Study Protocol

Tehran cohort study (TeCS) on cardiovascular diseases, injury, and mental health: Design, methods, and recruitment data

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ABSTRACT

Cardiovascular disease, mental health, and injury are among the top health issues globally. In Tehran Cohort Study, we aimed to determine the prevalence, incidence, and trend of cardiovascular diseases, psychiatric symptoms, injury, and risk factors in Tehran households. We enrolled 4215 households in the recruitment phase from March 2016 to March 2019. Demographic characteristics, past medical history, medications, and familial history of the participants were collected. Rose angina pectoris, general health Questionnaire-28 (GHQ-28), and injury questionnaires were completed. Fasting blood samples were collected to measure routine biochemistry and store samples in the biobank. Anthropometric and physiological measurements and electrocardiograms were performed. The participants are followed every three years for up to 12 years. In total, 8296 individuals participated in the cardiovascular section, 10247 completed the GHQ-28, and 4167 households completed the injury questionnaire. The mean age of the participants was 48.2 (16.41), and 46.5% were male. 64.3% of recruited individuals had no symptoms of psychiatric disorders, and 3729 (89.5%) households did not have any severe injury requiring treatment. The participants' diversity and their invaluable data will help us provide a general picture of the current prevalence and incidence of the main study objectives.

Introduction

The prevalence of non-communicable diseases has increased drastically within the past decades in every country. As a result, the mortality due to these etiologies is becoming more prominent [1–3]. Cardiovascular disease and injury are among the top causes of death and health burden, and Iran is not an exception [4–6]. In addition to chronic diseases, psychiatric disorders cause a significant burden on the health care system [7,8]. These three conditions account for a high attributable disability-adjusted life-years (DALY) in Iran. Due to an increase in the life expectancy and aging population, they need to be studied and managed carefully [7,9–13].

Several local studies were performed regarding cardiovascular disease, injury, psychiatric disorders, and their risk factors in Iran in the past years. Nevertheless, due to the limitations of funding and conduction in these studies, they could not enroll a high number of people in a single cohort, particularly from Tehran [14–19]. Considering that Tehran has a diverse population from various ethnic and tribal groups that includes over 10% of Iran's population. Therefore, the lack of an extensive and comprehensive cohort study in the capital is an absolute necessity in the era of non-communicable diseases and health problems.

Due to the high DALY from cardiovascular disease, injury, and psychiatric disorders in Iran and lack of enough documents regarding the incidence and prevalence of these diseases in Tehran as a metropolis, the Tehran Cohort Study (TeCS) was designed and performed. TeCS

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started in March 2016 in the Tehran metropolis and consisted of three sections: cardiovascular diseases, psychological health, and injury.

The principal aims of this study consist of:

1- To determine the prevalence and incidence of cardiovascular diseases and their risk factors in Tehran's adult residents (age ≥ 35 years).
2- To determine the prevalence and incidence of psychiatric symptoms and their risk factors in Tehran's adolescent and adult residents (age ≥ 15 years).
3- To determine the prevalence and incidence of injury and its risk factors in the households of Tehran.

In this manuscript, we report the study design and early findings of the recruitment phase of the TeCS.

Outcomes of interest

The outcomes of the TeCS include 1) the number of death due to cardiovascular disease, injury, and other causes; 2) prevalence and incidence of cardiovascular diseases, psychiatric disorders, and injury; 3) trends in the cardiovascular risk factors (hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity).

Methods

Study design

Tehran Cohort study is a multidisciplinary prospective longitudinal study that enrolls 5000 current households of the 22 districts of Tehran, the Capital of Iran (Fig. 1). The study is a joint project between Tehran Heart Center, Sina Trauma and Surgery Research Center, and Psychosomatic Medicine Research Center. All three centers are affiliated to Tehran University of Medical Sciences, Tehran, Iran.

Ethical approval and informed consent

The board of research and the committee of medical ethics at Tehran University of Medical Sciences approved the protocol of the TeCS (code

of ethics: IR.TUMS.MEDICINE.REC.1399.074). All the invitees willing to participate in the study were asked to sign written informed consent on recruitment day. For those who were illiterate or unable to read and sign, a relative or the accompanying person assisted them in completing the consent form.

Pilot study

To decide on the feasibility, study design, and budgeting, we conducted a pilot study between January and March 2015. We evaluated 157 households comprised of 297 members ≥35 years. They were visited at home or invited to our recruitment center. Based on the results of this pilot study, the current study design was developed. The results of the pilot study were not included in the main cohort.

Recruitment

As we aimed to evaluate several outcomes and exposures, we selected a large sample size to achieve our goals with adequate statistical power (at least 80%), assuming an alpha level of 0.05. A sample size of 10,000 people (≥35 years) can identify the prevalence/incidence values of cardiovascular diseases and the related risk factors ranging from 5 to 30% with the desired precision between 0.45 and 0.9% (all desired precisions less than 1%). A sample size of about 12,500 individuals (≥15 years) can detect prevalence/incidence rates of psychological symptoms and disorders ranging from 5 to 40% with the desired precision of less than 1%. Finally, five thousand households were sufficient to estimate an annual rate of 5000 per 100,000 person-years for injury with the desired precision of 350 per 100,000 person-years.

For recruitment, we selected 10,000 residential zip codes via systematic random sampling from a total of about 8 million residential zip codes. Then, we received the data of these 10,000 zip codes from the Tehran Telecommunication Company. These data included the identity of the line-owner, postal address, and landline telephone number. We then called every single telephone number. If the called number was not responsive after three calls or belonged to a commercial business
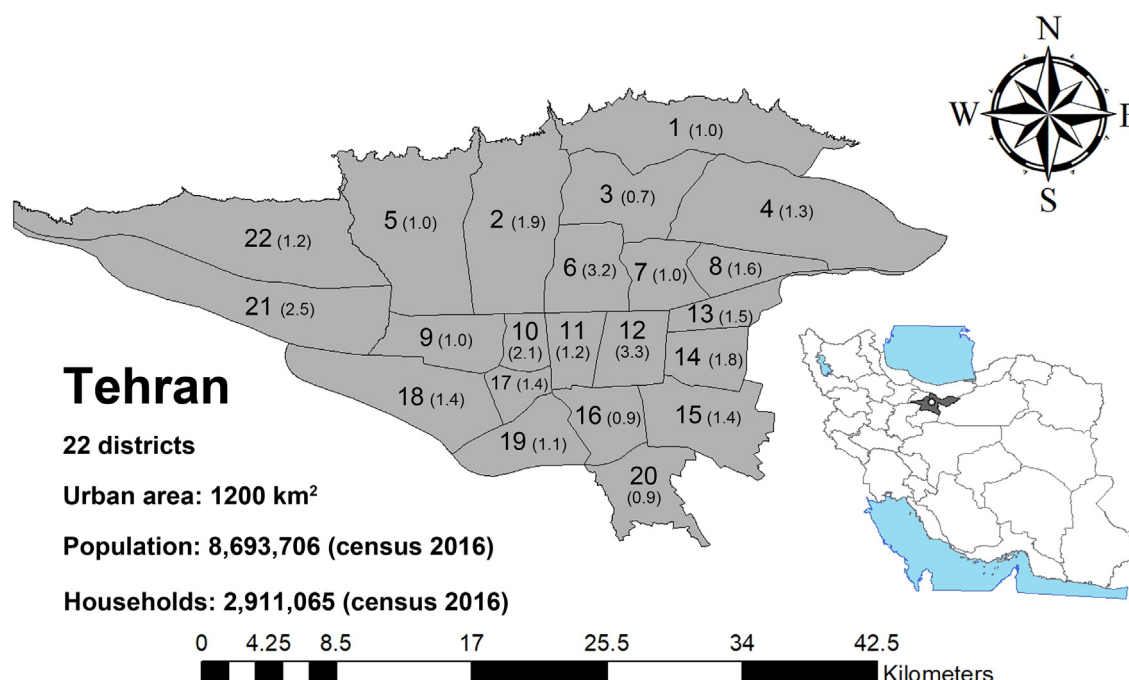

Fig. 1. Map of Tehran and its 22 districts. The number in parentheses represents the number of recruited households per 10,000 households in every district.

despite being registered as a residential landline, it was omitted from our list. In case the number was for a household and the members met the study criteria, the household was invited to participate in the study on the coming weekend (Friday in Iran). Upon acceptance, the households' data and the address were rechecked, and at least one mobile number was obtained to ensure follow-ups. They were also asked to bring their medical records and past test results if they have. Then, we mailed an introductory package to the participant's address to inform them about the study's features and hints on personal health. The enrollment visits were performed every Friday at Tehran Heart Center. For those unable to refer to our center, a scheduled home-visit for the initial interview and physical exam was set in the next coming week (s). Between 50 and 100 telephone numbers were contacted every week. The participants were asked to be fasting on the day of recruitment. The workflow of the cohort is shown in Fig. 2.

Participants

We contacted 10,000 households in Tehran for the recruitment phase from March 2016 to March 2019 to include 5000 households for the study. The inclusion criteria were residing in Tehran at the time of study and having at least one person aged 35 years and above in the household. The exclusion criteria were 1) inability to participate in the study, 2) not being a permanent resident in Tehran, 3) Immigrating to Tehran in less than a year, or 4) emigrating from Tehran during the study.

For the cardiovascular section of the cohort, we enrolled the household members aged 35 years and above. We collected the data from the household members aged 15 years and older for the psychological health section. In the injury section, we collected the whole household data, regardless of its members' age. The data of the injury section was obtained from the head of the household.

Registration

Upon arrival at our center, the participant's identity and contact details were verified and completed. We collected mobile numbers from all household members to track them for future follow-ups and reduce attrition. Then, the participants were asked to read and sign an informed consent form. A unique file number was given to every participant to track the records and biological samples. Next, the participants were directed to the laboratory department to obtain blood samples.

Phlebotomy and laboratory tests

A 20 mL venous blood sample from the antecubital vein was obtained after overnight fasting from every individual in the morning of the recruitment day (between 7:30 and 10:30 a.m.). Using quick serum tubes (VACUTEST KIMA group, Arzegrande, Italy), we collected serum, citrated, and EDTA plasma samples. The specimens were centrifuged and stored in four separate 1.5 mL cryotubes (Micronic, Lelystad, the Netherlands) for every sample (12 cryotubes in total). Using the buffy coat sample, we collected DNA-extracted samples in three 0.75 mL cryotubes for further genetic tests. DNA extraction was done via ion-exchange chromatography using Blood Genomic DNA Extraction Mini Kit + Proteinase K (Favorgen Biotech, Taiwan). All cryotubes were well-kept in a GFL Ultra freezer (500 L) at −85 °c in our biobank. The remaining serum sample was centrifuged and used for baseline measurements, including fasting blood sugar, cholesterol, triglyceride, blood urea nitrogen, creatinine, high-density lipoprotein, and low-density lipoprotein. The biochemistry measurements were performed using Roche kits (Roche Diagnostics, Basel, Switzerland) and COBAS Integra 400 plus device (Roche Diagnostics, Basel, Switzerland). The tests' results were recorded in our database. A free copy plus physician advice (including the need for further diagnostic tests or medication)
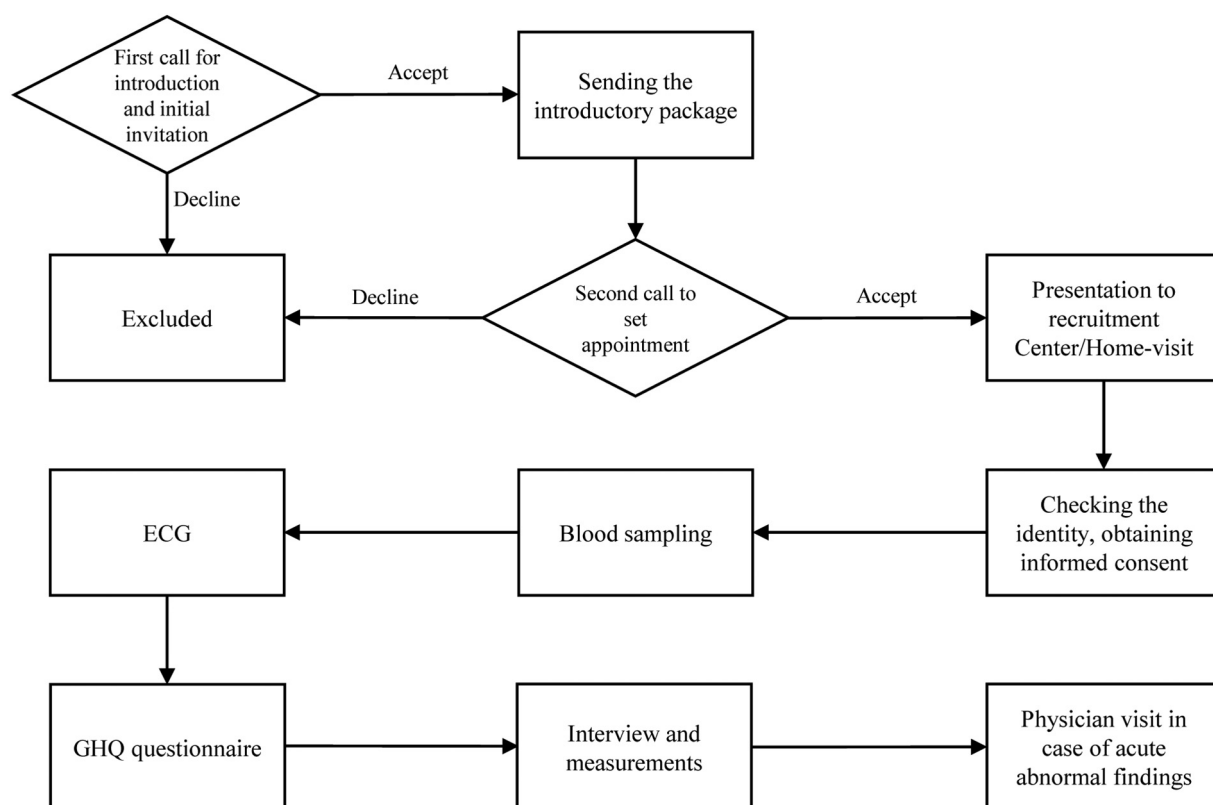

Fig. 2. The workflow of the recruitment phase of the Tehran Cohort Study, March 2016 to March 2019.

was sent to the participants by mail as an incentive. At the end of this process, a breakfast package was given to every participant.

Electrocardiogram

After obtaining blood samples, a 12-lead electrocardiogram (ECG) was obtained using a 12-channel M-TRACE ECG device (M4Medical, Lublin, Poland). A copy of the ECG was printed saved in the participant's file, and another copy was sent to them in the report package. Moreover, the electronic file of the ECG was saved on our server. An expert cardiologist reviewed and interpreted all the ECG recordings and entered the results in the ECG form.

Anthropometric measurements

For anthropometric and physiologic characteristics, weight, height, waist and hip circumference, blood pressure, and pulse rate were measured. Blood pressure and pulse rate were measured using a digital sphygmomanometer, M6 Comfort Omron (Omron Healthcare, Kyoto, Japan). A research nurse performed these measurements while the patient was sitting for at least five minutes from the right arm. If the first measurement was above 130/80 mmHg, a second measurement was done after another five minutes. For clinical decisions and data analysis, we considered the second measurement. The attending physician visited the participants who had high blood pressure, abnormal ECG patterns, or any other acute health condition at the cohort site.

Evaluations

In this study, we evaluated the participants through several questionnaires designed based on the study outcomes. Participants' sociodemographic data, habits, medical/medication history, family history of chronic diseases, and sudden death were gathered via separate questionnaires by the cohort team. Demographic data to be captured included date and place of birth, ethnicity, education level, occupation, marital status, and contact details. For habits, the individuals were asked for smoking (cigar, cigarette, pipe, and waterpipe), drug abuse, and alcohol. For smoking, we asked the participants about the number of cigarettes per day and the time they were smoking to calculate pack-year. Similar questions were asked from the pipe and waterpipe smokers. We asked the participants about the use of an opioid (opium, heroin, and other derivatives of opium) and non-opioid (marijuana, cocaine, methamphetamines, analgesics) drugs, their duration, frequency, amount, and route of use (inhalation, oral, injection). For alcohol users, we only asked about the duration of drinking alcoholic beverages and their frequency (occasional or regular). A thorough medical and medication history was obtained from the participants that included the history of the previous hospitalization, surgeries, chronic diseases, other comorbidities in all organ systems, and the name, frequency, and dosage of the medications. A history of sudden death, cerebrovascular accident, myocardial infarction, cancer, hypertension, diabetes, and dyslipidemia in the parents and siblings was asked for the family history. In the case of these outcomes, the family member's age at the time of occurrence was recorded.

We used the standardized Persian version of the Rose angina questionnaire [20] to assess chest pain and ischemic cardiac symptoms in the participants. This form was filled up for all the individuals aged 35 or more within every household.

To evaluate the participants' psychological health, we asked the participating household members aged 15 years and above to complete our questionnaire. We used the standardized Persian version of the general health Questionnaire-28 (GHQ-28) [21,22]. If the household member was not invited for the cardiovascular section (i.e., age between 15 and 35 years) and was not present at the recruitment center, we provided his/her family a stamped envelope to send back the completed form later.

The occurrence of injury within the household (regardless of the household member's age) was sought using a questionnaire developed by an expert panel. This form was completed via an interview with the head of the household. We asked about the occurrence and severity of poisoning, insect/animal bite, electric shock, road accident, drowning, asphyxia, fractures, fall, and burn, plus the time, place, and outcome of the event in every member of the household. All the elements of study evaluations and their brief description are summarized in Table 1.

Home-visit

For the invitees who could not attend the recruitment visit due to disability, loneliness, far distance, or any other reason, home-visits were performed. Two nurses and a laboratory technician were sent to the household address by a Tehran Heart Center ambulance. All the processes and measurements were similar to what was done in the routine visits. The collected blood samples were delivered to the Tehran Heart center's laboratory department in a cool box within four hours after sampling.

Interpretation and reporting of data

The study researchers reviewed all the collected data within one week after recruitment. The ECG was reviewed and interpreted by a

Table 1
Evaluations of Tehran Cohort Study participants at the recruitment phase.

Element	Description
Demographics	Including age, sex, marital status, number of children, education level, ethnicity, and occupation
Cardiovascular section	
Cardiovascular disease history	History of coronary artery disease, valvular disease, conduction disorders, or any other cardiac abnormality based on self-report or the available documents
Past medical history	History of chronic disease, surgery, or medical interventions in all organ systems
Habits	Tobacco smoking, drug abuse, and alcohol drinking
Medications	Frequent use of any prescribed drug within the past month
Family history	Consanguinity of the parents. History and age of occurrence of cancer, coronary artery disease, myocardial infarction, coronary revascularization (coronary artery bypass graft, surgery, or percutaneous coronary intervention), stroke, diabetes mellitus, hypertension, dyslipidemia, and sadden death in the parents and the siblings
Rose questionnaire	The Persian version of the Rose angina pectoris questionnaire
Anthropometry	Weight, standing height, waist and hip circumference
Blood pressure and pulse rate	Measurement with a digital sphygmomanometer in a sitting position
Electrocardiogram	Digitally recorded 12-lead electrocardiogram
Laboratory tests	Fasting blood sugar (normal range: 70–100 mg/dL), triglyceride (normal: <150 mg/dL), total cholestrol (normal: <200 mg/dL), high-density lipoprotein cholestrol (low risk: >60 mg/dL), low-density lipoprotein cholestrol (normal: <130 mg/dL), creatinine (normal: 0.5–0.9 mg/dL for women and 0.7–1.2 mg/dL for men), urea (normal: 16.6–48.5 mg/dL)
DNA and serum sample for biobank	Serum samples in three 1.5 mL cryotubes; citrated plasma samples in three 1.5 mL cryotubes; EDTA plasma samples in three 1.5 mL cryotubes; DNA-extracted samples in three 0.75 mL cryotubes
Psychological health section	
GHQ-28[a]	Self-completion of GHQ-28
Injury section	
Injury and trauma questionnaire	Completion of injury and trauma questionnaire via interview from the head of the household

[a] General Health Questionnaire-28.

cardiologist, and the results were filled in the related form adopted from the Minnesota Code Classification System for electrocardiographic findings [23]. The GHQ-28 questionnaire was scored and interpreted by an expert psychologist as well. Finally, a printed report package, including laboratory test results, cardiovascular assessment, psychological health evaluation, and individually-related health recommendations by a physician, was sent to the participants' addresses. We communicated all the participants with any abnormality in their assessments to visit their physician or refer for further workup.

Follow-up

All the participants are planned to follow up every three years for up to 12 years. The first round of follow-up visits began in September 2019 and is still ongoing. For the first follow-up, we are completing the same forms and performing similar measurements as the recruitment phase to track the participants' health condition changes or the occurrence of the study outcomes within the three years. Moreover, we have added the diet and physical activity questions from the STEPs instrument version 3.2 to measure the participants' nutritional habits and physical activity [24]. In addition to previous laboratory tests, we have also added hemoglobin A1c to our measurements. Serum sample for DNA extraction was only obtained in those enrolled in the first follow-up visit or did not have a viable sample in the recruitment phase.

The households not wishing to participate in the follow-up visits were requested to complete a short form via a telephone call, describing the occurrence of the study outcomes since the last visit. Furthermore, if they had done any laboratory test or cardiovascular diagnostic test (e.g., ECG, echocardiography, coronary angiography, else), we asked them to scan and send the results via the internet. If any of the participants within households died during the follow-up time, a mortality form was completed via telephone call or at the follow-up visit session of other household members. In this form, we asked his/her partner or the closest family member about the time, place, and cause of death of the deceased participant. In cases that died at a hospital, we would contact that hospital to get documented medical data.

Dynamic cohort

TeCS benefits from a combination of fixed and dynamic cohort populations. In our study, the initial location of every household is considered as the sampling unit. Therefore, if a household moved to another place, the new residents at the same zip code would be invited to participate (the dynamic population). To keep the original recruited cohort population (i.e., the fixed cohort population), the participants of the recruitment phase who had already moved from the baseline address would be contacted via their mobile numbers. If they were still residing in Tehran, they would be invited for a follow-up visit.

Another aspect of the dynamic cohort is the inclusion of family members under 35 years at the time of recruitment. If they gain the age criterion at any time during follow-up, they will be invited to participate in the cohort's cardiovascular section.

Data management and quality control

On the day of recruitment, the study manager supervised the process of visits and data collection to ensure their accordance with the TeCS protocol. In the following week, all the collected data were double-checked for completeness and legibility. The data manager regularly checks and cleans the dataset to ensure validity and completeness, and the reports are sent to the principal investigators. The data is confidential and saved on secure servers at Tehran Heart Center. The investigators welcome proposals requiring anonymous data. Reports and news of the study are published online via www.tehrancohort.com.

Statistical analysis

For descriptive results that are presented in this article, we reported the mean and standard deviation of systolic and diastolic blood pressure, age, and BMI. We reported qualitative variables including sex, age categories, marital status, BMI categories, ethnicity, occupation, and education year categories as the absolute frequencies with percentages.

For future reports on the study outcomes, age and sex weighted prevalence will be calculated using the Tehran population data from the 2016 national census, and point estimates with 95% confidence intervals will be reported.

Results

The recruitment phase began in March 2016 and finished in March 2019. We contacted 9548 household numbers within this period, and 5614 households (58.8% from contacted households and 56.1% from whole telephone numbers) agreed to participate in the study. Of these, 4215 households (75.1% from agreed households and 42.1% from whole telephone numbers) participated in the study that comprised 10,247 individuals from a total of 12,922 people. (Fig. 3, and Table 2).

Overall, 8296 individuals aged ≥35 years were visited at our recruitment center, their personal and clinical data and GHQ-28 data were obtained. Moreover, from 3752 individuals <35 years, 1951 individuals (52%) completed and returned the GHQ-28 questionnaire. A summary of the number of completed forms and questionnaires in the recruitment phase is depicted in Table 3.

In the cardiovascular section ($n = 8296$), the participants' mean age was 53.8 (12.75), and 45.3% were 55 years and older. Forty-six percent were men, and 99.2% were married. Almost 30% of the participants had some college/university degrees. The mean BMI of the participants was 28.0 (4.83) kg/m^2. The mean systolic and diastolic blood pressures were 121.7 (18.92) and 80.8 (10.92), respectively. In general, 69.6% of the participants had a normal ECG. Almost 99.7% of the participants reported ethnicity, of which 48.6% were Fars, 29.6% were Azari, and 21.4% were others. A summary of the baseline data of the recruitment is depicted in Table 4.

In the psychological health section and based on the assessment of the GHQ-28, 6572 (64.3%) participants had no symptoms of psychiatric disorders in the recruitment phase.

A total of 4167 households completed the injury questionnaire in the recruitment phase (including 14,247 household members, 49.3% men, mean age = 39.6 [20.18] years). The mean family size was 3.4 individuals (range: 1–8). In the initial assessment, 3729 (89.5%) households did not have any severe injury requiring treatment in the past year.

Discussion

TeCS includes noteworthy data of about 4300 households in Tehran, which is unique in Iran and even the Middle East. This random sample includes households from all 22 districts of Tehran that encompasses all levels of socioeconomic, educational, and ethnic groups. The large number and diversity of the participants help us to provide a general picture of the current prevalence and incidence of the main study objectives. On the other hand, we have designed a complete medical history questionnaire that could offer data regarding other concomitant conditions, particularly cancers and other chronic diseases. This preliminary article described the methodology and initial findings of the recruitment phase of TeCS and is actually the cornerstone for our cohort's future reports.

Another strength of our cohort is that it consists of a closed and dynamic cohort. This also allows us to observe the change in prevalence of location-specific risk factors and its association with the study outcomes incidence. It also helps provide a proper estimation
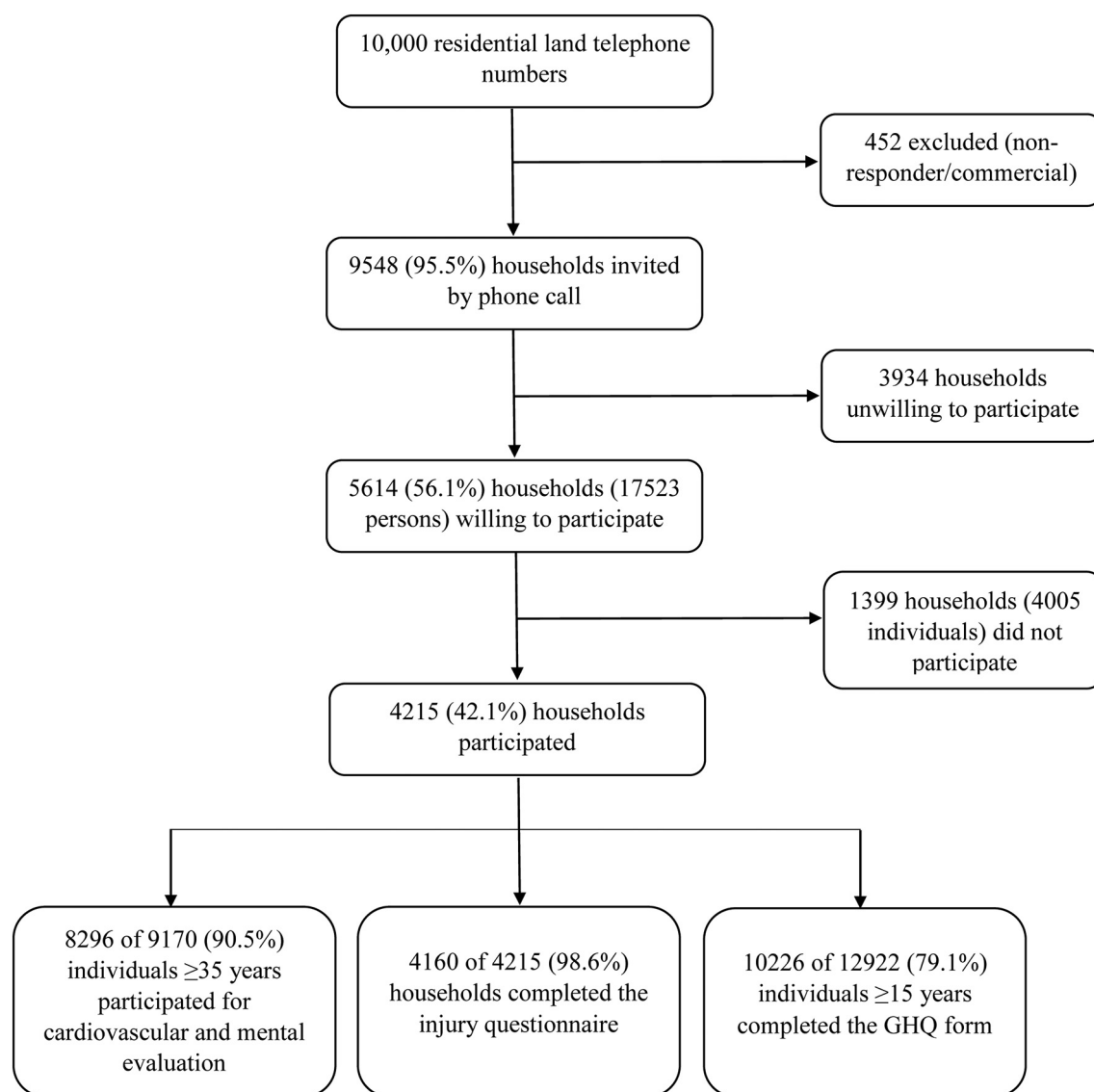
Fig. 3. Flow diagram of participation in the Tehran Cohort study.

of the prevalence of the study outcomes and their risk factors. Besides, the new households' involvement in the same zip code prevents the decrease in the number of our participants due to exhaustion, migration, or death. Additionally, tracking people moving out of their current residence enables us to study the association of reasons behind moving out (we assume socioeconomic reasons) with our study endpoints.

The limitations of this study can be listed as follows. First and as a major limitation of epidemiologic studies, non-participation is a serious concern in our study. Therefore, we randomly selected 10,000 zip code-based telephone numbers to reach a final sample of 5000 households. Non-participation happened in three stages of our study, as described in Fig. 3. All these events would be considered in our analyses by using the population pyramid from the Tehran census data, household

Table 2
Frequency, mean age, and sex of the participating and non-participating individuals within the 4215 participating households.

		15–34 years ($n = 3752$)		≥35 years ($n = 9170$)	
		Frequency (%)	Age (year), mean (SD)	Frequency (%)	Age (year), mean (SD)
Participants	Women	1007 (51.6)	24.7 (5.9)	4478 (54.0)	53.0 (13.1)
	Men	944 (48.4)	24.5 (5.5)	3818 (46.0)	54.8 (13.1)
	Total	1951 (52.0)*	24.6 (5.7)	8296 (90.5)*	53.8 (12.7)
Non-participants	Women	822 (45.6)	25.3 (5.7)	387 (44.3)	54.2 (15.8)
	Men	979 (54.4)	24.6 (5.6)	487 (55.7)	52.5 (13.6)
	Total	1801 (48.0)[a]	24.9 (5.6)	874 (9.5)*	53.3 (14.6)

SD: Standard Deviation.
[a] Percentage within the eligible individuals of the participating households.

Table 3
Number of completed forms for the participants (4215 households comprised of 8296 individuals aged ≥35 and 3752 aged 15–35 years).

Form/questionnaire	Completed forms (%)
Personal profile	8296 (100)
Cardiovascular disease profile	8278 (99.8)
Habits and risk factors	8277 (99.8)
History of diseases	8273 (99.7)
Rose angina pectoris	8279 (99.8)
Family history	8277 (99.8)
Drug history	8278 (99.8)
GHQ-28 (Age ≥ 35 years)	8275 (99.7)
GHQ-28 (Age: 15–35 years)[a]	1951 (52.0)
Injury questionnaire[b]	4167 (98.9)
ECG report	8273 (99.7)
Blood test	8277 (99.8)

ECG: Electrocardiogram; GHQ: General health questionnaire.

[a] The 15–35 year-old-members of the recruited households (n = 3752) were requested to complete the form at home and send it by prepaid post.

[b] The injury questionnaire was completed for every participating household (n = 4215).

Table 4
Baseline characteristics of the participants in the Tehran Cohort Study, cardiovascular section.

Characteristic	Study participants (n = 8296)
Men, n (%)	3818 (46.0)
Mean age, year[a]	53.8 (12.75)
Age group, n (%)	
35–44 years	2329 (28.1)
45–54 years	2209 (26.6)
55–64 years	1967 (23.7)
65–74 years	1222 (14.7)
≥75 years	569 (6.9)
Married, n (%)	8210 (99.2)
BMI, kg/m²[a]	28.0 (4.83)
BMI category, n (%)	
<20 kg/m2	227 (2.8)
20–24.99 kg/m²	2079 (25.3)
25–29.99 kg/m²	3426 (41.7)
30–34.99 kg/m²	1796 (21.9)
≥35 kg/m2	683 (8.3)
Systolic blood pressure, mmHg [a]	121.7 (18.92)
Diastolic blood pressure, mmHg [a]	80.8 (10.92)
Ethnicity, n (%)	
Fars	4035 (48.6)
Azari	2454 (29.6)
Gilak	332 (4.0)
Lor	319 (3.8)
Kurd	193 (2.3)
Mixed	682 (8.2)
Other[b]	207 (2.5)
Immigrants/refugees	51 (0.6)
Unknown	23 (0.3)
Occupation, n (%)	
Employed	3397 (40.9)
Housewife	3197 (38.5)
Retired	1447 (17.4)
Unemployed	232 (2.8)
Unknown	23 (0.3)
Education, n (%)	
Illiterate	585 (7.1)
1–5 years	841 (10.2)
6–11 years	4306 (52.0)
≥12 years	2541 (30.7)

[a] Quantitative variables are shown as mean (standard deviation).

[b] Including Mazani, Tat, Balooch, and Arab ethnicities.

numbers within each district of Tehran, and calculating age and sex weighted prevalence estimates for every study outcome. Accordingly, we lack the data for the non-responders to our calls, so we cannot evaluate their characteristics at all. As a remedy, we can compare responders' data with every district's population data in Tehran. Besides, some of the household members did not wish to participate in the study, and we could not assess their characteristics in detail. The only available data for such individuals are the demographics and injury completed through questionnaires for the whole household. However, they are re-invited and encouraged to join the cohort in every single follow-up visit. Nevertheless, those who did not meet the age criteria in the recruitment phase will be invited to join the cohort in the follow-up visits if they have reached the age of inclusion. Due to time and financial resource limitations, we could not utilize further cardiovascular diagnostic modalities, such as echocardiography, ankle-brachial index, and arterial stiffness measurements.

Recall bias should also be considered in recording some of our variables, particularly in the injury questionnaire. Another concern is hesitation to report some injuries or drinking habits, although we have ensured the participants that their data would remain confidential. Therefore, the underestimation of these variables is not far from the truth.

Like any other longitudinal study, loss of follow-up is a major restriction. Still, we try to minimize it by improving communication with our participants and providing transfer facilities and perhaps other incentives in the future. Recording the household members' mobile numbers could help us track the household in case of transfer or migration and invite them for future follow-ups. Completing a telephone follow-up form for those who do not wish to participate anymore could help us keep a good track of the study outcomes. Despite all these limitations, our cohort's ubiquitous population and the long duration of follow-up could help answer Tehran's major health problems.

Overall, the data collected in TeCS is of great importance and value because it can give us a broad picture of the present status and trend of cardiovascular diseases, psychological health, and injury in Tehran's citizens. Moreover, we can recognize any possible association between our cohort's major topics and discover novel causality links between them. Our findings can be the mainstay for future studies and be used as a reliable and valid reference for researchers in these fields. And finally, our cohort data can be utilized for health care planning and prevention of non-communicable diseases in Iran as the most comprehensive data source in the studied fields.

Authors' contribution

Study Design: Shafiee, Jalali, Sadeghian, Saadat, Alaeddini, Shahmansouri, Noorbala, Zafarghandi.

Data collection: Shafiee, Jalali, Haddadi, Tajdini, Ashraf, Omidi, Masoudkabir.

Supervision, logistics and consultations: Jalali, Alaeddini, Boroumand, Sadeghian, Poorhoseini, Salarifar, Karimi, Noorbala, Zafarghandi, Mansournia.

Drafting: Shafiee, Jalali.

Statistical analysis and data management: Jalali.

All the authors have read and confirmed the final version of the manuscript.

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Declaration of Competing Interest

The authors have no conflict of interest to declare.

Acknowledgments

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