVA, Vesselmap 3, Imedos, Jena, Germany). Ophthalmologic evaluation of the macula, the optic disc and the retina is performed.

Body plethysmography and cardiopulmonary exercise testing

Resting lung function tests are conducted using a body plethysmograph equipped with a pneumotachograph (VIASYS Healthcare, Jaeger, Hoechberg, Germany).[23–25] At least three lung function manoeuvres are performed to obtain a minimum of two acceptable readings.[26] Immediate on-screen error codes display the major acceptability and reproducibility criteria.

An exercise test is conducted on a calibrated electromagnetically-braked cycle ergometer following a modified Jones protocol.[27] In the absence of chest pain, ECG abnormalities or critical blood pressure changes, all tests are continued as symptom limited. All tests are applied at room temperature under continuous monitoring of ECG, blood pressure and oxygen saturation.[28]

Sleep monitoring

Cardiorespiratory polysomnography with camera monitoring is performed in a sleep laboratory using a polysomnography system (Alice 5, Philips Respironics, Eindhoven, The Netherlands). Electroencephalograms, electrooculograms and electromyograms from chin and tibialis muscles are recorded. Nasal flow, thoracic and abdominal efforts, body position, oxygen saturation, heart rate and snoring sounds are measured. Sleep stages are analysed visually.[29] Central, mixed and obstructive apnoeas, hypopnoeas, periodic breathing, hypoventilation periods, respiratory-related arousals and heart rate variability are documented. The apnoea–hypopnoea index,

the periodic leg movement arousal index and the pulse transit time are calculated.

Whole-body Magnetic Resonance Imaging

The detailed magnetic resonance imaging (MRI) protocol has been published elsewhere.[30] A standardized MRI protocol is performed using a 1.5-T MR imager (Magnetom Avanto, Siemens Medical Systems, Erlangen, Germany). Five phased-array surface coils are placed on the head, neck, abdomen, pelvis and lower extremities. A spine coil is embedded in the examination table. The basic programme includes native whole-body MRI and secretin-enhanced MR cholangio-pancreatography. Following the basic programme, contrast-enhanced cardiac MRI and MR angiography are performed in men, whereas cardiac MRI and MR mammography are performed in women.

Quality assurance

High-quality standards were established before the start of the SHIP.[31] For all examinations, standard operating procedures are available for obligatory perusal by the examiners. The conduction of the examinations is tested in pilot studies. Quality reports of all examinations are semi-annually discussed with a board of independent scientists.

Certification procedures for selected major characteristics are performed in 12 volunteers after the potential observer has been trained for at least 3 months. In Bland and Altman plots for continuously distributed variables, the mean bias for intra- and inter-observer variability must not exceed 5%, and two standard deviation of the bias must not exceed 25%. Statistical analyses for dichotomized variables are performed by κ statistics whereby $\kappa > 0.8$ is expected. Trainees who do not fulfil the quality criteria are subjected to an individualized calibration based on the results of the first certification. If no improvement is achieved in the second certification, the trainee is replaced by another person. During the study, observer certifications are repeated every 6–12 months.

Response and attrition

Considerable effort is made to maximize subject response.[32,33] Subjects are consecutively approached by three invitational letters, repeated telephone calls and in-person contacts at home. Finally, persons are offered examinations at the participant's home (SHIP-Home). SHIP-Home not only includes interview, ECG and blood pressure measurements, but also ultrasound and laboratory examinations. All target persons are provided catering, an abstract of the medical test results and either a €30 expense allowance or free transport to the examination centre and back home plus €20 expense allowance.

From the net sample drawn for the SHIP, 4308 subjects (2192 women) participated in SHIP-0 (response 68.8%). For SHIP-1, there were 130 passive non-respondents due to migration and 231 deceased subjects. Of the remaining subjects, 3300 took part in the follow-up examinations (response 83.6%).[32]

What has been found so far?

Analyses of baseline SHIP-0 data indicate that the West Pomeranian population suffers from a particularly high prevalence of common risk factors and diseases. For example, the prevalence of overweight and obesity is much higher in West Pomerania than in other German regions,[34] resulting, among other consequences, in an exceptionally high prevalence of gallstone disease.[35] Hepatic steatosis is present in ~30% of all adults.[36,37] Likewise, the prevalence of arterial hypertension in West Pomerania is comparatively high, with ~50% of the adult population affected.[38] Consequently, the prevalence of left ventricular hypertrophy in the northeast is 60% higher than in south Germany.[39]

The population-based study design and the profound information on potential exclusion criteria allow for analyses of population-representative reference values. Thus, reference values have been established for various serum hormone levels[40–42] and cardiopulmonary stress tests.[43]

The SHIP offers various opportunities for association studies. These studies include the association between genetic factors and a broad spectrum of phenotypes,[44,45] the association among risk factors and diseases,[35] the association between risk factors and subclinical disorders[37,46–48] and the association among risk factors, subclinical disorders and clinical diseases or mortality.[49,50] Much of this work has been done so far on endocrine–metabolic,[51–55] cardiovascular,[56–60] psychiatric,[61–64] neurological,[65–67] gastroenterological[36–68] and oral disorders.[58,69–71]

What are the main strengths and weaknesses?

The strengths of the SHIP include the comprehensiveness of information on risk factors, subclinical disorders and manifest diseases. Further strengths are the population representativeness, the high level of quality assurance, particularly in standardization of non-invasive examination methods and data management.

SHIP-0 was started as a classic prevalence study with high baseline response. Consequently, much effort was also put in the recruitment for SHIP-1. The follow-up response of 83.6% is certainly lower than follow-up responses in studies that have been *a priori* designed as longitudinal studies with usually less recruitment efforts at baseline. Our follow-up response, however, has to be adjusted for the comprehensive examination programme. The advantage of our approach with high baseline response over the

approach of classic cohort studies with low baseline response is that bias in both incidence estimates and association analyses can be evaluated.[32,33]

The broad range of examinations not only represents a major strength of the SHIP, but it also limits the conclusions drawn from our studies. Although the size of the original study population was based on *a priori* power calculations, and scientists who apply for data usage have to assess the power of their planned analysis, much data analysis must be regarded as hypothesis generating.

German residents must register by law with the local authorities. Provided that strict ethical and data safety regulations are adhered to, epidemiologists may gain access to the databases of population registries and health-care authorities. These regulations facilitate the high representativeness of many German population-based studies for fatal diseases. Unfortunately, the German infrastructure is less favourable for collecting information on non-fatal events. For data safety reasons, record linkage to hospital, pharmaceutical or other registries is at minimum vigorously restricted or may even be completely impossible. Harmonization of national data safety regulations within the European Union is needed, and we hope that record linkage will become possible in Germany as has been established in Scandinavian countries.[72]

Can I have access to the data? Where can I find more about the study?

For coordination of research projects based on the SHIP data, a request and transfer process has been established. Interested researches may apply for data by completing a web-based request form (http://ship.community-medicine.de). Once approved, a contract is closed to set the conditions of data transfer and transmission of results back to the Research Network of Community Medicine. Collaborations are welcome, respective wishes should be directed to voelzke@uni-greifswald.de

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KEY MESSAGES

- The Study of Health in Pomerania is a population-based project, which consists of two independent cohorts (SHIP and SHIP-TREND). The SHIP investigates common risk factors, subclinical disorders and manifest diseases in the high-risk population of northeast Germany.
- A particular characteristic of SHIP is that it does not specifically address one selected disease. It rather attempts to describe health-related conditions with the widest focus possible.
- Besides the comprehensiveness of information on risk factors, subclinical disorders and manifest diseases, the population representativeness, the high level of quality assurance, particularly in standardization of non-invasive examination methods and data management represent further strengths of the study.

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