Burden of cardiovascular diseases and risk factors distribution among persons with Type 2 diabetes: the Henan rural cohort baseline

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Abstract

Cardiovascular diseases (CVD) are the leading cause of mortality globally, responsible for 31% of all global deaths. This study highlights the prevalence and risk distribution of CVD in persons with type 2 diabetes in a rural population, the effect of glucose control in persons with diabetes, and the gender difference of diabetes impact on CVD occurrence. This study utilized baseline data from the Henan Rural cohort study. In all, 39184 participants with complete data were included in the present analysis. Logistic regression models were used to assess the association between diabetes and cardiovascular events. Diabetes was prevalent among the study participants (nearly 10%; 42% of persons with diabetes were undiagnosed). About10% of the participants had experienced a cardiovascular event before; persons with diagnosed diabetes were three times more likely to have experienced a cardiovascular event (OR=2.80, 95% CI: 2.51-3.12) compared to those without diabetes. There was a gender difference in the prevalence of CVD events, with more men experiencing a cardiovascular event; however, women with diagnosed diabetes were1.5 times more likely to have experienced a stroke compared to men. There was no association between glucose control and CVD in the subgroup of diagnosed diabetes. Persons with glucose control were at increased odds of a stroke event compared to those with no glucose control in the diagnosed diabetes group. Diabetes is strongly associated with CVD in our study population; women with diabetes are at increased risk of suffering a stroke. Glucose control was not associated with previous CVD history.

Summary

What is known about this subject?

- Diabetes is a known cause of cardiovascular diseases.
- Both diabetes and cardiovascular diseases share common risk factors.

What is the key question?

- Is there a difference in the gender-specific associations of diabetes and cardiovascular diseases in men and women?

What are the new findings?

- Diabetes is associated with cardiovascular diseases in the rural population.
- Women with diabetes have higher odds of stroke event compared to men.
- Glucose control is associated with higher odds of strokes.

How might this impact on clinical practice in the foreseeable future?

With further prospective studies in the association between glucose control and higher odds of stroke and the gender difference in the association of diabetes and stroke, more clarifications will thus impact on clinical decisions on glucose control and diabetes management

Introduction

Diabetes is a debilitating disease, and if undiagnosed/untreated and blood glucose brought under control often leads to fatal consequences. The objective of diabetes management is often to prevent, delay, or reverse the emergence of cardiovascular disease (CVD) and risk factors of CVDs in persons with diabetes. It has been demonstrated that persons with diabetes are at increased risk of developing a Cardiovascular Disease(1–3). Globally CVDs are the number one cause of death, and an estimated 17.9 million people died from CVDs in 2016, representing 31% of all global deaths (4).

Strokes and coronary heart disease (CHD) are the commonest CVDs that affect all countries, regardless of economic developmental status. The risk factors of CVDs have been well documented, albeit the roles of these factors in causing CVDs are still not fully understood. Obesity, high and low-density lipoproteins (HDL and LDL), triglycerides (TG), high blood pressure, age, gender and a family history of CVD are known to be positively associated with the development of CVDs (2). Lifestyle behaviors; such as sedentary lifestyle, smoking, and consumption of calorie-dense foods, are also known risk factors for CVDs (2,5,6). These risk factors are also usually intricately linked with diabetes, and thus puts persons with diabetes at increased risk of developing CVDs (7,8). Diabetes has been found to be independently associated with CVDs, and persons with diabetes are two to three times more likely to develop CVDs compared to those without (9,10). An estimated sixty to eighty percent of diabetes patients die prematurely from a cardiovascular event (11). Diabetes has also been linked to peripheral vascular diseases, such as retinopathy, nephropathy, and neuropathy of the lower limbs, usually leading to lower limb amputations (12).

Kang et al. in a recent study report that young Asians with type 2 diabetes, especially those with cardiovascular comorbidities lived relatively shorter lives compared to their counterparts without diabetes (13), depicting the effect of CVD on life expectancy in persons with diabetes.

There is little evidence from rural areas about the burden of the cardiovascular disease among persons with diabetes, particularly in China, with hundreds of millions of rural dwellers; this study thus seeks to fill this gap.

There are still inclusive findings on the association between blood glucose control and CVD in persons with diabetes (14–16). Additionally, the gender difference in the burden of CVD in persons with diabetes is still not well studied into. We are hypothesizing that that diabetes affects the susceptibility of men and women to CVD differently. This cross-sectional study highlights the prevalence and risk factors distribution of cardiovascular diseases in persons with type 2 diabetes in a rural population. The study further highlights the effect of glucose control in persons with diabetes and the gender difference of diabetes influence on CVD occurrence.

Methods

The study participants were recruited from the Henan Rural Cohort. Randomized cluster sampling was used to select the study sites in the Henan province, *PR* China. Men and women 18-79 years old were then invited to take part in the baseline study from July 2015 to September 2017. In all, 39259 adults answered the call to participate in the baseline. For the present analysis, 39184 participants were eligible after excluding participants with type 1 diabetes (n=4), and those without glucose measurement (n=71). Detail description of this study has been published elsewhere (17).

Data collection

Trained research assistants administered questionnaires to collect information on demographic characteristics, dietary behavior, physical activity, smoking and alcohol drinking status, family history of diabetes, and hypertension. Anthropometric measurements, blood pressure measurements were done by skilled staff, and laboratory analysis for blood lipids and glucose level were performed using Roche Cobas C501 automatic biochemical analyzer (GOD-PAP, Switzerland).

Participants were asked if they had ever been diagnosed with cardiovascular disease by a physician and the type of CVD diagnosed. Diagnosis of diabetes was in accordance with WHO recommended diagnostic criteria of diabetes using fasting blood glucose measurements of ≥7.0mmol/L (undiagnosed diabetes), and those previously diagnosed by a physician (diagnosed diabetes). Participants with glucose measurements greater than 6mol/L, but less than 7mmol/L were categorized as having impaired fasting glucose (IFG), (18).

Outcome variables

Having stroke (cerebral infarction, cerebral hemorrhage, and other types of strokes), coronary heart disease (myocardial infarction, angina, and arrhythmia) or both were classified as a cardiovascular disease for our analysis.

Covariates

For the present study, age, gender, body mass index (BMI), elevated blood lipids (triglycerides [TG] and Low Density Lipoprotein [LDL]), low High Density Lipoprotein(HDL), hypertension, smoking, drinking, lack of physical activity and the presence of diabetes were the risk factors for CVD considered in our analysis.

HbA1c measurements were performed for participants with diagnosed diabetes (n=2152) to assess blood glucose control. Participants with HbA1c less than 7% were considered to have their blood glucose under control according to the international diabetes federation and American Diabetes Association recommendations(3,19).

Statistical analysis

We summarized continuous data as means with standard deviations (± SD), categorical variables were summarized as participant counts and percentages, and groups comparisons done with Chi-square test. Glycaemia level was categorized into; 1. *IFG* (, 6.1-6.99mmol/L), 2.*Undiagnosed Diabetes* (≥7mmol/L), 3.*Diagnosed Diabetes*(self-reported diagnosis by a physician), and 4. *Normoglycemic* (<6.0mmol/L) in accordance with the WHO diagnostic criteria of diabetes and impaired fasting glucose(18). Baseline characteristics of participants were then described according to these groupings. Logistic regression models were then used to examine the association of risk factors with cardiovascular outcomes of interest and odds ratios used to assess the association between diabetes diagnosis status and the presence of a CVD; first in an unadjusted model and then in a second model adjusting for age, gender, hypertension, BMI, exercise, smoking and drinking status, diabetes and hypertension treatment and lipids. Odds ratios (*OR*) and confidence intervals at 95% were then used to interpret our results.

Results

This analysis used data from 39184 participants in the Henan Rural cohort baseline. The study participants were largely women (60%), with a mean age of 54±12years, had a high prevalence of dyslipidemia (75%), and nearly 60% were overweight or obese. Diabetes was prevalent (9.45%) in the population, of which 42% were undiagnosed (previously not diagnosed). About 10% (60% strokes and 40% CHDs) had experienced a cardiovascular event. Commonest CHD was arrhythmia (67.73% of all CHDs), and that of strokes was cerebral infarction (89.94% of all strokes). CVD events were more common in persons with diagnosed diabetes (22%), undiagnosed diabetes (12%), and IFG (11%) compared to those with normoglycemia. The mean HbA1c level was 5.18±2.15 percent (8.71±1.62 percent in participants with poor glucose control). The baseline characteristics of the participants are presented in Table1.

Risk factors for CVD

Generally, persons with diagnosed diabetes were more likely to have experienced a cardiovascular event (*OR=2.80, 95% CI: 2.51-3.12*) compared to those with undiagnosed diabetes, IFG, and normoglycemia (Table2). The risk factors for CVD were more prevalent in persons with diabetes (both diagnosed and undiagnosed). Persons with undiagnosed diabetes had the highest levels of CVD risks; they were three times more likely to have hyperlipidemia, two times more likely to be overweight, older, and had a high smoking rate (27%) compared to the normoglycemic group. Hypertension was strongly associated with strokes and more so, in persons with normal glucose level compared to other groups. Age was strongly associated with CHDs in normoglycemic individuals. Smoking was not associated with CVD in the study population, but in stratified analysis it was found to be associated in men with diagnosed diabetes (*OR= 1.58, 95% CI: 1.10-2.27*);we further found that the association between smoking and CVD was only with CHD but not strokes in a logistic regression by CVD type. The strongest association was in men with diagnosed diabetes (Supplementary Table3).

For persons with diagnosed diabetes, a restricted logistic regression analysis was performed to ascertain the association between CVD and glucose control. Of the 2152 persons with diagnosed diabetes, 27% had their blood glucose under control through HbA1c measurement. In general, there was no association between CVD and glucose control (*OR= 1.20; 95% CI, 0.96-1.50, P= 0.114*).However, a positive association between glucose control and events of strokes (*OR= 1.35; 95% CI, 1.05-1.73, P= 0.020*) was noted, and this was still significant after controlling for all known confounders in men (Supplementary Table2).

We further noted a gender difference in the prevalence of diabetes and CVD occurrence; men generally had a higher prevalence of both diabetes and CVD occurrence regardless of diabetes/IFG status (table1). While the occurrence of stroke was higher in all groups of men, women with diagnosed diabetes had a higher odds of haven experienced a stroke event compared to men with diagnosed diabetes (*OR=3.37, 95% CI: 2.84-3.99 vs. OR=2.54, 95% CI: 2.04-3.15*).On the other hand, CHDs occurrences were more common in women than men, but men with diagnosed diabetes had higher odds of haven experienced a CHD event compared to women (Table2).

Physical activity and drinking alcohol were found to be negatively associated with CVD events (*OR=0.77, 95% CI: 0.74-0.80 and OR=*0.86*, 95% CI:* 0.82-0.90). Generally, these risk factors were more prevalent in persons with impaired fasting glucose and undiagnosed diabetes than in normoglycemic individuals and persons with diagnosed diabetes. Persons with elevated blood glucose also generally engaged in less physical activity.

Discussion

Both diabetes and CVD events were prevalent in our study population. The prevalence of diabetes is consistent with the national prevalence of diabetes in China (20). Similar studies have found gender differences in the prevalence of diabetes in men and women (21)and a myriad of reasons have been attributed to this difference. We also noted a difference in the occurrence of CVD in men and women. Our finding of CVD Prevalence of 10% (consisting of strokes and CHDs) from a cross-sectional study is perhaps the first.

While stroke occurrences were more common in men (8% vs. 6%), CHDs were more common in women (5% vs. 4%). This finding is at variance with previous findings where strokes events were reported to be more common in women than men and CHD more common in men than in women (22,23). The observed difference in our study compared to previous studies probably is due to the differences in study populations. Men, in general, had a higher occurrence of CVD compared to women; strokes were more common among men while coronary heart disease events were common in women. While stroke events occurrences were generally more common in men, women with diagnosed diabetes had higher odds of a stroke experience, suggesting that women with diabetes lose their relative level of protection against strokes. Estrogenic protection, lifestyle difference, and health-seeking behavior of women are some factors that explain the protection of women against strokes, or delays the occurrence of CVD in women(22). The role of diabetes in lowering this protection is still not fully understood, but it is hypothesised that diabetes affects lipid metabolism leading to hyperlipidemia and hypertension, which are intricately associated with stroke incidence (21). Women with diabetes in our study population were older and had a higher prevalence of hypertension; this may partly explain the increased odds for strokes in women with diabetes.

After controlling for all known confounders, diabetes was independently associated with the occurrence of cardiovascular events in our study participants. Participants with diagnosed diabetes were more likely to have had experienced a cardiovascular event compared to those with undiagnosed diabetes, IFG, and normoglycemia. Persons with diagnosed diabetes had probably lived with hyperglycemia for a longer duration compared to those with undiagnosed diabetes; longer duration of exposure to hyperglycemia has been linked to the development of atherosclerosis of the vascular system as a result of non-enzymatic glycosylation of lipoproteins and proteins(2,24). Previous studies have reported diabetes to be an independent cause of cardiovascular disease (1,10,25–27), and the combination of hyperglycemia and other cardiovascular disease risk factors (often prevalent in persons with diabetes) calls for relentless efforts in lowering these risk factors in persons with diabetes.

We found a strong association between hypertension and CVD, which is a well-established risk factor of CVD(28,29). It was more strongly associated with strokes compared to CHD and more so in persons with normoglycemia. Generally, persons with normoglycemia were younger, and perhaps, since the development of hypertension is also concomitantly linked to strokes, and given that “old age” and diabetes are not present as risks factors for CVD in this group at this point, the role of hypertension will be preeminent.

Persons with diagnosed diabetes had a lower prevalence of the risk factors of CVD compared to their undiagnosed counterparts who had the highest level of risk factors with the exception of age. This phenomenon partly explains why persons with diagnosed diabetes although actively controlling their blood glucose levels and also lowering other risks for CVD, still had the highest burden of CVD; often diagnosis of diabetes is late in the progression of the disease (2) meaning no active effort is made at early stages to lower the risk of CVD and therefore irreversible damage to the vascular system would have occurred by the time they start lowering their CVD risks.

We further assessed the relationship of blood glucose control and CVD events among participants with diagnosed diabetes; no association was found between glucose control and a previous CVD history. Long term damage to the vascular system would have occurred (through atherosclerosis). Glycosylation of proteins and lipids are noted to be responsible for the development of atherosclerosis and the damage caused by advanced glycosylation are often irreversible and will persist after the resolution of hyperglycemia (30). This partly explains why there was no difference among persons with controlled diabetes and uncontrolled diabetes. Glucose control was found to be positively associated with stroke, this phenomenon is still unexplained, but previous findings by the ACCORD study linked glucose control to increased mortality (14), suggesting that intensive glucose control may have adverse effects.

This study was conducted on a large population and all possible confounders controlled for the determination of the association of diabetes and cardiovascular diseases. Notwithstanding this, some limitations are worth noting; this was a cross-sectional study, and therefore causal inference cannot be drawn, determination of the outcome variable was through interview and accuracy can be hampered by the accuracy of the responses. More so, we had a gender-imbalanced sample, making the determination of the association of variables like smoking and CVD not possible in the entire study population. Blood glucose control was based on a one-off measurement of HbAc1, and long term prior control could not be ascertained.

Conclusion

Diabetes is strongly associated with CVD in our study population, women with diabetes are at increased risk of suffering a stroke event compared to men and glucose control is not associated with CVD, but may have adverse effect health.

Early diagnosis of diabetes and the reduction of risk factors of CVD (particularly lipids and obesity) are critical in the prevention/delay of the development CVD in persons with diabetes. Further prospective studies are needed to clarify the association between glucose control and higher odds of stroke and the gender difference in the association of diabetes and stroke. Further clarifications will thus impact on clinical decisions on glucose control and diabetes management.

Declarations

Authors Contribution

CW & HY conceived and designed the study.

HZ, RT, XL, XD, and RL directed the collection of the data.

TA & HZ analyzed the data.

TA wrote the first draft of the manuscript.

All authors critically revised the manuscript and agreed on the final version to be published.

Competing interests

None.

Ethics approval

Ethics approval was obtained from the “Zhengzhou University Life Science Ethics Committee,” and written informed consent was obtained for all participants. Ethics approval code: [2015] MEC (S128).

Data Availability

Data will be made available upon reasonable request to the corresponding author.

Consent to Publish

Not applicable

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Tables

Table 1 Baseline Characteristic of Participants

VARIABLE	Total					Male					Female				
	Normal	IFG	Undiagnosed	Diagnosed	P	Normal	IFG	Undiagnosed	Diagnosed	P	Normal	IFG	Undiagnosed	Diagnosed	P
N	32812	2670	1550	2152		12935	1113	655	751		19877	1557	895	1401	
AGE	54.80±12.44	58.71±10.52	58.77±10.03	61.51±8.54	<0.001	56.22±12.56	57.66±11.41	57.74±10.34	60.82±9.25	<0.001	53.88±12.27	59.46±9.77	59.53±9.72	61.87±8.11	<0.001
GENDER	19877(60.58)	1557(58.31)	895(57.74)	1401(65.10)	<0.001										
Education					<0.001					0.207					<0.001
Prim or lower	14171(43.19)	1326(49.66)	800(51.61)	1248(57.99)	.	4394(33.97)	355(31.90)	203(30.99)	269(35.82)	.	9777(49.19)	971(62.36)	597(66.70)	979(69.88)	.
Middle School	13440(40.96)	948(35.51)	546(35.23)	674(31.32)	.	5984(46.26)	512(46.00)	308(47.02)	334(44.47)	.	7456(37.51)	436(28.00)	238(26.59)	340(24.27)	.
High School or higher	5201(15.85)	396(14.83)	204(13.16)	230(10.69)	.	2557(19.77)	246(22.10)	144(21.98)	148(19.71)	.	2644(13.30)	150(9.63)	60(6.70)	82(5.85)	.
Married/cohabiting	29545(90.04)	2354(88.16)	1370(88.39)	1908(88.66)	0.001	11588(89.59)	1023(91.91)	594(90.69)	697(92.81)	0.003	17957(90.34)	1331(85.48)	776(86.70)	1211(86.44)	<0.001
Income					<0.001					0.175					<0.001
<500RMB	11496(35.04)	1024(38.35)	565(36.45)	896(41.64)	.	4695(36.30)	375(33.69)	228(34.81)	294(39.15)	.	6801(34.22)	649(41.68)	337(37.65)	602(42.97)	.
500-999RBM	10832(33.01)	869(32.55)	506(32.65)	684(31.78)	.	4115(31.81)	352(31.63)	211(32.21)	239(31.82)	.	6717(33.79)	517(33.20)	295(32.96)	445(31.76)	.
1000+RBM	10484(31.95)	777(29.10)	479(30.90)	572(26.58)	.	4125(31.89)	386(34.68)	216(32.98)	218(29.03)	.	6359(31.99)	391(25.11)	263(29.39)	354(25.27)	.
Ever Smoking	8976(27.36)	766(28.69)	430(27.74)	485(22.54)	<0.001	8910(68.88)	756(67.92)	424(64.73)	479(63.78)	0.005	66(0.33)	10(0.64)	6(0.67)	6(0.43)	0.102
Ever Drinking	7440(22.67)	673(25.21)	379(24.45)	402(18.68)	<0.001	6,833(52.83)	641(57.59)	356(54.35)	385(51.26)	0.013	607(3.05)	32(2.06)	23(2.57)	17(1.21)	<0.001
High Fat	6430(19.60)	441(16.52)	278(17.94)	321(14.92)	<0.001	3289(25.43)	252(22.64)	164(25.04)	164(21.84)	0.036	3141(15.80)	189(12.14)	114(12.74)	157(11.21)	<0.001
Vegetables	14103(42.98)	935(35.02)	600(38.73)	721(33.50)	<0.001	5662(43.78)	404(36.30)	270(41.28)	268(35.69)	<0.001	8441(42.47)	531(34.10)	330(36.87)	453(32.33)	<0.001
Number of CVDs					<0.001					<0.001					<0.001
No CVD	29722(90.58)	2366(88.61)	1364(88.00)	1667(77.46)	.	11598(89.66)	986(88.59)	574(87.63)	569(75.77)	.	18124(91.18)	1380(88.63)	790(88.27)	1098(78.37)	.
CHD only	1120(3.41)	104(3.90)	62(4.00)	144(6.69)	.	385(2.98)	39(3.50)	22(3.36)	59(7.86)	.	735(3.70)	65(4.17)	40(4.47)	85(6.07)	.
Stroke only	1765(5.38)	175(6.55)	108(6.97)	291(13.52)	.	868(6.71)	79(7.10)	54(8.24)	108(14.38)	.	897(4.51)	96(6.17)	54(6.03)	183(13.06)	.
Both CHD & Stroke	205(0.62)	25(0.94)	16(1.03)	50(2.32)	.	84(0.65)	9(0.81)	5(0.76)	15(2.00)	.	121(0.61)	16(1.03)	11(1.23)	35(2.50)	.
Exercise					<0.001					<0.001					<0.001
Light	10235(31.19)	986(36.93)	569(36.71)	892(41.45)	.	4464(34.51)	435(39.08)	267(40.76)	344(45.81)	.	5771(29.03)	551(35.39)	302(33.74)	548(39.11)	.
Moderate	12565(38.29)	913(34.19)	547(35.29)	757(35.18)	.	3615(27.95)	299(26.86)	169(25.80)	212(28.23)	.	8950(45.03)	614(39.43)	378(42.23)	545(38.90)	.
Vigorous	10012(30.51)	771(28.88)	434(28.00)	503(23.37)	.	4856(37.54)	379(34.05)	219(33.44)	195(25.97)	.	5156(25.94)	392(25.18)	215(24.02)	308(21.98)	.
Hypertension	9617(29.34)	1297(48.65)	761(49.13)	1133(52.67)	<0.001	3914(30.28)	537(48.29)	310(47.33)	353(47.07)	<0.001	5703(28.72)	760(48.91)	451(50.45)	780(55.67)	<0.001
CHD	1325(4.04)	129(4.83)	78(5.03)	194(9.01)	<0.001	469(3.63)	48(4.31)	27(4.12)	74(9.85)	<0.001	856(4.31)	81(5.20)	51(5.70)	120(8.57)	<0.001
Stroke	1970(6.00)	200(7.49)	124(8.00)	341(15.85)	<0.001	952(7.36)	88(7.91)	59(9.01)	123(16.38)	<0.001	1018(5.12)	112(7.19)	65(7.26)	218(15.56)	<0.001
CVD	3090(9.42)	304(11.39)	186(12.00)	485(22.54)	<0.001	1337(10.34)	127(11.41)	81(12.37)	182(24.23)	<0.001	1753(8.82)	177(11.37)	105(11.73)	303(21.63)	<0.001
BMI	24.58±3.49	26.03±3.63	26.46±3.74	25.99±3.64	<0.001	24.28±3.40	25.81±3.54	26.31±3.63	25.82±3.51	<0.001	24.78±3.54	26.20±3.68	26.57±3.82	26.08±3.72	<0.001
TG (mmol/L)	1.61±1.05	1.92±1.31	2.20±1.48	2.05±1.39	<0.001	1.60±1.08	1.91±1.38	2.21±1.59	1.93±1.40	<0.001	1.61±1.04	1.93±1.25	2.20±1.39	2.11±1.38	<0.001
HDL (mmol/L)	1.34±0.33	1.28±0.34	1.23±0.33	1.23±0.32	<0.001	1.27±0.33	1.23±0.33	1.14±0.30	1.14±0.30	<0.001	1.38±0.33	1.31±0.33	1.30±0.34	1.28±0.32	<0.001
LDL (mmol/L)	2.83±0.79	3.07±0.90	3.12±0.96	2.99±0.94	<0.001	2.80±0.78	3.00±0.90	3.00±0.96	2.80±0.89	<0.001	2.85±0.80	3.12±0.90	3.21±0.96	3.09±0.95	<0.001
Glucose (mmol/L)	5.09±0.47	6.42±0.25	8.97±2.45	8.93±3.12	<0.001	5.08±0.49	6.41±0.25	9.02±2.52	9.07±3.05	<0.001	5.10±0.46	6.42±0.24	8.93±2.40	8.86±3.15	<0.001

BMI: Body Mass Index, CHD: Coronary Heart Disease, CVD: Cardiovascular Disease, HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein, TG: Triglycerides, Prim.: Primary school

Table 2a Logistic regression analysis; association of diabetes and CVD

	CVD				CHD				Stroke			
	Normal	IFG	Undiagnosed	Diagnosed	Normal	IFG	Undiagnosed	Diagnosed	Normal	IFG	Undiagnosed	Diagnosed
Total												
N	3090/32812	304/2670	186/1550	485/2152	1325/32812	129/2670	78/1550	194/2152	1970/32812	200/2670	124/1550	341/2152
Model 1	1	1.24(1.09-1.40)	1.31(1.12-1.54)	2.80(2.51-3.12)	1	1.21(1.00-1.45)	1.26(1.00-1.59)	2.36(2.01-2.76)	1	1.27(1.09-1.47)	1.36(1.13-1.64)	2.95(2.60-3.34)
Model 2	1	0.96(0.84-1.09)	1.01(0.86-1.19)	1.95(1.73-2.18)	1	0.98(0.81-1.18)	1.00(0.78-1.27)	1.65(1.40-1.95)	1	0.98(0.83-1.14)	1.06(0.87-1.29)	2.08(1.82-2.38)
Male												
N	1337/12935	127/1113	81/655	182/751	469/12935	48/1113	27/655	74/751	952/12935	88/1113	59/655	123/751
Model 1	1	1.12(0.92-1.36)	1.22(0.96-1.56)	2.78(2.33-3.31)	1	1.20(0.88-1.62)	1.14(0.77-1.70)	2.91(2.25-3.76)	1	1.08(0.86-1.36)	1.25(0.95-1.64)	2.47(2.01-3.02)
Model 2	1	0.91(0.74-1.11)	1.02(0.79-1.31)	1.91(1.58-2.31)	1	1.01(0.74-1.37)	0.93(0.62-1.39)	1.90(1.45-2.50)	1	0.88(0.69-1.12)	1.06(0.80-1.42)	1.74(1.40-2.17)
Female												
N	1753/19877	177/1557	105/895	303/1401	856/19877	81/1557	51/895	120/1401	1018/19877	112/1557	65/895	218/1401
Model 1	1	1.33(1.13-1.56)	1.37(1.11-1.69)	2.85(2.49-3.27)	1	1.22(0.97-1.54)	1.34(1.00-1.80)	2.08(1.71-2.54)	1	1.44(1.17-1.76)	1.45(1.12-1.88)	3.41(2.92-4.00)
Model 2	1	0.98(0.83-1.17)	0.98(0.79-1.22)	1.94(1.68-2.24)	1	0.94(0.74-1.20)	1.01(0.75-1.35)	1.48(1.21-1.82)	1	1.06(0.86-1.30)	1.04(0.80-1.36)	2.30(1.94-2.72)

Model1 is Unadjusted, Model2 is adjusted for Age, gender, Hypertension, BMI, Lipids, Exercise, Smoking, Drinking, and Diabetes treatment

Table 2b Logistic regression analysis; association of diabetes and CVD

	Only CHD				Only stroke				Both CHD and Stroke			
	Normal	IFG	Undiagnosed	Diagnosed	Normal	IFG	Undiagnosed	Diagnosed	Normal	IFG	Undiagnosed	Diagnosed
Total												
N	1120/30842	104/2470	62/1426	144/1811	1765/31487	175/2541	108/1472	291/1958	205/29927	25/2391	16/1380	50/1717
Model 1	1	1.17(0.95-1.43)	1.21(0.93-1.57)	2.29(1.92-2.75)	1	1.25(1.06-1.46)	1.33(1.09-1.63)	2.94(2.57-3.36)	1	1.53(1.01-2.33)	1.70(1.02-2.84)	4.35(3.18-5.95)
Model 2	1	0.94(0.76-1.15)	0.94(0.72-1.23)	1.59(1.32-1.92)	1	0.95(0.81-1.13)	1.02(0.83-1.26)	2.05(1.78-2.37)	1	1.13(0.74-1.75)	1.32(0.79-2.22)	2.85(2.05-3.95)
Male												
N	385/11983	39/1025	22/596	59/628	868/12466	79/1065	54/628	108/677	84/11682	9/995	5/579	15/584
Model 1	1	1.19(0.85-1.67)	1.15(0.75-1.79)	3.12(2.35-4.16)	1	1.07(0.84-1.36)	1.26(0.94-1.68)	2.54(2.04-3.15)	1	1.26(0.63-2.51)	1.20(0.49-2.98)	3.64(2.09-6.35)
Model 2	1	0.97(0.69-1.37)	0.93(0.59-1.45)	2.04(1.51-2.77)	1	0.86(0.67-1.11)	1.05(0.78-1.43)	1.80(1.43-2.27)	1	0.99(0.49-2.00)	0.95(0.38-2.38)	2.24(1.25-4.04)
Female												
N	735/18859	65/1445	40/830	85/1183	897/19021	96/1476	54/844	183/1281	121/18245	16/1396	11/801	35/1133
Model 1	1	1.16(0.90-1.51)	1.25(0.90-1.73)	1.91(1.51-2.41)	1	1.41(1.13-1.75)	1.38(1.04-1.83)	3.37(2.84-3.99)	1	1.74(1.03-2.93)	2.09(1.12-3.88)	4.78(3.26-6.99)
Model 2	1	0.90(0.69-1.17)	0.92(0.66-1.29)	1.33(1.05-1.70)	1	1.03(0.82-1.28)	0.97(0.73-1.30)	2.21(1.85-2.65)	1	1.21(0.70-2.09)	1.51(0.81-2.83)	3.17(2.13-4.72)

Model1 is Unadjusted, Model2 is adjusted for Age, gender, Hypertension, BMI, Lipids, Exercise, Smoking, Drinking, and Diabetes treatment

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