PLOS ONE

RESEARCH ARTICLE

Risk factors for self-reported diabetes among Bhutanese adults: A nationally representative survey data analysis

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Citation: Wangdi K, Jamtsho T (2018) Risk factors for self-reported diabetes among Bhutanese adults: A nationally representative survey data analysis. PLoS ONE 13(11): e0206034. https://doi.org/10.1371/journal.pone.0206034

Editor: Xianwu Cheng, Nagoya University, JAPAN

Received: September 29, 2017

Accepted: October 7, 2018

Published: November 15, 2018

Data Availability Statement: The full datasets have not been made available as it is owned by the Ministry of Health, Bhutan. Interested researchers may apply for access with the Chief Programme Officer, Planning and Policy Division, Ministry of Health, P.O. Box: 726, Kawajangsa, Thimphu, Bhutan, Phone: +975-2-328095, 321842, 322602, 328091.

Funding: The authors received no specific funding for this work.

Competing interests: The authors have declared that no competing interests exist.

Abstract

Background

Bhutan, a small land-locked country in the eastern Himalayas has been undergoing an epidemiological and nutritional transition in the last two decades. The objective of this paper was to determine the prevalence and explore the risk factors of self-reported diabetes among Bhutanese adults.

Methods

We conducted a secondary data analysis among adults 18 years and older Bhutanese using the data from the National Health Survey 2012 (NHS, 2012) of Bhutan. The self-reported information on risk factors was obtained using standard protocols of the WHO STEPwise approach to Surveillance. The outcome of interest was self-reported diabetes on medication. Adjusted and unadjusted logistic regression analyses were performed to identify the risk factor of diabetes.

Results

A total of 31,066 participants aged 18 years and older were included for the analysis. The prevalence of self-reported hypertension was 1.8% (491). Risk factors for diabetes were: age groups: 35–44 years adjusted odds ratio (AOR) = 2.82 (95% CI, 1.07, 7.41), 45–54 years AOR = 6.02 (95% CI, 2.29, 15.83), 55–64 year AOR = 15.7 (95% CI 5.93, 41.55) and >65 years AOR = 19.60 (95% CI, 6.93, 55.71); high school and diploma/certificate education AOR = 2.57, (95% CI 1.62, 4.07) and AOR = 3.92 (95% CI 1.70, 9.07); and urban dwellers AOR = 2.37, (95% 1.58, 3.57); hypertension AOR = 3.3, (95% CI 2.47, 4.41); and fruit servings of 1–3 per week AOR = 1.63 (95% CI 1.15, 2.31).

Conclusion

The number of Bhutanese adults with diabetes and co-morbidities associated with it is likely to increase with the ageing of the population, nutrition transition, and high rural-urban

migration in the near future. This calls for an urgent need to implement strategies to prevent diabetes in the Bhutanese population targeting risk factors including healthy lifestyle with increased physical activities and reduced smoking. At the same time treating other chronic morbidities including hypertension.

Introduction

Diabetes Mellitus (DM) is a major public health problem globally with an estimated 422 million adults living with DM in 2014 [1]. Worldwide DM prevalence has increased over the last 30 years and now ranks in the top four high priority non-communicable diseases (NCDs) of the World Health Organisation (WHO) [2]. By 2035, DM is projected to reach 592 million cases [3–5] mainly in middle and low-income countries [6]. DM requires lifelong care and treatment which incur massive health care costs. The costs associated with diabetes health care expenditure was at least USD$ 376 billion worldwide in 2010 and will increase to USD$ 490 billion by 2030 [7, 8].

The aetiology of diabetes is multifactorial and includes modifiable and non-modifiable risk factors. The non-modifiable risk factors include genetics and age [9], while modifiable risk factors are obesity [10], sedentary lifestyle [11], an unhealthy diet that contains a high level of sugar [12–14] and saturated fats [15], and smoking [16–19]. The modifiable risk factors are associated with rising living standards, rural-urban migration, and lifestyle changes [20, 21]. Diabetes is a health challenge fuelled by rapidly ageing populations and lifestyle risk factors, in particular, smoking and obesity [3, 22, 23]. Whilst advances in treatment have extended life expectancy, diabetes and its associated complications and comorbidities have been found to result in increased long-term physical disability [24, 25].

Bhutan, with a population of 757,042 [26, 27] has been undergoing an epidemiological and nutritional transition in the last two decades [28]. This transition is characterised by rising disposable income levels, a shift from traditional high-carbohydrate, low-fat diets towards diets lower in carbohydrates and higher in saturated fat, sugar and salt, and lower levels of physical activity [29]. Further, demographics are changing rapidly as young people in particular move to towns for work, education and entertainment [30–32]. Despite this societal transformation, no prior systematically analysed in-depth study representing the whole national prevalence exists on diabetes and its associated risk factors. Therefore, the primary objective of this paper is to determine the prevalence and explore the risk factors for diabetes among the adult Bhutanese. Findings from this study will provide a better understanding of the risk factors of diabetes. This knowledge can be used to guide policy changes and initiate a national preventive programme targeting these risk factors.

Methods

Study population

This study utilized secondary, a nationally representative data from the National Health Survey (NHS 2012) conducted in all the 20 districts of Bhutan in 2012. The survey samples were estimated using the census sample frame adopted for the first Population and Housing Census of Bhutan (PHCB, 2005) in 2005. The survey samples were appropriately derived and designed to produce statistically reliable estimates of most indicators at the national and 20 districts level, further aggregated by rural and urban categorization. The study participants were adult older

than 18 years and the outcome variable of interest was self-reported diabetes under medication.

Risk factor assessment

The variables were all self-reported and followed the WHO STEPwise approach to Surveillance of non-communicable diseases (STEP) survey guidelines. The outcome variable of interest was self-reported diabetes mellitus (DM) defined as elevated blood sugar requiring medication to lower the blood sugar [33]. One fruit serving included either: (a) ½ cup of chopped, cooked or canned fruit; or (b) 1 medium-sized piece of fruit such as banana, apple, orange; or (c) ½ cup of fruit juice (not artificially flavoured). One standard vegetable serving was: (a) 1 cup of raw green leafy vegetable such as spinach, salad greens, etc. or (b) ½ cup of other vegetables, cooked or chopped, such as carrots, pumpkin, corn, beans, onion, etc., but excluding tubers such as potatoes. A "standard drink" was the amount of ethanol contained in standard glasses of beer, wine, fortified wine such as sherry, and spirits and usually between 8–13 grams. Vigorous activity was defined as an activity that results in increased breathing or heart rate similar to carrying or lifting heavy loads, digging or construction work for at least 10 minutes.

Statistical analysis

Estimation procedures included sampling weights to adjust for the complex sample design. All statistical analyses were weighted and performed using the appended sample weights of respective survey data-set (individual module) as to provide nationally representative estimates. The individual module data-set comprised appended sample weights that were adjusted, calculated and normalised in accordance with the survey sample weights calculation technique. Sample weights were thus available for the public use for further analysis of survey data. The analysis was performed using the SVY module for complex samples of the statistical package STATA version 15 (Stata Corporation, College Station, TX, USA). Univariate and multivariate logistic regression models for risk factors of diabetes were built using backward elimination to identify significant covariates. A value of $p \leq 0.05$ was considered statistically significant for any observed differences.

Results

Socio-demographic characteristics of study population

A total of 31,066 participants aged 18–75 years were included for the analysis. The men made up 46.1% (14,335) of the samples, and the median age of the study subject was 37 years (range 18–75). A fourth of the study participants were in the age group of 25–34 years (8,060) and more than 75.0% (23,420) participants were from rural areas. Half (15,666) of the participants had no formal education, 20.2% (6,260) completed high school and less than 1% (275) had completed a diploma or certificate level education. The majority of participants were married 74.1% (22,985). Farmers, unskilled and clerical workers and service and sales workers made up 66.1% (10,061) and 20.7% (3,155) of participants. The self-reported hypertension was 17.4% (5,408). Alcohol intake and smoking were reported in 47.3% (14,681) and 4.2% (1,322) of the study population.

A high proportion of study participants 55.4% (16,744) did not consume any fruit, however, only a small percentage reported not consuming enough vegetables, 3.0% (900). Vegetables were consumed throughout the week with varying durations; 41.0% (12,420) consumed vegetables 6–7 days a week, 30.3% (9,206) consumed vegetables 4–5 days a week, and 25.7% (7,788)

consumed vegetables 1–3 days a week. Physical (vigorous) activities were reported by 47.4% (14,725) of the study participants (Table 1).

Socio-demographic characteristics of diabetic patients

The prevalence of diabetes in this study was 1.8% (491) and there were equal men and women 49.3% (242) to 50.7% (249). More than one fifth (101) of diabetic patients were older than 65 years. Sixty-two percent (304) of diabetic patients were from urban areas. More than half (281) of diabetic patients did not have formal education, and 3.3% (16) were university educated. Eighty-two percent (400) of diabetic individuals were married and only 2.7% (13) were single. Of 419 diabetic patients, occupation was recorded for 215 participants. The commonest occupation of diabetic patients were farmers (clerical and unskilled), followed by service and sales workers at 58.9% (127) and 23.6% (51) respectively. Forty-six percent (224) had concurrent hypertension, and more than half consumed alcohol (54.7%, 224), 4.3% (21) were current smokers and 22.9% (112) who had ever smoked. Forty-three percent (207) did consume fruits in a typical week, while 12.6% (62), 30% (147) and 10.1% (15) consumed fruits in 1–3, 4–5 and 6–7 days respectively. Only 34.7% (170) engaged in vigorous physical activities (Table 1).

Smoking and alcohol use stratified by sex

There was a difference between men and women in smoking and alcohol. More than 7% (1,044) of men were current smokers as compared only 1.7% (277) of women. Similarly, men were more than thrice 25.1% (3,592) likely to have ever smoked than women 8.4% (1,407). However, the difference in alcohol use between the men and women were much closer, 58.5% (8,386) of men ever consumed alcohol while it was 37.6% (6,295) for women. Men tend to be younger for both current smokers (mean age 32.5 years) and ever smoked (mean age 40 years) as compared to women. However, there was no age difference between men (mean age 41.2 years) and women (mean age 41.1 years) who ever consumed alcohol (Table 2).

Factors associated with diabetes

Older than 35 years, being a single and widow, high school educated, having hypertension, living in urban areas, ever smoked and engaging in a vigorous physical activity were each independently associated with hypertension in univariate analysis.

After adjusting for other variables, participants in age groups of 35–44 years, 45–54, 55–65 and above 65 years were approximately adjusted odds ratio (AOR) = 2.82 (95% CI, 1.07, 7.42), AOR = 6.03 (95% CI, 2.29, 15.85), AOR = 15.74 (95% CI 5.95, 41.63) and AOR = 19.82 (95% CI, 6.99, 56.21) more at risk of diabetes compared to participants aged 18–24 years. High school and diploma educated AOR = 2.58, (95% CI 1.63, 4.09) and AOR = 3.02 (95% CI 1.70, 9.06) were at higher risk of diabetes in comparison with no education group. Hypertension was a major risk factor for diabetes; participants with hypertension were 3.3 times more likely to have diabetes as compared to those who do not report having hypertension (AOR = 3.30, 95% CI 2.47, 4.41). Urban dwellers were 2.37 times more at risk of diabetes to rural inhabitants (AOR = 2.37, 95% 1.58, 3.57). Interestingly fruit servings of 1–3 per week were associated with diabetes risk as compared to those who do not consume fruits (AOR = 1.63, 95% CI 1.15, 2.31) (Table 3).

Discussion

This is the first epidemiological study on the prevalence of diabetes and its risk factors in the adult Bhutanese. The data for this study was obtained from the National Health Survey 2012.

Table 1. Sociodemographic characteristics of study population and diabetes participants in Bhutan.

Variables	Total (%) N = 31,065	Diabetes (%) N = 491
Gender		
Women	16,730 (53.9)	249 (50.7)
Men	14,335 (46.1)	242 (49.3)
Age group (years)		
18–24	6,083 (19.6)	15 (3.1)
25–34	8,060 (26.0)	34 (6.8)
35–44	6,172 (19.9)	75 (15.2)
45–54	5,100 (16.4)	104 (21.3)
55–64	3,543 (11.4)	162 (33.1)
≥65	2,107 (7.8)	100 (20.5)
Urban-rural		
Rural	23,420 (75.4)	186 (37.9)
Urban	7,645 (24.6)	304 (62.1)
Education		
No formal education	15,666 (50.6)	281 (57.4)
Non-formal education	2,560 (8.3)	25 (5.0)
Primary school	3,820 (12.3)	57 (11.6)
High school	6,260 (20.2)	74 (15.1)
Diploma/Certificate	275 (0.9)	11 (2.3)
University	1,501 (4.8)	16 (3.3)
Monastic education	899 (2.9)	26 (5.0)
Marital status		
Single	5,223 (16.8)	13 (2.7)
Married	22,985 (74.1)	400 (81.6)
Divorced/Separated	1,299 (4.2)	28 (5.6)
Widowed	1,531 (4,9)	50 (10.1)
Occupation		
Clerical/farmer/unskilled	10,061 (66.1)	127 (58.9)
Army	540 (3.5)	7 (3.3)
Manager and professionals	1,339 (8.8)	25(11.5)
Service and sales worker	3,155 (20.7)	51 (23.6)
Monks	134 (0.9)	6 (5.6)
Hypertension		
No	25,646 (82.6)	218 (44.5)
Yes	5,408 (17.4)	272 (55.5)
Alcohol intake		
No	16,378 (62.7)	266 (54.3)
Yes	14,681 (47.3)	224 (45.7)
Current smoker		
No	29,741 (95.8)	469 (95.7)
Yes	1,322 (4.2)	21 (4.3)
Ever smoked		
No	26,067 (83.9)	378 (77.1)
Yes	4,999 (16.1)	112 (22.9)
Fruit serving per week		
No	16,744 (55.4)	207 (42.9)
1–3 days	8,352 (27.6)	165 (34.2)

(*Continued*)

Table 1. (Continued)

Variables	Total (%) N = 31,065	Diabetes (%) N = 491
4–5 days	2,916 (9.6)	61 (12.8)
6–7 days	2,239 (7.4)	49 (10.1)
Vegetable servings per week		
No	900 (3.0)	14 (2.8)
1–3 days	7,789 (25.7)	103 (21.4)
4–5 days	9,206 (30.3)	145 (30.1)
6–7 days	12,420 (41.0)	220 (45.7)
Vigorous physical activities		
No	16,334 (52.6)	320 (65.3)
Yes	14,725 (47.4)	170 (34.7)

Source: **National Health Survey 2012**

https://doi.org/10.1371/journal.pone.0206034.t001

The national prevalence of diabetes was estimated at 1.8%, which is lower to 2010 global diabetes prevalence of 6.4% [34]. The risk of diabetes is likely to increase as Bhutan undergoes an epidemiological, a nutritional and a demographic transition. Further, increased life expectancy will predispose a higher proportion of the population to the risk of diabetes. In the light of these changes, it is important to initiate a preventive programme targeting these modifiable diabetes risk factors. The significant modifiable risk factors for diabetes in this study were: high school and diploma or certificate education level, hypertension and urban dwellers.

Age is an important non-modifiable risk factor for diabetes [9, 35, 36] and this highlights the risk of pre-diabetic respondents progressing to develop diabetes if appropriate measures are not undertaken. As people live longer in Bhutan due to improvement in the healthcare, the cost of managing diabetes and its complication is likely to increase the medical expenditure. Diabetes-related morbidity and mortality have been increasing each year in Bhutan [37, 38]. This calls for public health interventions through education on a regular screening of blood sugar of older people using both pharmacological and non-pharmacological control of any elevated blood sugar to avert complications associated with it.

Table 2. Smoking and alcohol use stratified by sex in Bhutan.

Characteristics		Sex			
		Men		Women	
		Number (%)	Mean age*	Number (%)	Mean age*
Current smoker					
	No	13,290 (92.7)	40.3	16,451 (98.3)	38.3
	Yes	1,044 (7.3)	32.5	277 (1.7)	40.4
Ever smoked					
	No	10,743 (74.9)	39.6	15,324 (91.6)	37.8
	Yes	3,592 (25.1)	40.0	1,407 (8.4)	44.2
Ever consumed alcohol					
	No	5,944 (41.5)	37.6	10,435 (62.4)	36.3
	Yes	8,386 (58.5)	41.2	6,295 (37.6)	41.1

* years

Source: **National Health Survey 2012**

https://doi.org/10.1371/journal.pone.0206034.t002

Table 3. Univariate and multivariate logistic regression analysis with risk factors for diabetes in Bhutan.

Variable	Unadjusted Correlates			Adjusted Correlates		
	OR[†]	95% CI[*]	p-value	OR[†]	95% CI[*]	p-value
Sex						
Men	1			1		
Women	0.91	0.76, 1.09	0.288	0.85	0.57, 1.26	0.416
Age group						
18–24	1			1		
25–34	1.66	0.91, 3.06	0.1	0.79	0.29, 2.15	0.65
35–44	5.00	2.88, 8.70	<0.001	2.82	1.07, 7.42	0.035*
45–54	8.71	5.08, 14.95	<0.001	6.03	2.29, 15.85	<0.001*
55–64	21.47	12.66, 36.42	<0.001	15.74	5.95, 41.63	<0.001*
>65	24.31	14.12, 41.85	<0.001	19.82	6.99, 56.21	<0.001*
Marital status						
Single	1			1		
Married	7.40	4.26, 12.83	<0.001	1.42	0.60, 3.37	0.425
Separated[‡]	9.19	4.75, 17.80	<0.001	1.77	0.61, 5.14	0.219
Widow	16.14	8.75, 29.76	<0.001	0.72	0.22, 2.35	0.583
Education						
No education	1			1		
Primary	0.74	0.56, 0.99	0.42	1.39	0.90, 2.15	0.142
High	0.53	0.41, 0.69	<0.001	2.58	1.63, 4.09	<0.001*
University or equivalent	0.48	0.29, 0.79	0.004	1.63	0.76, 3.50	0.213
Diploma/ certificate	1.90	1.04, 3.48	0.038	3.92	1.70, 9.06	0.001*
Monk	1.44	0.95, 2.16	0.082	1.34	0.68, 2.65	0.403
NFE	0.49	0.32, 0.74	0.001	0.48	0.13, 1.78	0.270
Occupation						
Clerical/farmer /unskilled	1			1		
Army	0.89	0.41, 1.90	0.76	0.62	0.27, 1.42	0.255
Manager and professionals	1.21	0.79, 1.88	0.382	0.62	0.35, 1.12	0.111
Service and sales worker	1.13	0.81, 1.57	0.465	0.85	0.57, 1.27	0.436
Monks	3.36	1.42, 7.94	0.006	1.72	0.64, 4.62	0.283
Urban-rural						
Rural	1			1		
Urban	1.64	1.38, 1.98	<0.001	2.37	1.58, 3.57	<0.001*
Hypertension						
No	1			1		
Yes	6.04	5.04, 7.24	<0.001	3.30	2.47, 4.41	<0.001*
Current Smoker						
No	1					
Yes	0.99	0.65, 1.55	1.0	-	-	-
Ever smoked						
No	1			1		
Yes	1.52	1.23, 1.88	<0.001	1.27	0.92, 1.75	0.154
Ever consumed alcohol						
No	1					
Yes	0.96	0.80, 1.14	0.618	-	-	-
Fruit servings days per week						

(*Continued*)

Table 3. (Continued)

Variable	Unadjusted Correlates			Adjusted Correlates		
	OR†	95% CI*	p-value	OR†	95% CI*	p-value
0	1			1		
1–3	1.48	1.20, 1.82	<0.001	1.63	1.15, 2.31	0.006*
4–5	1.56	1.17, 2.09	0.002	1.56	0.98, 2.50	0.062
6–7	1.62	1.18, 2.22	0.003	1.38	0.82, 2.35	0.23
Vigorous physical activity						
No	1					
Yes	0.62	0.51, 0.74	<0.001	0.95	0.69, 1.30	0.731

†OR- odds ratio

*CI-confidence interval

‡Separated include those divorced and living separately

Source: **National Health Survey 2012**

https://doi.org/10.1371/journal.pone.0206034.t003

Urbanities were at the risk of suffering from diabetes in this study which is similar to the findings from the neighbouring countries [39–42]. There are a number of reasons such as the rapid urbanization, industrialization, and modernization leading to less physical activity at work, travelling to and from work, and at leisure, resulting in a more sedentary lifestyle [43]. Studies have shown that urban dwellers are more likely to consume food containing higher levels of sugar including sugar-sweetened beverages than rural residents [12, 44–48]. Other study showed that urban poor were at higher risk than rural people [49], suggesting that those that are well educated can choose to adopt a healthy lifestyle, the poor have fewer food choices and more limited access to nutritional education [50]. The diabetic burden in Bhutan is expected to increase with increased rural-urban migration in the coming years [30–32].

Participants with education levels of high school and diploma holders were at a higher risk of diabetes as compared to those without education as reported in other studies [35]. However, other literature reported an increased risk with lesser education [51]. The risk could be associated with an unhealthy diet as compared to the physical activity because the occupation was not a risk factor in this study.

Diabetes and hypertension are closely linked morbidities [21, 52–54], with obesity being a common risk factor for hypertension and diabetes. In Bhutan, it is estimated that around 40% of those aged 15 and above are overweight or obese [55]. The coexistence of hypertension with diabetes is associated with a six-fold increase in the risk of cardiovascular events compared to the general population [56]. Therefore, it is important to initiate aggressive sustained intervention in people with diabetes to control blood pressure and lower body weight [57–59].

Physical activity offered protection against diabetes in univariate analysis consistent with other published studies [16, 60, 61]. Regular physical activities including walking, cycling, jogging, and swimming should be advocated because it may prevent or delay type 2 diabetes development [11, 60, 62]. In addition, the benefits of a physical activity extend beyond protection against diabetes [63]. Regular physical exercise can improve lipid profile, decrease body weight, lower blood pressure, and reduce cardiovascular disease risk [64–66]. This reduction in cardiovascular disease risk in individuals with diabetes is very important because they are twice at risk of experiencing serious cardiovascular disease events and are two to four times more likely to die from the complications of cardiovascular events compared to the general population [67, 68].

The main strength of the study is that this is the first nationally representative study on the risk of diabetes and risk factors. However, this study is subjected to a number of limitations. The study is subjected to probable recall bias. The behavioural risk factors in this study (i.e. fruit and consumption, tobacco use, alcohol use, and physical activity) were self-reported which could have led to under or overestimates of the actual levels of risk factors. In communities where certain behaviours are discouraged, there may be under-reporting of these behaviours (e.g. alcohol and tobacco consumption), especially among females. Additionally, the applied method of self-reporting diabetes status is neither able to provide data in relation to the level of diabetes's awareness (thus the evaluated prevalence of diabetes may be underestimated) nor can be as accurate as clinical examination. This study, given its cross-sectional approach, cannot establish causal relations, but rather can only generate hypotheses that could be evaluated by future prospective randomized trials.

Conclusion

The number of Bhutanese adults with diabetes and co-morbidities associated with it is likely to increase with the ageing of the population, nutrition transition, and high rural-urban migration in the near future. This calls for an urgent need to implement strategies to prevent diabetes in the Bhutanese population targeting risk factors including healthy lifestyle with increased physical activities, and treating co-morbidities including hypertension. In addition, there is also a need for epidemiological studies to monitor the trends of diabetes and related risk factors, as well as outcome, both fatal and non-fatal.

Acknowledgments

The authors would like to acknowledge the Ministry of Health, for allowing us to use the data of NHS 2012 for this study. We would also like to thank all the study participants.

Author Contributions

Conceptualization: Tshering Jamtsho.

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Methodology: Tshering Jamtsho.

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