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Research article

Risk factors and characteristics of new-onset coronary heart disease in adults with physical disabilities: A retrospective cohort study

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ABSTRACT

Objectives: There is limited information about coronary heart disease (CHD) in adults with physical disabilities. This study was performed to assess the incidence and predictors of the new development of CHD in adults with physical disabilities.

Methods: A retrospective cohort study was performed on 3902 physically disabled people in Shanghai, China. Baseline information was collected in January 2012, and participants were followed-up with for 7.5 years for CHD events. Risk factors for demographic characteristics, disease history, electrocardiography, and blood biochemical indicators were evaluated using a Cox proportional hazard model. Subgroup analyzes were performed according to gender and level of physical disability.

Results: Out of the total 3902 adults with physical disabilities (average age 55.9 ± 8.5 years), 468 (12.0%) developed CHD, during a median follow-up period of 7 years. Independent predictors of CHD included the following: age (HR = 1.411, 95% CI = 1.255–1.587, $p < 0.001$), gender (HR = 0.773, 95% CI = 0.637–0.940, $p = 0.010$), abnormal electrocardiogram(HR = 1.396, 95% CI = 1.088–1.792, $p = 0.009$), hypertension (HR = 1.657, 95% CI = 1.369–2.006, $p < 0.001$), diabetes (HR = 1.649, 95% CI = 1.307–2.081, $p < 0.001$), serum uric acid (HR = 1.001, 95% CI = 1.000–1.002, $p = 0.046$), and total cholesterol (HR = 1.416, 95% CI = 1.054–1.902, $p = 0.021$). In addition to the risk factors of the total population with physical disability, triglyceride was also a significant risk factor for CHD in the subgroup with women and mild disability.

Conclusions: During a 7.5 years period, the CHD incidence rate among physically disabled people was 12.0%. We identified the role of CHD risk factors such as age, gender, hypertension, diabetes, serum uric acid, total cholesterol, and abnormal electrocardiogram.

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1. Introduction

According to the second sample survey of people with disabilities in China, as many as 83.96 million people in China suffer from some form of disability [1]. People with physical disabilities make up the largest subgroup of all Chinese individuals with disabilities, reaching almost 30% [1]. The health problems of people with physical disabilities can be problematic due to the aging of the population and the high prevalence of chronic diseases. Individuals with a physical disability may face multiple physical, psychological, and social challenges because of a prolonged loss or limitation of motor function. Studies have established that physically disabled people have a poorer quality of life, higher risk of morbidity and mortality, and heavier economic burdens than their healthy peers [2–4].

Coronary heart disease (CHD) is a major public health concern because of its increasing prevalence worldwide and potentially severe sequelae, especially in disabled people who have a limited capacity for self-care [5–7]. However, previous articles have focused on healthy or general populations. Other studies have shown that individuals with physical disabilities are at higher risk of cardiovascular diseases than the general population [8,9]. Research gaps for CHD in people with physical disabilities have limited the healthcare support that they urgently need. Despite the higher prevalence and diverse risk of CHD among people with physical disabilities, little is known about CHD-related risk factors during the long-term follow-up of people with physical disabilities.

Individuals with physical disabilities and the general population have different etiologies and risk profiles for CHD resulting in differences in disease progression, prognosis, and treatment. The identification and management of risk factors are therefore essential to reduce morbidity and mortality in this population. In this study, we estimated the incidence of CHD and the risk factors for CHD in the physically disabled population.

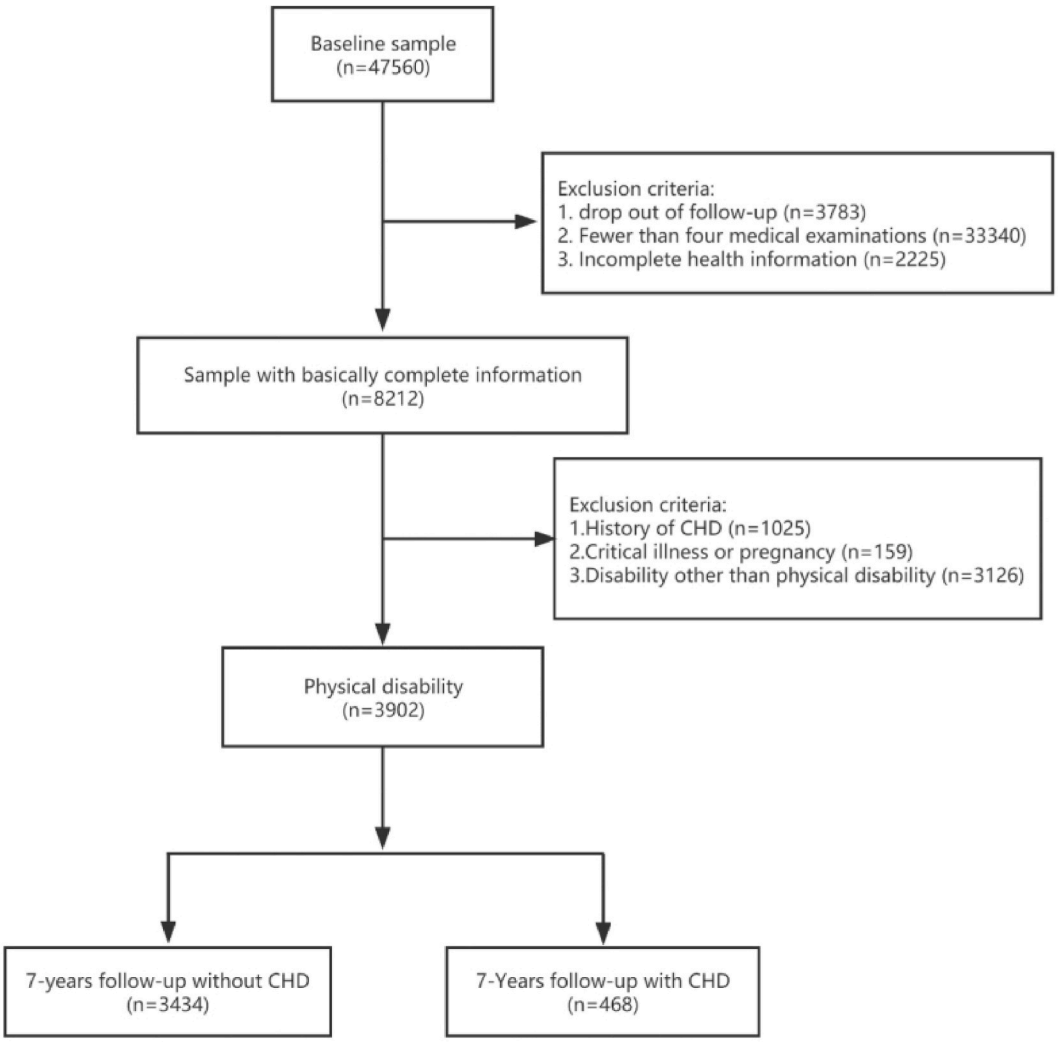

Fig. 1. Flow diagram of the study population.

2. Materials and methods

2.1. Ethics statement

This study was approved by the Ethics Committee of Shanghai Yangzhi Rehabilitation Hospital (YZ 2019–051) and written informed consent was obtained from involved patients prior to enrollment.

2.2. Data source

All data were derived from a 7.5-year retrospective cohort based on the database of people with disabilities established from January 2012 to June 2019 by the Shanghai YangZhi Rehabilitation Hospital (Shanghai Sunshine Rehabilitation Center). The retrospective cohort consisted of 47,560 licensed people with disabilities aged 18 years and over who had health check-up records, which included demographic information, history of chronic disease, history of medication and disability, and physical examination indicators.

2.3. Study population

A retrospective cohort study of people with physical disabilities was performed. Inclusion criteria: (1) Completion of at least 4 physical examinations and follow-ups within 7.5 years; (2) Have complete health check-up records for each physical examination, and the last follow-up was in 2019. Exclusion criteria: (1) Diagnosed CHD before 2012: The diagnosis was confirmed by professional physicians concerning WHO standards, subjects with typical clinical symptoms, combined with electrocardiograms(ECGs) manifestations of myocardial ischemia and/or elevated myocardial enzymes; (2) Those with other critical diseases, such as malignant tumor, heart failure, renal failure, respiratory failure, liver failure, severe trauma, and cerebral cortex damage; (3) Pregnant women, lactating women and those who are planning to become pregnant in the past six months; (4) People with disabilities other than physical disabilities.

Fig. 1 presents the flow diagram of the study population. We enrolled 47,560 disabled adults who voluntarily received free physical examinations at the Shanghai YangZhi Rehabilitation Hospital from January 2012 to June 2019. Among them, 3783 participants voluntarily withdrew during the follow-up for some reason, 33,340 individuals had less than 4 physical examination follow-up visits in 7.5 years, and 2225 people had incomplete health check-up records. Of the remaining 8212 adults with disabilities, 1025 were diagnosed with CHD before 2012, 159 were severely ill or pregnant, and 3126 people without physical disabilities were excluded. Finally, 3902 physically disabled people were included in the follow-up analysis and entered the observation cohort of CHD incidence.

The outcome was CHD events during follow-up from January 2012 to June 2019, coded by ICD-10 (I 20 – I 25), and included mainly unstable and stable angina, acute myocardial infarction, and chronic ischemic heart disease.

2.4. Measurements

The sociodemographic characteristics, history of chronic disease, history of medication, and disability of the participants were collected through questionnaires. History of chronic disease mainly included hypertension, diabetes mellitus (DM), chronic kidney disease (CKD), and nonalcoholic fatty liver disease (NAFLD). All participants voluntarily underwent health examinations by professional medical personnel, including physical examinations, laboratory tests, and electrocardiography. Body mass index (BMI) was calculated based on weight (kg)/(height (m)^2). For those who did not move or were unable to stand, the height was measured in the supine position. Blood pressure was measured twice with an automatic arm blood pressure monitor (Omron, Tokyo, Japan), and the average value was recorded. Participants generally received upper extremity blood pressure measurements in a sitting position. For participants with missing upper extremities, physicians measured blood pressure in both lower extremities in the prone position and used the blood pressure measurement with the highest reading. All participants were required to fast overnight for at least 12 h, and venous blood was drawn the next morning for biochemical assays. Fasting blood glucose (FBG), total cholesterol (TC), total triglyceride (TG), serum uric acid (SUA), serum creatinine (SCr), serum urea (SU), hemoglobin (Hb) were measured and reported by laboratory physicians for each participant.

2.5. Definitions

Physical disability is defined as the mutilation of the extremities or paralysis or deformity of the extremities or trunk resulting from a structural or functional injury to the human motor system, resulting in varying degrees of loss of human motor function and limitations of activity or participation. The physical disability level was classified into four levels based on the classification and grading criteria of disability (GB/T 26,341–2010) and the International Classification of Functioning, Disability, and Health (ICF) [10]. Subjects with Level I and II were those who were suffer from severe disability and unable to independently perform activities of daily living. Therefore, we classify Level I and II into one category and Level III and IV into another.

Hypertension was defined as systolic blood pressure $\geq$140 mmHg or diastolic blood pressure $\geq$90 mmHg according to WHO criteria or history of a previously diagnosed disease [11]. DM was defined as fasting blood sugar levels $\geq$7.0 mmol or a previous medical diagnosis of diabetes mellitus [12]. Chronic kidney disease is defined as kidney damage (either functional abnormalities of the kidneys or structural abnormalities as noted in imaging studies) or a glomerular filtration rate $<$60 mL/min/1.73 m^2 for more than 3 months

[13]. NAFLD is defined as evidence of hepatic steatosis by imaging or histology and without causes for secondary hepatic fat accumulation such as significant alcohol consumption, use of steatogenic medication or hereditary disorders [14]. Abnormal ECGs findings were defined as evidence of ST-T change, T wave change, tachycardia, bradycardia, arrhythmia, and conduction blockade.

2.6. Statistical analysis

The statistical analyses were conducted using SPSS 24.0 (SPSS, Chicago, IL, USA). We divided people with physical disabilities into two groups according to whether CHD events occurred and compared the differences in disease history and clinical indicators between the two groups. Using Cox proportional hazards regression analyses, models with age and multiple adjustments were applied to assess the risk factors for CHD in people with physical disabilities. We identified independent variables for multivariate Cox regression models by univariate analyses and regression models adjusted for age only ($p < 0.10$). Covariates in the multivariable Cox proportional hazards regression models included age, gender, FBG, TC, TG, SU, SUA, hypertension, Diabetes, and abnormal ECGs. The model met the proportional hazards assumption. We used receiver operating characteristic (ROC) curve analyses to determine whether the predictors have diagnostic accuracy. To explore the effect of gender and level of disability on the associated risk elements of CHD, we conducted a subgroup analysis. We also showed HRs with 95% CI and p values for each of the risk factors.

3. Results

3902 physically disabled people were included in this cohort, with an average age of (55.9 ± 8.5) years, of which 1727 (44.3%) were male. Over a median follow-up period of 7.5 years, a total of 468 out of 3902 subjects had developed CHD, with an incidence rate

Table 1
Baseline clinical characteristics of the study population according to the presence or absence of coronary heart disease events at follow-up.

Variables	Total (n = 3902)	CHD (n = 468)	Non-CHD (n = 3434)	P values
Sociodemographic features				
Age, mean (SD), year	55.94 (8.5)	57.73 (6.6)	55.56 (8.7)	< 0.001
Age, mean (SD), per 10 years	5.49(0.9)	5.77(0.7)	5.46(0.9)	**< 0.001**
Gender, *n* (%)				0.076
Male	1727 (44.3)	225 (48.1)	1502 (43.7)	
Female	2175 (55.7)	243 (51.9)	1932 (56.3)	
Education, *n* (%)				0.455
Illiterate	59 (1.5)	7 (1.5)	52 (1.5)	
Primary school	612 (15.7)	63 (13.5)	549 (16.0)	
Middle school	3085 (79.1)	377 (80.6)	2708 (78.9)	
College or over	146 (3.7)	21 (4.5)	125 (3.6)	
Level of disability, *n* (%)				0.675
I-II	477(12.2)	60(12.8)	417(12.1)	
III-IV	3425(87.8)	408(87.2)	3017(87.9)	
SBP, mean (SD), mmHg	134.76 (20.5)	136.96 (20.5)	134.46 (20.5)	**0.013**
DBP, mean (SD), mmHg	79.91 (12.3)	80.79 (12.5)	79.79 (12.2)	0.105
BMI, *n* (%), kg/m^2				0.071
<18.5	158(4.0)	14(3.0)	144(4.2)	
18.5 ~ < 24.0	1823(46.7)	203(43.5)	1620(47.4)	
24.0 ~ < 28.0	1440(36.9)	181(38.8)	1259(36.9)	
≥28.0	461(11.8)	69(14.8)	392(11.5)	
Abnormal ECG, *n* (%)	430 (11.0)	75 (16.0)	355 (10.3)	**< 0.001**
HR, mean (SD), beats/min	77.7 (9.8)	78.18 (11.1)	77.67 (9.6)	0.294
Medical history				
Hypertension, *n* (%)	1651(42.3)	273 (58.3)	1378 (40.1)	**< 0.001**
Diabetes, *n* (%)	459 (11.8)	89 (19.0)	370 (10.8)	**< 0.001**
CKD, *n* (%)	627 (16.1)	86 (18.4)	541 (15.8)	0.147
NAFLD, *n* (%)	348 (8.9)	36 (7.7)	312 (9.1)	0.321
Blood biochemistry				
TC, *n* (%), mmol/L				**0.001**
< 6.22	3627(93.0)	418(89.3)	3209(93.4)	
≥6.22	275(7.0)	50(10.7)	225(6.6)	
TG, *n* (%), mmol/L				**0.013**
< 2.26	3311(84.9)	379(81.0)	2932(85.4)	
≥2.26	591(15.1)	89(19.0)	502(14.6)	
FBG, mean (SD), mmol/L	5.20 (4.9,5.6)	5.30 (4.9,5.9)	5.20 (4.9,5.6)	**< 0.001**
SUA, median (quartiles), mol/L	319.2 (266.4378.8)	331.6 (276.7389.6)	317.1 (265.4377.6)	**0.004**
SCr, median (quartiles), μmol/L	62.90 (51.9,74.7)	63.45 (51.3,77.1)	62.80 (51.9,74.2)	0.537
SU, median (quartiles), mmol/L	5.10 (4.3,5.9)	5.20 (4.5,6.1)	5.10 (4.3,5.9)	**0.001**
Hb, mean (SD), g/L	138.65 (15.7)	137.62 (15.9)	138.79 (15.7)	0.136

Abbreviations: SBP: Systolic Blood Pressure; DBP: Diastole Blood Pressure; BMI: Body Mass Index; HR: Heart rate; CKD: Chronic kidney disease; NAFLD: Nonalcoholic fatty liver disease; TC: Total cholesterol; TG: Triglyceride; FBG: Fasting blood glucose; SUA: Serum uric acid; SCr: Serum creatinine; SU: serum urea; Hb: hemoglobin.

of 12.0%. Baseline clinical characteristics between subjects with CHD and subjects with non-CHD are listed in Table 1. Other than the traditional CHD risk factors such as age, hypertension, and Diabetes, variables including SBP, FBG, TC, TG, SUA, and SU were all significantly higher in subjects with CHD ($p < 0.05$).

Age (HR = 1.547, 95% CI = 1.383–1.731, $p < 0.001$) is a high predictor of CHD in people with physical disabilities. Significant age-adjusted predictors of CHD also included gender (HR = 0.824, 95% CI = 0.687–0.988, $p = 0.037$), abnormal ECG (HR = 1.546, 95% CI = 1.208–1.980, $p = 0.001$), hypertension (HR = 1.745, 95% CI = 1.446–2.106, $p < 0.001$), diabetes (HR = 1.731, 95% CI = 1.373–2.182, $p < 0.001$), TC (HR = 1.561, 95% CI = 1.164–2.094, $p = 0.003$), TG (HR = 1.389, 95% CI = 1.103–1.750, $p = 0.005$), FBG (HR = 1.094, 95% CI = 1.043–1.148, $p < 0.001$), SUA(HR = 1.001, 95% CI = 1.000–1.002, $p = 0.038$) and SU (HR = 1.061, 95% CI = 1.000–1.127, $p = 0.050$) (Table 2). In the multivariate model, age (HR = 1.411, 95% CI = 1.255–1.587, $p < 0.001$), gender (HR = 0.773, 95% CI = 0.637–0.940, $p = 0.010$), abnormal ECG (HR = 1.396, 95% CI = 1.088–1.792, $p = 0.009$), hypertension (HR = 1.657, 95% CI = 1.369–2.006, $p < 0.001$), diabetes (HR = 1.649, 95% CI = 1.307–2.081, $p < 0.001$), SUA (HR = 1.001, 95% CI = 1.000–1.002, $p = 0.046$), and TC (HR = 1.416, 95% CI = 1.054–1.902, $p = 0.021$) were the independent predictors of CHD (Table 3). The risk factors for developing CHD identified in Table 3 may have potential diagnostic value. We performed ROC curve analysis for all participants with physical disabilities, and the multivariate model had an Area Under roc Curve (AUC) of 0.659 ($p < 0.001$) (Fig. 2). The ROC results grouped according to gender, age, and disability grade were shown in Table 4. The Kaplan-Meier curves showed that those with abnormal ECG, hypertension, diabetes, and TC $\geq$ 6.22 had a significantly higher incidence of CHD events (Fig. 3).

Cox regression results grouped by gender and level of disability (Multivariate adjusted model) were shown in Figs. 4 and 5. Age, hypertension, and diabetes were independent predictors of CHD in both gender subgroups. In addition, age was a strong risk factor in subgroups of disability level.

4. Discussion

In this study, we established that the incidence rate of CHD among people with physical disabilities varies significantly across different demographics, clinical characteristics, and disability-specific characteristics. Almost 12% of physically disabled people who were free of CHD at baseline developed CHD during a median follow-up period of 7 years. In addition, age, gender, abnormal ECGs, hypertension, diabetes, SUA, and TC were independent predictors of CHD. A combined assessment of these indicators in the disabled population may facilitate early detection of CHD.

Disability is often a life-altering experience that could further deteriorated health issues via negative impact on physical, cognitive, and/or psychosocial. Existing evidence, while limited, supports that physically disabled people have been shown to be at higher risk of vascular comorbidities compared with their healthy peers. In the current study, we identified the robust risk predictors of CHD among physical disabled people, including age, abnormal ECGs, hypertension, and diabetes. The elevated level of BMI is known to be associated with cardiovascular events in the general population, which showed no significant correlation with CHD in our study. BMI measurement may be distorted due to the absence of limbs in our study population. The Kaplan-Meier curve showed that there was no significant gender difference in the incidence rate of CHD, which is different from the traditional study of gender susceptibility to CHD [15–17]. In consistent with the previous studies, co-morbidities including hypertension and diabetes were independent predictors of CHD events in physically disabled population.

Table 2
Age-adjusted model for prediction of CHD events.

Variables	*HR (95% CI)*	*P-value*
Age (years, per 10 year)	1.547 (1.383–1.731)	**< 0.001**
Gender (male/female, %)	0.824(0.687–0.988)	**0.037**
SBP (mmHg)	1.001(0.997–1.006)	0.540
BMI (kg/m^2, %)		
<18.5	1 (reference)	
18.5 ~ < 24.0	1.172(0.682–2.015)	0.566
24.0 ~ < 28.0	1.297(0.753–2.234)	0.349
≥28.0	1.522(0.856–2.705)	0.152
Abnormal ECG (%)	1.546(1.208–1.980)	**0.001**
HR (beats/min)	1.006(0.997–1.015)	0.208
Hypertension (%)	1.745(1.446–2.106)	**< 0.001**
Diabetes (%)	1.731(1.373–2.182)	**< 0.001**
TC (mmol/L, %)		
< 6.22	1 (reference)	
≥6.22	1.561(1.164–2.094)	**0.003**
TG (mmol/L, %)		
< 2.26	1 (reference)	
≥2.26	1.389(1.103–1.750)	**0.005**
FBG (mmol/L)	1.094(1.043–1.148)	**< 0.001**
SUA (mmol/L)	1.001(1.000–1.002)	**0.038**
SU (mmol/L)	1.061(1.000–1.127)	**0.050**

Abbreviations: SBP: Systolic Blood Pressure; BMI: body mass index; HR: Heart rate; TC: Total cholesterol; TG: triglyceride; FBG: fasting blood glucose; SUA: serum uric acid; SU: serum urea.

Table 3
Multivariate-adjusted model for prediction of CHD events.

Variables	*HR (95% CI)*	*P-value*
Age (years, per 10 year)	1.411 (1.255–1.587)	< 0.001
Gender (male/female, %)	0.773 (0.637–0.940)	0.010
Abnormal ECG (%)	1.396(1.088–1.792)	0.009
Hypertension (%)	1.657 (1.369–2.006)	< 0.001
Diabetes (%)	1.649(1.307–2.081)	< 0.001
SUA (mmol/L)	1.001(1.000–1.002)	0.046
TC (mmol/L, %)		
< 6.22	1 (reference)	
≥6.22	1.416 (1.054–1.902)	0.021

Abbreviations: SUA: serum uric acid; TC: Total cholesterol.

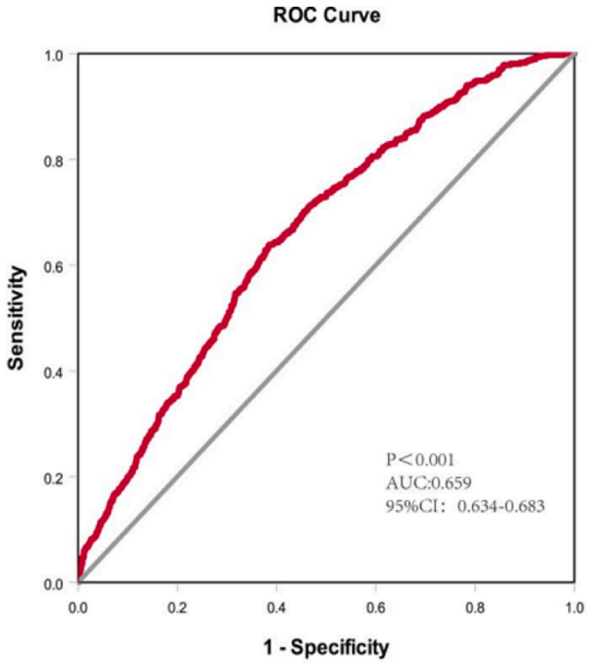

Fig. 2. ROC curves of Multivariate-adjusted model for the prediction of CHD events.

Table 4
Receiver operating characteristic (ROC) curves of Multivariable model for the prediction of CHD events.

		AUC	95%CI
Total		0.659	0.634–0.683
Gender	Male	0.648	0.610–0.685
	Female	0.707	0.672–0.742
Age	Age<60	0.666	0.637–0.696
	Age≥60	0.613	0.567–0.659
Level of disability	III-IV	0.702	0.667–0.737
	I-II	0.636	0.564–0.708

SUA is a factor affecting circulating metabolites. It can directly cause vascular endothelial damage and increase the risk of individual metabolic diseases [18]. However, there is still much controversy regarding whether SUA is an independent risk factor for CHD because SUA is closely related to many of the established risk factors for cardiovascular diseases, including hypertension, dyslipidemia, obesity, and metabolic syndrome [19–21]. Our findings show that elevated level of SUA significantly increases the risk of CHD in people with physical disabilities. This is consistent with the findings of a cohort study conducted in China [22]. Likewise, the relationship between TC and CHD is unclear, which is related to adjusting for relevant variables such as BMI and physical activity. Data from a seven-country study showed that elevated TC levels increased the risk of death from CHD in Western countries, while the opposite trend was shown in Japan [23]. In the multivariate model of this study, TC levels were positively correlated with CHD

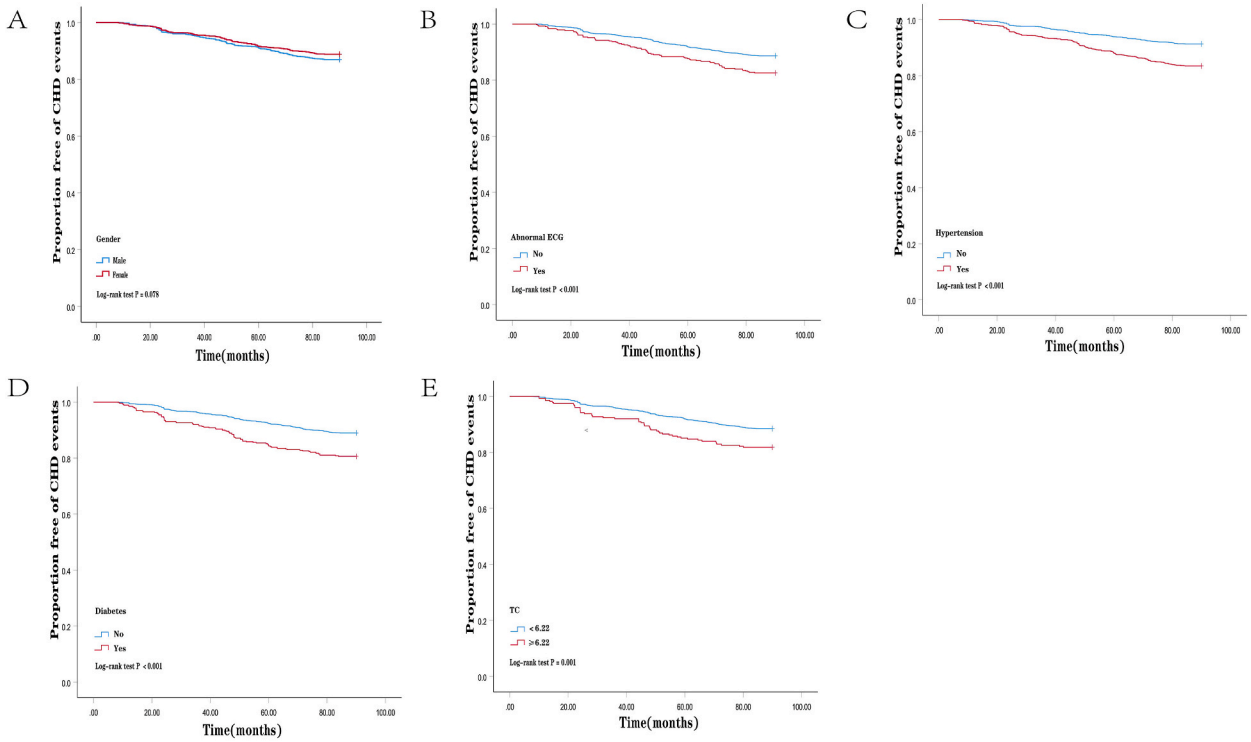

Fig. 3. Kaplan-Meier curves for CHD events in different subgroup. A. Kaplan-Meier curves for CHD events in genders. B. Kaplan-Meier curves for CHD events in Abnormal ECG. C. Kaplan-Meier curves for CHD events in hypertension. D. Kaplan-Meier curves for CHD events in diabetes. E. Kaplan-Meier curves for CHD events in TC.

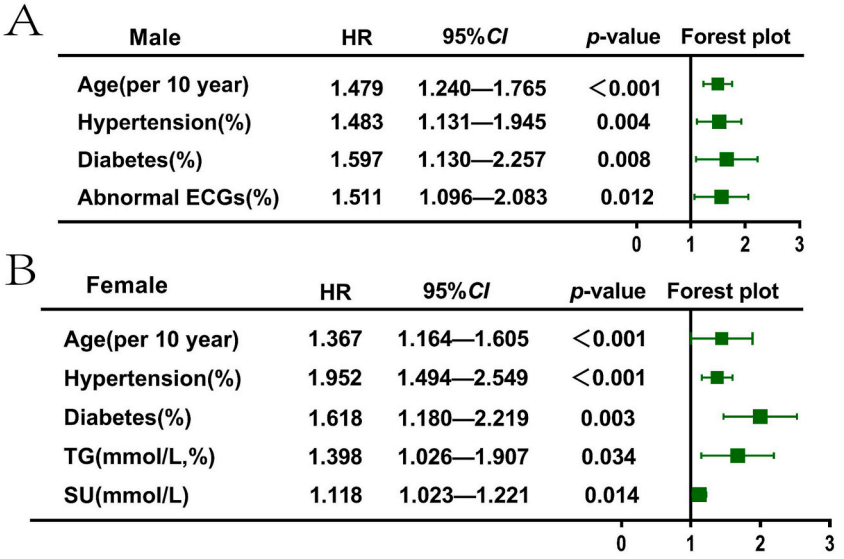

Fig. 4. **S**ubgroup analyses according to gender (multivariate-adjusted model).

prevalence. Therefore, the effect of TC on CHD in people with physical disabilities needs to be further explored. Abnormal ECGs have also been reported to play an important role in screening for CHD in the general population, which is consistent with our finding [24, 25]. This suggests that an early ECG is particularly important and can provide useful information for physicians in their preventive efforts [26].

Subgroup analysis revealed that the risk factors for CHD were not identical among people of different sexes and disability levels. In addition to the risk factors of the total population with physical disability, TG was also an independent predictor of CHD in the

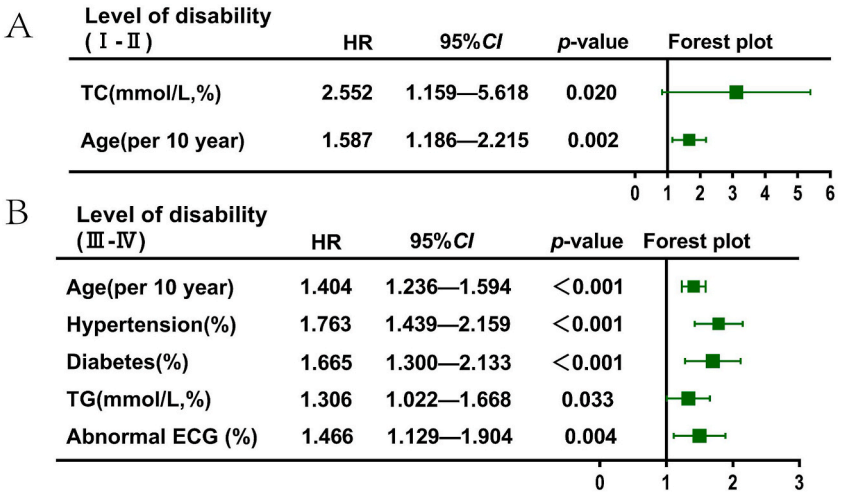

Fig. 5. Subgroup analyses according to level of disability (multivariate-adjusted model).

subgroup with women and mild disability. Better strategies are needed to manage dyslipidemia in these two subgroups to prevent cardiovascular diseases [27,28]. is impossible to ignore the importance of indicators such as BMI and blood lipids in people with physical disabilities. Because of their physical limitations, they may have difficulty participating in physical activity or may not be able to control food selection and preparation.

We performed ROC analysis based on the composite risk indicators in the multivariate model to test the diagnostic value of the predictors. ROC analysis by gender, age, and level of disability showed that the mild physical disability and female group had a larger AUC than the other groups. But in general, the AUC of the current risk factors for the incidence of CHD is not very ideal, which may be because we have neglected some risk predictors. In addition to the patients' deviant behaviors, the amputation related hemodynamic abnormalities are the leading factors for the increased risk of cardiovascular diseases [29]. Hemodynamic factors are involved in the reconstruction of vascular structure and function by affecting the morphology and proliferation of vascular endothelial cells. Future prospective cohort studies should focus on hemodynamic changes in people with physical disabilities, and hemorheological parameters such as ankle-brachial index (ABI), brachial-ankle pulse wave velocity (BaPWV), erythrocyte sedimentation rate (ESR) and blood viscosity can be taken into account.

There are a few limitations of our study that should be taken into consideration. Our target population consisted almost entirely of adults with physical disabilities from China; as a result, the results cannot be generalized to all people with disabilities. We did not collect data on the lifestyles of people with physical disabilities, such as diet and physical inactivity, and therefore cannot comment on the role of these risk factors. In addition, central obesity may be more powerful than BMI as a discriminator of cardiovascular risk factors. Future studies should include a prospective cohort survey targeting the disabled population, including lifestyle, and mental or psychological variables, and should more comprehensively assess the early warning factors for cardiovascular and cerebrovascular diseases in the disabled population.

5. Conclusion

The present study used retrospective cohort data to determine the incidence and risk predictors of CHD among people with physical disabilities during a 7-year median follow-up period. The incidence in this population was about 12%, and the risk predictors were age, gender, hypertension, diabetes, SUA, TC, and abnormal ECGs. This study provides useful information for the prevention of CHD in a special population of people with physical disabilities. More attention should be paid to the problem of CHD among people with physical disabilities. It is necessary to carry out the screening of cardiovascular and cerebrovascular risk factors in the physically disabled population, so as to facilitate early detection and early intervention and reduce the occurrence and development of adverse cardiovascular events.

Author contribution statement

Hengjing Wu; Chenghua Jiang: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data.

Jing Wu; Lan Huang: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Airong Wu; Jianlei Xu; Zhenghong Wu; Meihua Le: Performed the experiments; Contributed reagents, materials, analysis tools or data.

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Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interest's statement

The authors declare no conflict of interest.

Declaration of competing interest

The findings and conclusions in this paper are those of the authors and there are no conflicts of interest. This manuscript, including data and tables, has not been published elsewhere in whole or part, and is not under review for publication elsewhere.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e13841.

References

[1] Disability, L.G.o.t.S.C.N.S.S.o. and N.B.o.S.o.t.P.s.R.o. China, Communiqué on major statistics of the second China national sample survey on disability, Chin. J. Rehabil. Theory Pract. 12 (12) (2006).
[2] A. Dixon-Ibarra, W. Horner-Johnson, Disability status as an antecedent to chronic conditions: national health interview survey, 2006-2012, Prev. Chronic Dis. 11 (2014), 130251.
[3] G.L. Krahn, D.K. Walker, R. Correa-De-Araujo, Persons with disabilities as an unrecognized health disparity population, Am. J. Publ. Health 105 (Suppl 2) (2015) S198–S206.
[4] M. Rowland, et al., Health outcome disparities among subgroups of people with disabilities: a scoping review, Disabil Health J 7 (2) (2014) 136–150.
[5] R.Y. Khamis, T. Ammari, G.W. Mikhail, Gender differences in coronary heart disease, Heart 102 (14) (2016) 1142–1149.
[6] J. Steinberger, et al., Cardiovascular health promotion in children: challenges and opportunities for 2020 and beyond: a scientific statement from the American heart association, Circulation 134 (12) (2016) e236–e255.
[7] D. Zhao, et al., Epidemiology of cardiovascular disease in China: current features and implications, Nat. Rev. Cardiol. 16 (4) (2019) 203–212.
[8] R.A. Marrie, et al., A systematic review of the incidence and prevalence of cardiac, cerebrovascular, and peripheral vascular disease in multiple sclerosis, Mult. Scler. 21 (3) (2015) 318–331.
[9] D.W. Hollar Jr., J.S. Lewis, Heart age differentials and general cardiovascular risk profiles for persons with varying disabilities: nhanes 2001-2010, Disabil Health J 8 (1) (2015) 51–60.
[10] General administration of quality supervision, i.a.q.o.t.P.R.C. standardization administration of the P.R.C, Classification and Grading Criteria of Disability, 2011.
[11] J.A. Whitworth, World health organization (WHO)/International society of hypertension (ISH) statement on management of hypertension, J. Hypertens. 21 (11) (2003) 1983–1992.
[12] WHO, Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia: Report of a WHO/IDF Consultation, 2006.
[13] Group, K.D.I.G.O.K.C.W., KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease, Kidney Int. Suppl. (3) (2013) 1–150.
[14] N. Chalasani, et al., The diagnosis and management of non-alcoholic fatty liver disease: practice guideline by the American Gastroenterological Association, American Association for the Study of Liver Diseases, and American College of Gastroenterology, Gastroenterology 142 (7) (2012) 1592–1609.
[15] E.L. de Hollander, K.I. Proper, Physical activity levels of adults with various physical disabilities, Prev. Med. Rep. 10 (2018) 370–376.
[16] R. Diaz, et al., Impact of adaptive sports participation on quality of life, Sports Med. Arthrosc. Rev. 27 (2) (2019) 73–82.
[17] D.K. Arnett, et al., ACC/AHA guideline on the primary prevention of cardiovascular disease: executive summary: a report of the American college of cardiology/American heart association task force on clinical practice guidelines, Circulation 140 (11) (2019) e563–e595.
[18] A. So, B. Thorens, Uric acid transport and disease, J. Clin. Invest. 120 (6) (2010) 1791–1799.
[19] A.H. Wu, et al., Relation of serum uric acid to cardiovascular disease, Int. J. Cardiol. 213 (2016) 4–7.
[20] S.G. Wannamethee, Serum uric acid and risk of coronary heart disease, Curr. Pharmaceut. Des. 11 (32) (2005) 4125–4132.
[21] Y. Saito, et al., Uric acid and cardiovascular disease: a clinical review, J. Cardiol. 78 (1) (2021) 51–57.
[22] X. Lai, et al., Dose-response relationship between serum uric acid levels and risk of incident coronary heart disease in the Dongfeng-Tongji Cohort, Int. J. Cardiol. 224 (2016) 299–304.
[23] A. Sekikawa, et al., Continuous decline in mortality from coronary heart disease in Japan despite a continuous and marked rise in total cholesterol: Japanese experience after the Seven Countries Study, Int. J. Epidemiol. 44 (5) (2015) 1614–1624.
[24] F. Hadaegh, et al., Electrocardiographic abnormalities improve classification of coronary heart disease risk in women: tehran Lipid and Glucose Study, Atherosclerosis 222 (1) (2012) 110–115.
[25] K. Schröder, et al., Resting electrocardiogram predicts mortality in postmenopausal women with coronary heart disease or with risk factors for coronary heart disease, Eur. J. Prev. Cardiol. 21 (6) (2014) 749–757.

[26] R. Chou, et al., Screening asymptomatic adults with resting or exercise electrocardiography: a review of the evidence for the U.S. Preventive Services Task Force, Ann. Intern. Med. 155 (6) (2011) 375–385.
[27] A. Morrison, J.E. Hokanson, The independent relationship between triglycerides and coronary heart disease, Vasc. Health Risk Manag. 5 (1) (2009) 89–95.
[28] C.J. Packard, et al., Modelling total coronary heart disease burden and long-term benefit of cholesterol lowering in middle aged men with and without a history of cardiovascular disease, Eur Heart J. Qual. Care Clin. Outcomes 3 (4) (2017) 281–288.
[29] T. Ohkuma, et al., Brachial-ankle pulse wave velocity and the risk prediction of cardiovascular disease: an individual participant data meta-analysis, Hypertension 69 (6) (2017) 1045–1052.