



## Original Article

Prevalence and Control Status of Diabetes and Related Risk Factors Among 4196 Chinese Male Older Elderly Aged  $\geq 80$  YearsMiao Liu <sup>a\*,1</sup>, Xianyu Lv <sup>b,1</sup>, Yihe Li <sup>c</sup>, Jiaqi Li <sup>b</sup>, Yao He <sup>a</sup>

<sup>a</sup> Institute of Geriatrics, Beijing Key Laboratory of Aging and Geriatrics, Chinese PLA General Hospital, 28 Fuxing Road, Beijing, 100853, China, <sup>b</sup> The Third Outpatient Department of the General Logistics Department, Beijing, 10039, China, <sup>c</sup> Department of Clinical Laboratory, Affiliated Hospital of Military Medical Science Academy of PLA, 8 East Street, Beijing, 100071, China

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## SUMMARY

**Backgrounds:** Diabetes had become one of the major public health problems. However there was little information about the situation among older elderly, those who were aged more than 80 years old and usually had a worse health conditions. The purpose of this study was to evaluate the prevalence and control status of diabetes among 4196 Chinese male older elderly.

**Methods:** A cross-sectional study was conducted in all the cadre sanitariums in Beijing. 4196 men aged  $\geq 80$  years old were included in this study.

**Results:** The prevalence of diabetes was 38.1% among this male older elderly. Among participants with diabetes, the awareness rate, treatment rate and control rate were 84.4%, 60.6% and 36.6% respectively among those with diabetes. Age, marital status, physical activity, BMI, combined chronic diseases, and polypharmacy were related with diabetes management. Age was reversely associated with diabetes management. Participants, who were divorced/widowed, overweight/obesity, had more combined chronic diseases, and had polypharmacy, had worse diabetes management. The ORs of BMI  $\geq 24$  kg/m<sup>2</sup> for treatment and control rates were 0.53 (95%CI: 0.42–0.66) and 0.17 (95%CI: 0.13–0.26). The ORs of polypharmacy for awareness, treatment and control rates were 0.38(95%CI: 0.28–0.53), 0.17(95%CI: 0.13–0.26) and 0.70 (95%CI: 0.53–0.90).

**Conclusion:** The prevalence of diabetes was up to 38.1%, among this male older elderly. The awareness rate was high; however the treatment and control rates were relatively low. Age, marital status, lifestyles, obesity, combined chronic diseases, and polypharmacy were related risk factors with diabetes management.

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## 1. Introduction

Diabetes had become one of the most important public health problems in the world<sup>1</sup>, mainly because of the aging population and huge socioeconomic change, along with the unhealthy lifestyles, the situation was more serious in developing countries in these years<sup>2,3</sup>. There will be an increase of at least 20% of diabetes patients in low and middle income countries between 2010 and 2030<sup>4</sup>. The situation was also severe in China, which had the largest population in the world<sup>5</sup>. Based on the latest national survey, the

prevalence of diabetes in China was 11.6%<sup>6</sup>. Diabetes does not only cause heavy disease burden, but also has an important influence on quality of life and long-term health outcomes. Diabetes related costs are expected to be \$376 billion \$ in 2030<sup>4,7</sup>.

There were a series of studies which have shown information on the prevalence of diabetes and also the control status<sup>8–10</sup>. The results showed that management of diabetes were far from optimistic. The 2011 National Health and Morbidity Survey of Malaysia showed that the prevalence of diabetes among people aged  $\geq 65$  years was 34.4%, while the awareness, treatment, and control rates were 65.2%, 57.1% and 12.4% respectively<sup>11</sup>. A meta-analysis for diabetes management in China from 1979 to 2012 also showed the similar results, the pooled awareness rate, treatment rate, and control rate of diabetes were 45.81%, 42.54%, and 20.87% respectively<sup>5</sup>. However, there surveys mainly focused on adults or

\* Corresponding author. Institute of Geriatrics, Chinese PLA General Hospital, 28 Fuxing Road, Beijing, 100853, China.

E-mail address: [liumiao1mbxb@163.com](mailto:liumiao1mbxb@163.com) (M. Liu).

<sup>1</sup> The first two authors contributed equally to this work.

younger elderly (under 80 years old)<sup>9,11,12</sup>; there were little information about the situation among older elderly, those who were aged more than 80 years old and usually had a worse health conditions<sup>13</sup>. Along with the aging process, there were more and more older elderly. According to Ministry of Civil Affairs in China, there were 23 million older elderly in 2013, and this group increase by 5% each year<sup>14,15</sup>. Therefore, it's urgent and highly demanded to examine the prevalence and control status of diabetes among older elderly. Hence, the purposes of this study were: (1) to assess prevalence of diabetes in this large sample older elderly population; (2) to evaluate the management status; (3) to explore the associated risk factors.

## 2. Methods

### 2.1. Sampling method

A cross-sectional study was conducted in all the army cadre sanitariums in Beijing, between May 2012 and December 2014. All the retired elderly military officers lived in the cadre sanitariums were invited to participant the survey. Those who were aged more than 80 years old were included in the analysis. Since there were only less than 10% of female participants, we only selected males. Excluding those with incomplete data, there left 4196 male participants in the following analysis.

### 2.2. Data collection

A standard protocol was used by trained doctors and nurses for the survey. There were three parts of the whole survey: questionnaire, physical examination and blood tests. A face-to-face questionnaire was answered by each participant including gender, age, education, marriage status, disease history, medical treatment, unhealthy lifestyles (current smoking: currently smoke at least one cigarette daily; current drinking: currently drinking alcohol at least once a week; physical exercise: an average of more than 0.5 h per day) and family histories. Physical examination were measured based on protocol. Height and weight were measured using standard methods. Blood pressures were obtained using mercury sphygmomanometer while the participant in a sitting position after 30 min of rest, and after a 10-min interval, the second blood pressures were also obtained, mean values were calculated to be the final blood pressure results. Fasting blood samples were collected before 8:00 a.m. Total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and fasting plasma glucose (FPG) were tested. We also did Oral glucose tolerance test and recorded the 2 h plasma glucose (2hPG) level.

### 2.3. Definitions

Polypharmacy was defined as having taken medicine more than 6 kinds at the same time. Diabetes was defined positive if one of the following was satisfied: FPG was higher than 7.0 mmol/L (126 mg/dL); or 2hPG was higher than 11.1 mmol/L; or had been diagnosed as having diabetes before; or having received drug treatment for diabetes regularly. A positive answer to the question "Have you ever been diagnosed as having diabetes by a doctor" was considered as being aware of diabetes. The awareness rate was defined as those who were aware of diabetes among those who had diabetes. Medication information was obtained from the participants' medical records. The treatment rate was defined as those who had taken medication regularly or injected with insulin among those who had diabetes. The control rate was defined as those whose FPG level was lower than 7.0 mmol/L among those who had diabetes.

### 2.4. Statistical analysis

Epidata 3.1 was used for data entry. SPSS 20.0 was used for data analysis. The counts of categorical variables were compared using  $\chi^2$  test, and continuous variables were compared using T (two groups) test or ANOVA ( $\geq 3$  groups) test. Prevalence, awareness rate, treatment rate and control rate of diabetes were calculated separately. Wu used multivariate logistic regression to calculate the odds ratios (ORs) (95% confidence intervals (CIs)) for related risk factors. The variables include in the multivariable analysis were age (continuous), education years (0–6 years,  $\geq 7$  years), marital status (married, divorced/widowed), current smoking (yes, no), current drinking (yes, no), physical exercise (yes, no), BMI  $\geq 24$  kg/m<sup>2</sup> (yes, no), family history of diabetes (yes, no),  $\geq 4$  kinds of combined chronic diseases (yes, no), polypharmacy (yes, no).

### 2.5. Ethics approval and consent to participate

Ethics approval was obtained from the Ethics committee of Chinese PLA General Hospital (S2013-067-01). Informed consent was signed by each participant.

## 3. Results

### 3.1. General characteristics of the participants

There were 4196 male participants who completed the survey. The general characteristics of all participants were summarized in Table 1. The mean age was  $87.1 \pm 3.8$  years, and 18.8% of the participants were aged more than 90 years old. Compared with those without diabetes, participants who had diabetes had a bigger WC, higher BMI, higher blood pressures, TG, and glucose levels. In addition, diabetic participants had higher education level, lower smoking and alcohol drinking rates, lower rates of physical exercise, and a higher percentage of family history.

### 3.2. The prevalence of diabetes according to age groups

The prevalence of diabetes was 38.1% in this Chinese male older elderly. Along with different age groups, the prevalence of diabetes increased significantly (36.9%, 37.2%, 45.4% for 80–84 yrs, 85–89 yrs, and  $\geq 90$  yrs,  $p$  for trend = 0.016). On the other hand, percentage of participants with normal glucose decreased significantly.

### 3.3. Awareness, treatment and control of diabetes by related risk factors

The overall awareness, treatment and control rate were 84.4%, 60.6% and 36.6% respectively. Table 2 also showed the univariate analysis of diabetes management. The awareness rate was lower among participants who did physical exercise compared to those without (82.3% vs. 88.2%), higher rates of married status (85.6% vs. 81.0%), and also younger age. On the other hand, participants with more combined chronic diseases and polypharmacy had lower awareness rate. Treatment and control rates showed the same trend for age group, marital status, more combined chronic diseases and polypharmacy. Participants with BMI  $\geq 24$  kg/m<sup>2</sup> had significantly lower rates of treatment and control rates.

### 3.4. Multivariate logistic regression analyses on risk factors for prevalence and management of diabetes

Table 3 showed the logistic regression results. Five variables, including education level, marital status, physical activity, BMI and

**Table 1**  
General characteristics of the participants.

Characteristic	Diabetes (n = 1599)	No diabetes (n = 2597)	P value	Total (n = 4196)
$\bar{x} \pm s$				
Age (yrs)	87.2 ± 3.8	87.1 ± 3.8	0.052	87.1 ± 3.8
WC(cm)	83.8 ± 30.9	81.0 ± 24.3	0.019	82.1 ± 27.2
BMI(kg/m <sup>2</sup> )	24.7 ± 3.0	24.4 ± 3.2	<0.001	24.5 ± 3.2
SBP(mmHg)	133.5 ± 12.5	132.5 ± 14.4	0.018	132.9 ± 13.7
DBP(mmHg)	72.5 ± 10.5	73.2 ± 9.6	0.041	72.9 ± 10.0
TC (mmol/l)	4.5 ± 1.6	4.5 ± 1.1	0.447	4.5 ± 1.3
TG (mmol/l)	1.7 ± 1.3	1.4 ± 0.8	<0.001	1.5 ± 1.0
HDL-C (mmol/l)	1.6 ± 1.1	1.6 ± 0.9	0.628	1.6 ± 1.0
LDL-C (mmol/l)	2.5 ± 0.9	2.5 ± 0.8	0.115	2.5 ± 0.8
FPG (mmol/l)	7.1 ± 2.3	5.5 ± 0.6	<0.001	6.1 ± 1.7
2hPG (mmol/l)	9.2 ± 2.4	7.3 ± 1.0	<0.001	8.0 ± 1.9
n (%)				
Education ≥ 7 yrs	987 (61.7)	1474 (56.8)	0.002	2461 (58.7)
Married	1193 (74.6)	2064 (79.5)	<0.001	3257 (77.6)
Current smoking	37 (2.3)	95 (3.7)	0.015	132 (3.1)
Current alcohol drinking	126 (7.9)	309 (11.9)	<0.001	435 (10.4)
Physical exercise	1236 (77.3)	2175 (83.8)	<0.001	3411 (81.3)
Family history of diabetes	174 (10.9)	132 (5.08)	<0.001	306 (7.3)

Data are mean ± SD for continuous values or n (%) for category values.

WC: waist circumference; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; TC: total cholesterol; TG: triglyceride; HDL-C: high density lipoprotein cholesterol; LDL-C: low density lipoprotein cholesterol; FPG: fasting plasma glucose; 2hPG: 2 h postprandial blood glucose.

**Table 2**  
Awareness, treatment, control rates of diabetes by age and related risk factors.

	Awareness	Treatment	Control
Age group			
80–84 yrs	86.8*	62.0*	32.7*
85–89 yrs	83.9	61.0	33.1
≥90 yrs	81.3	57.5	42.2
Education years			
0–6 years	84.8	60.4	35.6
≥7 years	84.2	60.9	38.2
Marital status			
Divorced or widowed	81.0*	60.2	30.3*
Married	85.6	61.8	38.7
Current smoking			
Yes	85.3	54.1	24.3
No	85.9	60.8	36.9
Current alcohol drinking			
Yes	81.7	67.5	41.3
No	84.7	60.0	36.2
Physical exercise			
Yes	82.3*	59.5	37.5
No	88.2	64.2	33.3
BMI ≥ 24 kg/m <sup>2</sup>			
Yes	83.8	55.9*	32.3*
No	85.5	68.7	43.9
Family history of diabetes			
Yes	90.5*	67.6*	40.1*
No	81.0	56.9	34.3
≥4 kinds of combined chronic diseases			
Yes	73.7*	55.6*	29.8*
No	91.4	63.8	41.0
Polypharmacy			
Yes	70.1*	28.6*	35.4*
No	87.9	68.3	41.5
Total	84.4	60.6	36.6

\*P < 0.05.

family history, were statistically positively associated with prevalence of diabetes. Participants with higher education level, divorced/widowed, overweight/obesity and positive family history had higher diabetes prevalence. The corresponding ORs for the four variables were 1.22(95%CI: 1.07–1.39), 1.24(95%CI: 1.05–1.42), 1.34(95%CI: 1.17–1.52) and 2.17 (95%CI: 1.56–2.78). Participants with regular physical activity had lower diabetes prevalence, the corresponding OR were 0.73 (0.62–0.86).

Age was reversely associated with diabetes management. The corresponding ORs for awareness, treatment and control rates were 0.98(95%CI: 0.96–0.99), 0.98(95%CI: 0.97–0.99) and 0.97 (95%CI: 0.96–0.99). Participants, who were divorced/widowed, overweight/obesity, had more combined chronic diseases, and had polypharmacy, had worse diabetes management. For example, the ORs of BMI ≥ 24 kg/m<sup>2</sup> for treatment and control rates were 0.53 (95%CI: 0.42–0.66) and 0.17 (95%CI: 0.13–0.26). The ORs of polypharmacy for awareness, treatment and control rates were 0.38(95%CI: 0.28–0.53), 0.17(95%CI: 0.13–0.26) and 0.70 (95%CI: 0.53–0.90).

#### 4. Discussion

There is little data about the prevalence and control status of diabetes among older elderly. Thus, our study has provided important information for public health and medical policy. This large sample population-based study reported the prevalence and control status among male older elderly in China also reported the related factors. It was revealed that in this Chinese male older elderly, prevalence of diabetes was up to 38.1%, and 19.4% of the participant had IFG/IGT. The awareness rate was 84.4%, however, the treatment and control rates were 60.6% and 36.6% respectively. There were many factors related with diabetes management.

Prevalence of diabetes among this older elderly was 38.1%, and increased with age groups. The results were comparable with other studies. Data from national survey showed that prevalence of diabetes among those aged more than 70 years was 23.5%<sup>6</sup>. A survey among elderly from nursing home in American showed that there were 32.8% of total subjects had diabetes<sup>16</sup>. Also, a variety of studies have suggested that diabetes was associated with higher BMI and low physical activity. Study among rural Bangladeshi population showed that obesity had good association with diabetes, the OR of BMI for diabetes was 2.16 (95%CI: 1.57, 2.97)<sup>17</sup>. A meta-analysis of cohort studies showed that physical activity was significantly associated with decreased risk of diabetes, the hazard ratio was 0.69 (95%CI: 0.61–0.78)<sup>18</sup>.

In this study, 84.4% of the diabetic patients were aware of their condition, 60.6% received treatment, and 36.6% kept their glucose level under control. The control status of diabetes was not optimistic. The results of our study were similar to previous ones.

**Table 3**  
Multivariate logistic regression analyses on risk factors for prevalence and management of diabetes.

Variable	Risk factor	OR	95%CI	P value	
Prevalence	Age (years)	1.01	1.00–1.02	0.048	
	Education years			0.004	
	≥7 years	1.22	1.07–1.39		
	0–6 years	1.00(Ref)			
	Marital status			0.010	
	Divorced or widowed	1.24	1.05–1.42		
	Married	1.00(Ref)			
	Physical exercise			<0.001	
	Yes	0.73	0.62–0.86		
	No	1.00(Ref)			
	BMI≥24 kg/m <sup>2</sup>			<0.001	
	Yes	1.34	1.17–1.52		
No	1.00(Ref)				
Awareness rates	Family history of diabetes			<0.001	
	Yes	2.17	1.56–2.78		
	No	1.00(Ref)			
	Age (years)	0.98	0.96–0.99	0.042	
	Marital status			0.001	
	Divorced or widowed	0.59	0.43–0.81		
	Married	1.00(Ref)			
	≥4 kinds of combined chronic diseases			<0.001	
	Yes	0.30	0.22–0.44		
	No	1.00(Ref)			
	Family history of diabetes			<0.001	
	Yes	2.86	1.98–3.74		
No	1.00(Ref)				
Treatment rates	Age (years)	0.98	0.97–0.99	0.021	
	BMI≥24 kg/m <sup>2</sup>			<0.001	
	Yes	0.53	0.42–0.66		
	No	1.00(Ref)			
	Polypharmacy			<0.001	
	Yes	0.17	0.13–0.26		
	No	1.00(Ref)			
	Family history of diabetes			<0.001	
	Yes	1.85	1.48–2.23		
	No	1.00(Ref)			
	Control rates	Age (years)	0.97	0.96–0.99	<0.001
		Marital status			0.001
Divorced or widowed		0.67	0.51–0.84		
Married		1.00(Ref)			
BMI≥24 kg/m <sup>2</sup>				<0.001	
Yes		0.61	0.49–0.75		
No	1.00(Ref)				

Middle aged and elderly participants from Kazakhstan showed that among those subjects who had diabetes, and the awareness rate was 72.3%; 65.6% had drug treatment and 27.7% had well controlled FPG<sup>19</sup>. The results of 19,374 individuals aged ≥60 years old from the National Health Examination Survey III of Thailand showed that the awareness of diabetes was 58.8% while the control rate was only 12.4%<sup>20</sup>. A meta-analysis about the management of diabetes in China showed the pooled awareness, treatment, and control rates were 45.8%, 42.5%, and 20.9% respectively<sup>5</sup>. Our study also showed that among older elderly, the awareness was relative high, but the treatment and control rates were far from optimistic.

The multivariate analysis showed that age, higher BMI, marital status, combined chronic diseases, and polypharmacy were significantly associated with diabetes management status among Chinese male older elderly. This result was consistent with previous researches. Married people may have a lasting support environment to restrain their healthy behavior and maintain health<sup>21</sup>. A cohort study had followed 41,378 men for 22 years, and have concluded that compared to married men, unmarried participants (including divorced and widowed) had a 16% higher risk of developing diabetes (95%CI:1.04,1.30), after adjusted for a series of covariates<sup>22</sup>. Different from adults and younger elderly, the older elderly often had a high prevalence of multi-morbidity and polypharmacy. Data from UK nursing homes showed that about 84% of

the diabetes residents had polypharmacy<sup>23</sup>. Also, evidence showed that patients who had taken more medicine was associated with increased risk of mortality, study based on 5052 elderly showed that the risk ratio was 1.83 (95% CI: 1.51–2.21) for participants on polypharmacy<sup>24</sup>. For older age, obesity and family history of diabetes, there were a series of evidences support that these factors were related with diabetes management.

This was a cross-sectional study focused on the prevalence and control status of diabetes of older elderly aged more than 80 years old. All the field survey and physical examination had strict quality control measures. All the data were double entered in order to avoid errors. All the doctors and nurses involved in the study were specially trained. Second, the study had made up the blank about situation of diabetes management among older elderly, which was important for health policy and health care. Early prevention and treatment measures could be taken to prevent related complications and reduce disease burden. Third, we also analyzed the related risk factors associated with prevalence and management of diabetes. Results were helpful for physicians to target high risk diabetes patients, and take countermeasures.

There were also some limitations to be considered. First, the temporal relationship between risk factors and management rates of diabetes was calculated based on cross-sectional study, which was weak on construction of causality. Second, our participants

were retired military cadres, and they were different from ordinary community residents. So the results had a limited representation. Third, there were only less than 10% of female in the army cadre sanitariums. So we only included male participants. Since there were no data on female, it needs to be cautious when comparing with other researches. Fourth, there may be estimates errors in the awareness rate, since the numerator of awareness rate was calculated by participants' self-aware of suffering from diabetes or not. Last, the information of lifestyles was self-reported; there may be potential reporting and there may be recall bias. We used standard questionnaire and trained doctors before the field survey in order to decrease this bias.

## 5. Conclusion

In summary, the prevalence of diabetes was high among Chinese male older elderly. Four-fifths of diabetic patients were aware of their condition, and three-fifths were treated, but the control rate was only less than two-fifths. Considering the huge number of older elderly and their health condition, it's urgent to improve the diabetes control status among older elderly and to prevent related disease burden.

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## Conflict of interest statement

None declared.

## References

- Guariguata L, Whiting DR, Hambleton I, et al. Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes Res Clin Pract.* 2014;103(2):137–149.
- Nanditha A, Ma RC, Ramachandran A, et al. Diabetes in Asia and the Pacific: implications for the global epidemic. *Diabetes Care.* 2016;39(3):472–485.
- Smith-Spangler CM, Bhattacharya J, Goldhaber-Fiebert JD. Diabetes, its treatment, and catastrophic medical spending in 35 developing countries. *Diabetes Care.* 2012;35(2):319–326.
- Zhang P, Zhang X, Brown J, et al. Global healthcare expenditure on diabetes for 2010 and 2030. *Diabetes Res Clin Pract.* 2010;87(3):293–301.
- Li MZ, Su L, Liang BY, et al. Trends in prevalence, awareness, treatment, and control of diabetes mellitus in mainland China from 1979 to 2012. *Int J Endocrinol.* 2013;2013(4):753150.
- Xu Y, Wang L, He J, et al. Prevalence and control of diabetes in Chinese adults. *JAMA.* 2013;310(9):948–959.
- Alberti KG, Zimmet P. Global burden of disease—where does diabetes mellitus fit in? *Nat Rev Endocrinol.* 2013;9(5):258–260.
- Yang F, Qian D, Chen J, et al. Prevalence, awareness, treatment and control of diabetes mellitus in rural China: results from Shandong Province. *Diabet Med.* 2016;33(4):1.
- Lee HS, Lee SS, Hwang IY, et al. Prevalence, awareness, treatment and control of hypertension in adults with diagnosed diabetes: the fourth Korea national health and nutrition examination survey (KNHANES IV). *J Hum Hypertens.* 2013;27(6):381–387.
- Rahman M, Nakamura K, Kizuki M. Socioeconomic differences in the prevalence, awareness, and control of diabetes in Bangladesh. *J Diabetes Complicat.* 2015;29(6):788–793.
- Ho BK, Jasvinder K, Gurpreet K, et al. Prevalence, awareness, treatment and control of diabetes mellitus among the elderly: the 2011 National Health and Morbidity Survey, Malaysia. *Malays Fam Physician.* 2014;9(3):12–19.
- Zhou X, Guan H, Zheng L, et al. Prevalence and awareness of diabetes mellitus among a rural population in China: results from Liaoning Province. *Diabet Med.* 2015;32(3):332–342.
- Castro-costa E, Uchoa E, Firmo JO, et al. Association of cognitive impairment, activity limitation with latent traits in the GHQ-12 in the older elderly. The Bambui Health and Aging Study (BHAS). *Aging Clin Exp Res.* 2008;20(6):562–568.
- Leng SX, Tian XP, Durso S, et al. The aging population and development of geriatrics in China. *J Am Geriatr Soc.* 2008;56(3):571–573.
- Smith JP, Strauss J, Zhao Y. Healthy aging in China. *J Econ Ageing.* 2014;4:37–43.
- Dybicz SB, Thompson S, Molotsky S, et al. Prevalence of diabetes and the burden of comorbid conditions among elderly nursing home residents. *Am J Geriatr Pharmacother.* 2011;9(4):212–223.
- Siddiquee T, Bhowmik B, Karmaker RK, et al. Association of general and central obesity with diabetes and prediabetes in rural Bangladeshi population. *Diabetes Metab Syndr.* 2015;46(6):492–504.
- Huai P, Han H, Reilly KH, et al. Leisure-time physical activity and risk of type 2 diabetes: a meta-analysis of prospective cohort studies. *Endocrine.* 2016;52(2):1–5.
- Supiyev A, Kossumov A, Kassenova A, et al. Diabetes prevalence, awareness and treatment and their correlates in older persons in urban and rural population in the Astana region, Kazakhstan. *Diabetes Res Clin Pract.* 2016;112:6–12.
- Porapakham Y, Pattaraarchachai J, Aekplakorn W. Prevalence, awareness, treatment and control of hypertension and diabetes mellitus among the elderly: the 2004 National Health Examination Survey III, Thailand. *Singap Med J.* 2008;49(11):868–873.
- Stephens MA, Franks MM, Rook KS, et al. Spouses' attempts to regulate day-to-day dietary adherence among patients with type 2 diabetes. *Health Psychol.* 2013;32(10):1029–1037.
- Cornelis MC, Chiuve SE, Glymour MM, et al. Bachelors, divorcees, and widowers: does marriage protect men from type 2 diabetes? *PLoS One.* 2014;9(9):e106720.
- Gadsby R, Galloway M, Barker P, et al. Prescribed medicines for elderly frail people with diabetes resident in nursing homes—issues of polypharmacy and medication costs. *Diabet Med.* 2012;29(1):136–139.
- Gomez C, Vega-Quiroga S, Bermejo-Pareja F, et al. Polypharmacy in the elderly: a marker of increased risk of mortality in a population-based prospective study (NEDICES). *Gerontology.* 2015;61(4):301–309.