Prevalence of Diabetes and Health-Related Quality of Life Among Rural-to-Urban Nong Zhuan Fei Migrants in an Urban Area of Northern China, 2013

SHUANG YAN, MD[a]
XINCAI HONG, MBBS[a]
HAIQIAO YU, MBBS[a]
ZHEN YANG, MBBS[a]
SIYING LIU, MBBS[a]
WEI QUAN, MBBS[a]
JIANKAI XU, PHD[b]
LIYING ZHU, MD[c]
WEILUN CHENG, MB[d]
HONG XIAO, MD[e]
HEATHER KITZMAN-ULRICH, PHD[f]
MARK J. DEHAVEN, PHD[g]

ABSTRACT

Objective. In China's Nong Zhuan Fei (NZF) communities, farmers living in rural villages are uprooted and moved into newly constructed urban apartments when the government purchases their land for residential and commercial development. With their relocation from a traditional rural setting to a modern urban setting, residents of NZF communities face lifestyle-based risk factors for diabetes and other chronic diseases. We reported estimates of diabetes prevalence, risk factors, and health-related quality of life among adult Chinese NZF rural-to-urban migrants.

Methods. We conducted a descriptive cross-sectional study through a U.S.-China partnership with an NZF community of 3,184 residents. Health and disease history, risk factors, and sociodemographic information were collected by questionnaire. Participants completed a 24-hour diet recall, three-day physical activity recall, a health-related quality of life Short-Form 36 (SF-36) health survey, the Beck Depression Inventory, and fasting blood glucose tests.

Results. We gathered complete data from 1,150 of 1,772 eligible participants. The prevalence of diabetes was 11.6% (95% confidence interval 9.8, 13.6). Diabetes risk increased significantly with age, income, obesity, and hypertension. Based on SF-36 scores, residents aged ≥60 years with diabetes reported significantly greater physical (47.7 v. 70.2, $p=0.001$) and emotional (76.9 vs. 89.7, $p=0.006$) limitations, more bodily pain (79.7 vs. 84.9, $p=0.021$), and worse overall physical health (67.6 vs. 76.0, $p=0.015$) than those without diabetes.

Conclusion. The Chinese government hopes to integrate an additional 250 million people into city living by 2025. As the NZF population increases, so may the prevalence of diabetes associated with the change from a rural to an urban lifestyle. Action is needed now by public health professionals to prevent a possible diabetes crisis in NZF communities in the future.

[a]4th Affiliated Hospital of Harbin Medical University, Department of Endocrinology and Metabolism, Harbin, Heilongjiang Province, China
[b]Harbin Medical University, College of Bio-informatics Science and Technology, Harbin, Heilongjiang Province, China
[c]4th Affiliated Hospital of Harbin Medical University, Department of Infectious Diseases, Harbin, Heilongjiang Province, China
[d]Harbin Medical University, Harbin, Heilongjiang Province, China
[e]University of Texas Southwestern Clinically Affiliated Physicians, Dallas, TX
[f]University of North Texas, Health Science Center, Texas Prevention Institute, Fort Worth, TX
[g]University of North Carolina at Charlotte, College of Health and Human Services, Academy for Research on Community Health, Engagement, and Services (ARCHES), Charlotte, NC

Address correspondence to: Shuang Yan, MD, 4th Affiliated Hospital of Harbin Medical University, Department of Infectious Diseases, 37 Yiyuan St., Harbin, China; tel. +86-137-669-37866; e-mail <dr.yanshuang@gmail.com>.

Estimated deaths from diabetes increased 50% worldwide from 2000 to 2012,[1] and the International Diabetes Federation estimates that diabetes will increase worldwide from 382 million people in 2013 to 592 million people by 2035.[2] China leads the world in the estimated number of people with diabetes at about 114 million, many of whom are undiagnosed.[3,4] The prevalence of diabetes in China has increased rapidly during the past 20 years. The estimated prevalence has increased rapidly from 1.0% in 1980, to 3.0% in 1994,[5] 9.7% in 2007,[6] and 11.6% in 2010.[4] More efforts are needed to reverse the rise of diabetes in this country.[7]

Diabetes prevalence in China varies with a community's level of urbanization, with a twofold higher prevalence of diabetes in more urban areas than in less urban areas.[7] The components of urbanization—economic and income diversity, communications (e.g., percentage of households with a television, computer, or cell phone), transportation (e.g., presence and number of paved roads and bus/train stations), and modern markets—are each independently and positively related to diabetes prevalence. Differences in these components contribute to a broad range of diabetes prevalence across provinces, from 4.8% to 12.1%.[7] Furthermore, national studies stratified by level of economic development indicate that diabetes prevalence is 9.9% in economically undeveloped areas, 10.5% in intermediately developed areas, and 14.3% in developed areas.[4]

Preventing diabetes in China will require diverse strategies that address the unique features of individual communities' urbanization process.[8] Nationally, about 250 million rural residents are expected to emigrate into newly constructed towns and cities by 2025.[9] There are currently two types of migration. Active migration occurs when people move from rural to urban areas in search of better education, work, and/or living conditions. Induced migration occurs when people do not move from their local community, but their local community is transformed around them—by government fiat—from a rural to an urban community through the construction of buildings for commercial and residential use. When induced migration occurs, the government takes possession of farmers' land and, in exchange, the farmers are given thousands of dollars and are relocated to rent-free low-rise apartments constructed nearby. The process of induced migration is known as Nong Zhuan Fei (NZF), or "agriculture people migrate to non-agriculture people." With NZF, the traditional rural, agricultural ways of living are replaced almost overnight by more modern, urban ways of living. As residents of newly constructed NZF communities become part of the urban landscape growing up around them, they face new lifestyle-based risk factors for diabetes and other chronic diseases.[10,11]

Little is known, however, about the health and health-related quality of life (HRQOL) of China's millions of NZF individuals, or how to best implement health promotion and disease prevention efforts in these communities. In 2008, we created The Northern China Chronic Disease Management Program (NCCDMP) to establish a baseline for measuring increases in chronic disease over time among NZF individuals due to abrupt lifestyle changes, and to develop a community-based approach for preventing diabetes and other chronic diseases in NZF communities. Using community-based participatory research methods to engage community leaders and residents, the NCCDMP develops community-based prevention programs and connects them to hospital-based primary, secondary, and tertiary chronic disease prevention services.[12] The work is modeled after similar work in the United States.[13–16]

NCCDMP partners include the University of North Carolina at Charlotte, College of Health and Human Services, Academy for Research on Community Health, Engagement, and Services; the Department of Endocrinology and Metabolism at the 4th Affiliated Hospital of Harbin Medical University, Harbin, China; and the Golden Star Community in Harbin, China, the capital of Heilongjiang Province and China's 10th largest city (population: 11 million). The Golden Star Community is an NZF low-rise-apartment community located in Songbei District; residents were relocated from 2004 to 2009 from four local agricultural villages that no longer exist—Fanshengang, Dawangjia, Jinxing, and Xinzhen. Songbei District is rapidly growing: its population increased almost 50% in eight years (from 160,000 people in 2004 to 237,300 people in 2012). We present data from a baseline study conducted by the partnership on the prevalence of diabetes among adult residents of Golden Star Community, and examined the HRQOL of adults with diabetes who live in the community.

METHODS

Baseline study

The Golden Star Community is governed by a neighborhood committee drawn from the former village leaders, who participated with investigators in developing the study protocol and procedures for gathering baseline data. According to committee records, at the time of data gathering (May 2013), there were believed to be 1,310 families and approximately 3,184 residents living in Golden Star Community, ranging in age from newborn to 92 years. However, because villagers were not obligated to live in the apartments given to them and the neighborhood committee did not perform a resident census, the exact number of residents was unknown.

Recruitment and data collection

Baseline data were collected from May to September 2013 among all residents aged ≥17 years. A door-to-door recruitment method identified 1,772 eligible residents, who were then invited to participate in the study. Participants completed study questionnaires and most measurements one day and a fasting blood glucose test the following day. Residents completing all study questionnaires received a towel, toothbrush, or calcium tablets as a token of appreciation. Complete data were gathered from 1,150 residents; 272 residents who refused to participate and 350 residents who contributed data on the first day but failed to return the following day for the fasting blood glucose test were not included in the study.

Data collection instruments and variables

Data collected included sociodemographic characteristics, a physical examination, a three-day 24-hour food recall, the three-day physical activity recall, the Short-Form 36 (SF-36) Health Survey,[17] and the Beck Depression Inventory, a 21-question, multiple-choice, self-report instrument that is widely used to measure depression.[18] Personal information included sex, date of birth, ethnicity, marital status, education, occupation, family income, and family history of chronic disease. The physical examination included height and weight measurements; neck, waist, and hip circumference; blood pressure measurement; a fasting blood glucose test; electrocardiogram; and bone mineral density measurement.

To identify self-reported chronic diseases, participants were asked, "Have you ever been diagnosed by a health professional as having (name of disease: e.g., diabetes, hypertension, cardiovascular disease, chronic obstructive pulmonary disease, or cancer)?" We included both undiagnosed and diagnosed diabetes.[6] We coded participants as having diabetes if they (*1*) responded "yes" to the self-reported diabetes question or (*2*) responded "no" to the question but had a fasting blood glucose level ≥7.0 millimoles per liter (mmol/l).[7] Blood pressure was measured manually using the non-dominant arm after 15 minutes of rest.[19] We coded participants as having hypertension if they (*1*) responded "yes" to a self-reported hypertension question or (*2*) responded "no" to the question but had a systolic blood pressure of ≥140 millimeters of mercury (mmHg). Weight and height were measured according to a standard protocol, and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2). We classified weight in two ways: (*1*) using the World Health Organization (WHO) method, according to which obesity is a BMI ≥30 kg/m^2 and overweight is a BMI ≥25 kg/m^2 for adults aged ≥18 years, and (*2*) using the Working Group on Obesity in China (WGOC) method, according to which obesity is a BMI ≥28 kg/m^2 and overweight is a BMI ≥24 kg/m^2.[20,21] We used WHO standard methods to measure waist and hip circumference.[22] We measured neck circumference with head erect and eyes facing forward, horizontally, at the upper margin of the laryngeal prominence (Adam's apple).[23] We measured bone mineral density using the Sahara Clinical Bone Sonometer (Hologic, Inc., Bedford, Massachusetts) with coupling agent smearing in the calcaneus.

A 24-hour food recall was used to assess energy and nutrient intakes for the past three days. The 24-hour food recall assessed dietary behaviors and habits (e.g., portion sizes, and where, when, and how often meals are consumed), carbohydrates, fat, protein, fiber, water, energy intake (calories), and numerous vitamins and minerals (e.g., beta carotene, vitamins C and E, retinal, folate, calcium, phosphorus, magnesium, iron, zinc, and potassium).[24,25] Trained interviewers used food models and common household measures (e.g., spoons and cups) to help participants estimate food portions. Participants were classified as above or equal to and below the Chinese Nutrition Society recommended energy intake after adjusting for age, sex, and activity levels.[26] We used the three-day physical activity recall to estimate participants' typical activity pattern for the previous three days.[27]

We calculated the mean level of metabolic equivalents (METS) for the three previous days (METS/day/person); because the values were highly skewed (skewness = 2.9), tertiles were used to reflect low (≤32.0), medium (>32.0 to <36.8), or high (≥36.8) levels of physical activity. Smoking was defined as having smoked daily for at least six months during one's life.[28] Alcohol use was defined as having up to one drink per day for women and up to two drinks per day for men.[29] We used the SF-36 to assess HRQOL. The SF-36 is a 36-item scale consisting of eight subscales measuring different HRQOL domains; the Chinese version has demonstrated good reliability and validity for evaluating HRQOL in Chinese populations.[30,31] Overall scores and subscale scores ranged from 0 to 100, with higher scores indicating better health. The eight health domains included physical functioning (i.e., performance in daily activities, such as taking care of oneself, getting dressed, and climbing stairs); role physical (i.e., physical health impact on performance in daily activities); bodily pain (i.e., level of pain and impact on performance of daily activities); general health (i.e., subjective perception of general health condition); vitality (i.e., subjective perception of energy and fatigue); social functioning (i.e., impact of physical health condition on social activities); role emotional (i.e., impact of emotional condition on performance in daily activities); and mental health (i.e., general mood and mental well-being). We combined subscale scores for each participant into a physical composite score and a mental composite score, which provided summary measures of general physical and mental health status.

Statistical analysis. We categorized demographic, socioeconomic, clinical, and lifestyle variables as percentages with 95% confidence intervals (CIs) for categorical variables, in subgroups of sex and age, and categories of education, income level, BMI, central obesity, and other risk factors. We used the chi-squared test to assess the association between each factor and diabetes. We used the Mann-Whitney U test to test mean differences on SF-36 domains between those with diabetes and those without diabetes. We used multivariable stepwise logistic regression models using backward elimination to examine the associations between all demographic, socioeconomic, clinical, and lifestyle variables and the odds of having diabetes. The model of best fit was estimated based on likelihood-ratio tests. All *p*-values were two-tailed and were not adjusted for multiple testing; we considered $p<0.05$ to be statistically significant. Analyses were conducted using SPSS® version 19[32] and R software version 3.1.1.[33]

RESULTS

Diabetes and diabetes prevalence

Our sample comprised mostly female respondents (62.1%) and those aged ≥50 years (56.1%). Most participants had ≤middle school education (74.4%) and more than half (55.0%) had an annual family income ≤30,000 Yuan (about $5,000 U.S. dollars). Many respondents were overweight or obese according to WHO (41.4%) or WGOC (53.7%) criteria. The sample included equivalent percentages of high (25.4%) and low (27.0%) physical activity levels. About two-thirds (62.3%) had central obesity according to waist circumference (Table 1).

Diabetes prevalence was 11.6% (95% CI 9.8, 13.6). In bivariate analysis, age was significantly related to having diabetes ($p<0.001$); those aged ≥70 years had the highest prevalence of diabetes (25.4%, 95% CI 17.9, 34.3). Clinical and lifestyle characteristics associated with having diabetes were higher BMI ($p<0.001$), self-reported hypertension ($p<0.001$), cardiovascular disease ($p<0.001$), chronic obstructive pulmonary disease ($p=0.001$), and cerebral infarction ($p<0.001$); consuming above the recommended Chinese Nutrition Society energy intake ($p=0.020$); and central obesity ($p<0.001$) (Table 2).

In the multivariate logistic regression model, older age, higher income, obesity, and hypertension were significantly associated with greater odds of having diabetes. Older age was associated with 1.7 (95% CI 1.5, 2.0) times higher odds of having diabetes. The odds of having diabetes were 1.3 (95% CI 1.0, 1.5) times higher for those with higher incomes, 2.0 (95% CI 1.1, 3.8) times higher for those with obesity, and 2.2 (95% CI 1.5, 3.3) times higher for those with hypertension (Table 3).

HRQOL

We examined the relationship between SF-36 scores and having diabetes among middle-aged (aged 40–59 years) and retirement-age (≥60 years) residents; however, the numbers needed to examine this association among residents aged 17–39 years with diabetes were insufficient. Residents aged ≥60 years with diabetes compared with those without diabetes reported significantly more physical (47.7 vs. 70.2, $p=0.001$) and emotional (76.9 vs. 89.7, $p=0.006$) limitations on their activities, more bodily pain (79.7 vs. 84.9, $p=0.021$), and worse overall physical health (67.6 vs. 76.0, $p=0.015$). Among respondents aged 40–59 years, those with diabetes also reported more emotional limitations on their activities (80.3 vs. 89.5, $p=0.035$) and poorer general health (61.9 vs. 69.2, $p=0.029$) than those without diabetes (Table 4).

DISCUSSION

Diabetes in China: a growing epidemic

Songbei experienced 48% population growth from 2004 to 2012. Thus, residents who were moved from agricultural villages in 2004–2009 and resettled in urban low-rise apartments are living in a rapidly urbanizing area and are likely to be adopting more urban lifestyles. Studies have documented a strong positive relationship between diabetes prevalence and level of economic development and urbanization, with a diabetes prevalence of 9.9% in economically undeveloped areas, 10.5% in intermediately developed areas, and 14.3% in developed areas.[4,7] According to the most recently published data, diabetes prevalence in

Table 1. Characteristics of Golden Star Community residents aged ≥17 years in a study of diabetes prevalence among rural-to-urban migrants in Songbei District, Harbin, China, 2013

Characteristic	N	*Percent*[a] *(95% CI)*
Total	1,150	
Age (in years)		
17–29	128	11.1 (9.4, 13.1)
30–39	150	13.0 (11.2, 15.1)
40–49	227	19.7 (17.5, 22.2)
50–59	328	28.5 (25.9, 31.2)
60–69	199	17.3 (15.2, 19.6)
≥70	118	10.3 (8.6, 12.2)
Sex		
Male	436	37.9 (35.1, 40.8)
Female	714	62.1 (59.2, 64.9)
Education		
None	100	8.7 (7.1, 10.5)
Primary school	313	27.2 (24.7, 29.9)
Middle school	443	38.5 (35.7, 41.4)
Senior/technical school	180	15.6 (13.6, 17.9)
Junior college	67	5.8 (4.5, 7.3)
≥University	47	4.1 (3.0, 5.4)
Annual income (in Yuan)		
<10,000	214	18.6 (16.4, 20.9)
10,001–30,000	418	36.4 (33.6, 39.2)
30,001–50,000	364	31.6 (28.9, 34.4)
50,001–100,000	126	11.0 (9.2, 12.9)
100,001–200,000	28	2.4 (1.6, 3.5)
BMI in kg/m^2 (WGOC)[b]		
Normal (<24.0)	532	46.3 (43.4, 49.2)
Overweight (24.0–27.9)	441	38.3 (35.5, 41.2)
Obese (≥28.0)	177	15.4 (13.4, 17.6)
BMI in kg/m^2 (WHO)[c]		
Normal (<25.0)	674	58.6 (55.7, 61.5)
Overweight (25.0–29.9)	399	34.7 (31.9, 37.5)
Obese (≥30.0)	77	6.7 (5.3, 8.3)
Smoking (yes)[d]	352	30.6 (27.9, 33.4)
Alcohol (yes)[e]	317	27.6 (25.0, 30.3)
Hypertension (yes)	268	23.3 (20.9, 25.9)
Cardiovascular disease (yes)	238	20.7 (18.4, 23.2)
Tumor (yes)	40	3.5 (2.5, 4.7)
Chronic obstructive pulmonary disorder (yes)	33	2.9 (1.9, 4.0)
Cerebral infarction (yes)	153	13.3 (11.4, 15.4)
Physical activity[f]		
Low (≤32.0)	310	27.0 (24.4, 29.6)
Medium (32.1–36.7)	548	47.6 (44.7, 50.6)
High (≥36.8)	292	25.4 (22.9, 28.0)
Recommended energy intake below Chinese Nutrition Society standards[g]	1,027	89.3 (87.9, 91.0)
Central obesity (waist circumference) ≥90 cm in men, ≥80 cm in women	716	62.3 (59.4, 65.1)

[a]Percentages may not sum to 100 because of rounding.

[b]Chen C, Lu FC; Department of Disease Control Ministry of Health, PR China. The guidelines for prevention and control of overweight and obesity in Chinese adults. Biomed Environ Sci 2004;17 Suppl:1-36.

[c]World Health Organization. Obesity and overweight [cited 2015 Sep 5]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en

[d]Defined as having smoked daily for at least six months during one's life

[e]Defined as having up to one drink per day for women and up to two drinks per day for men

[f]Calculated as the mean level of metabolic equivalents for the three previous days

[g]Source: Keyou G. How to apply Dietary Reference Intakes (DRIs) to evaluate individual and group dietary. J Hyg Res 2002;31:1-4.

CI = confidence interval

BMI = body mass index

kg/m^2 = kilograms per meter squared

WGOC = Working Group on Obesity in China

WHO = World Health Organization

cm = centimeter

Table 2. Diabetes prevalence in Golden Star Community residents aged ≥17 years, by demographic characteristics, in a study of diabetes prevalence among 1,150 rural-to-urban migrants in Songbei District, Harbin, China, 2013

Characteristics	N	*Percent (95% CI)*[a]	P-*value*[b]
Total participants	1,150		
Total with diabetes	133	11.6 (9.8, 13.6)	
Age (in years)			<0.001
17–29	1	0.1 (0.0, 4.3)	
30–39	6	4.0 (1.5, 8.5)	
40–49	16	7.0 (4.1, 11.2)	
50–59	45	13.7 (10.2, 17.9)	
60–69	35	17.6 (12.6, 23.6)	
≥70	30	25.4 (17.9, 34.3)	
Sex			0.624
Male	53	11.2 (9.2, 15.6)	
Female	80	12.2 (28.9, 13.8)	
Education			0.275
None	11	11.0 (5.6, 18.8)	
Primary school	45	14.4 (10.7, 18.8)	
Middle school	43	9.7 (7.1, 12.9)	
Senior/technical	17	9.4 (5.6, 14.7)	
Junior college	9	13.4 (6.3, 23.9)	
≥University	8	17.0 (7.7, 30.8)	
Annual income (in Yuan)			0.668
<10,000	27	12.6 (8.5, 17.8)	
10,001–30,000	47	11.2 (8.4, 14.7)	
30,001–50,000	43	11.8 (8.7, 15.6)	
50,001–100,000	11	8.7 (4.4, 15.1)	
100,001–200,000	5	17.9 (6.1, 36.9)	
BMI in kg/m^2 (WGOC)[c]			<0.001
Normal (<24.0)	40	7.5 (5.4, 10.1)	
Overweight (24.0–27.9)	59	13.4 (10.3, 16.9)	
Obese (≥28.0)	34	19.2 (13.7, 25.8)	
BMI in kg/m^2 (WHO)[d]			0.001
Normal (<25.0)	58	8.6 (6.6, 10.9)	
Overweight (25.0–29.9)	60	15.0 (11.7, 18.9)	
Obese (≥30.0)	15	19.5 (11.3, 30.1)	
Smoking (yes)[e]	38	10.8 (7.8, 14.5)	0.588
Alcohol (yes)[f]	41	12.9 (9.4, 17.1)	0.371
Hypertension (yes)	67	25.0 (19.9, 30.6)	<0.001
Cardiovascular disease (yes)	54	22.7 (17.5, 28.5)	<0.001
Tumor (yes)	7	17.5 (7.3, 32.8)	0.232
Chronic obstructive pulmonary disorder (yes)	10	30.3 (15.6, 48.7)	0.001
Cerebral infarction (yes)	42	27.5 (20.6, 35.2)	<0.001

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Heilongjiang Province is 6.3%;[7] the higher level of diabetes among Golden Star Community's NZF residents (11.6%) is consistent with the more rapid urbanization occurring in Songbei District compared with other parts of Heilongjiang Province. This prevalence is consistent with the most comprehensive assessment of diabetes in China to date, which found 11.6% diabetes prevalence in a representative national sample.[4] As in our study, the national study found that age, obesity, and systolic blood pressure were among the factors contributing to higher odds of having diabetes. However, our study also found that level of income (not included in the national study) was related to higher odds of having diabetes.

Our findings are consistent with those of a study using national census data to explain the emergence of chronic diseases in China.[34] That study concluded that two major forces are contributing to increases in noncommunicable diseases: the aging of the Chinese population and increases in high-risk behaviors associated with economic development. These forces increase levels of hypertension and obesity and the risk of disease as people age. Our finding of higher diabetes risk with age and the presence of hypertension are consistent with these conclusions.

Table 2 (continued). Diabetes prevalence in Golden Star Community residents aged ≥17 years, by demographic characteristics, in a study of diabetes prevalence among 1,150 rural-to-urban migrants in Songbei District, Harbin, China, 2013

Characteristics	N	*Percent (95% CI)*[a]	P-*value*[b]
Physical activity[g]			0.108
Low (≤32.0)	46	14.8 (11.71, 19.3)	
Medium (32.1–36.7)	57	10.4 (7.9, 13.3)	
High (≥36.8)	30	10.3 (7.0, 14.3)	
Recommended energy intake above Chinese Nutrition Society standards[h]	111	10.8 (8.9, 12.9)	0.020
Central obesity (waist circumference) ≥90 cm in men, ≥80 cm in women	101	14.1 (11.6, 16.9)	0.001

[a]Percentages calculated using the total number of people in each subcategory as the denominator.

[b]Chi-squared tests

[c]Chen C, Lu FC; Department of Disease Control Ministry of Health, PR China. The guidelines for prevention and control of overweight and obesity in Chinese adults. Biomed Environ Sci 2004;17 Suppl:1-36.

[d]World Health Organization. Obesity and overweight [cited 2015 Sep 5]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en

[e]Defined as having smoked daily for at least six months during one's life

[f]Defined as having up to one drink per day for women and up to two drinks per day for men

[g]Calculated as the mean level of metabolic equivalents for the three previous days.

[h]Source: Keyou G. How to apply Dietary Reference Intakes (DRIs) to evaluate individual and group dietary. J Hyg Res 2002;31:1-4.

CI = confidence interval

BMI = body mass index

kg/m² = kilograms per meter squared

WGOC = Working Group on Obesity in China

WHO = World Health Organization

cm = centimeter

Diabetes and diminished quality of life

Residents aged ≥60 years with diabetes reported substantially more physical and emotional limitations on their activities, more bodily pain, and worse overall physical health than those without diabetes. Residents aged 40–59 years with diabetes also reported more emotional limitations on their activities and poorer general health than those without diabetes. Substantially lower scores on HRQOL measures suggest that residents with diabetes have more limitations in performing routine activities of daily living than those without diabetes.

The relationship between having diabetes and diminished quality of life is well established,[35–37] and there are multiple reasons why diabetes contributes to diminished quality of life: individuals with diabetes tend to be older, more overweight, and more likely to have comorbidities (e.g., hypertension) than individuals without diabetes.[38] In our study, all of these variables—age, obesity, and the presence of hypertension—were independently associated with having diabetes.

The implications of diminished quality of life for those living with diabetes in NZF communities are important. Studies have shown that HRQOL is an independent risk factor for hospitalization and survival in patients with kidney disease,[39,40] long-term survival in patients with peripheral artery disease,[41] and mortality in patients with coronary artery disease and coronary heart failure.[42,43] Individuals' HRQOL provides important independent information for health-care professionals about the disease process from the patients' perspective, in addition to information obtained from biomedical risk factors. Understanding and accounting for the relationship between HRQOL and diabetes may be as important for managing patients with diabetes as it is for managing patients with these other conditions.

Implications of findings

It has been reported that the Chinese government plans to move as many as 250 million more people from farms to cities by 2025.[9] Thus, the government's modernization plan would integrate 70% of the country's population, or 900 million people, into cities by that time. Although many people are excited about their new lives—they receive free apartments and thousands of dollars for their land—others are uncertain about what they will do when the money runs out; our study indicates that most NZF community residents have low education and income levels.

No published English-language studies have examined the health needs of NZF community residents, but the few Chinese-language studies that have been conducted document a high prevalence of chronic

Table 3. Multivariable logistic regression model examining the odds of having diabetes among Golden Star Community residents aged ≥17 years, in a study of diabetes prevalence among 1,150 rural-to-urban migrants in Songbei District, Harbin, China, 2013

Risk factor[a]	*OR (95% CI)*	*P-value*
Sex	0.9 (0.5, 1.5)	0.690
Age	1.7 (1.5, 2.0)	<0.001
≥Junior high school education	1.2 (0.8, 1.9)	0.418
Income	1.3 (1.0, 1.5)	0.050
Obesity (WGOC)	2.0 (1.1, 3.8)	0.050
Energy intake	1.2 (0.7, 2.1)	0.520
Hypertension	2.2 (1.5, 3.3)	<0.001
Physical activity	1.6 (1.0, 2.4)	0.050
Central obesity	1.3 (0.7, 2.2)	0.387
Smoking	0.8 (0.5, 1.3)	0.335
Alcohol intake	1.4 (0.8, 2.5)	0.189

[a]Obesity was defined by Working Group on Obesity in China (WGOC) criteria as a body mass index of ≥28 kilograms per meter squared (kg/m²); energy intake was classified as being above or equal to or below the Chinese Nutrition Society recommended caloric intake after adjusting for age, sex, and activity levels; hypertension was present if a participant: (*1*) responded "yes" to the self-reported diabetes question or (*2*) responded "no" to the question but had a fasting blood glucose level of ≥7.0 millimoles per liter; the three-day physical activity release was used to estimate physical activity during the previous three days (metabolic equivalents/day/person) in three categories: low (≤32.0), medium (>32.0 to <36.8), and high (≥36.8); central obesity was waist circumference of ≥80 centimeters (cm) for women and ≥90 cm for men; smoking was yes if smoked daily for at least six months during one's life; and alcohol intake was yes if drank on average up to one drink per day for women and two drinks per day for men.

OR = odds ratio

CI = confidence interval

disease and low level of health literacy among NZF community residents. For example, a qualitative study examining the level of chronic disease and health knowledge of NZF residents in Chongqing, China, found that NZF residents had low education levels and unstable economic conditions, and two-thirds of those >50 years of age suffered from chronic diseases, with more than half having two or more chronic diseases. Although residents indicated that chronic diseases were critical problems for them, they indicated that they had little ability to improve their health behaviors. Awareness of fundamental health behaviors was low, and few resources or health education personnel were available in the community, which limited the ability of community residents to understand or initiate needed health behavior changes.[11]

Although the exact number of NZF individuals in China is unknown, the numbers could easily reach the hundreds of millions in the next decade, and their risk of developing diabetes and other chronic diseases is likely to be disproportionately high. Much of what we know today about diabetes is based on the pioneering work with the Pima Indians by Peter Bennett and others, who identified increased diabetes prevalence due to lifestyle changes during a relatively compressed time period.[44–46] Residents of NZF communities may experience a similar increase in diabetes prevalence unless steps are taken now to intervene in ways that can reduce the risk.

Our study adds support to the efforts of others who have called for specialized departments of health education to be established in NZF communities and for health education professionals to be deployed in greater numbers in these communities.[11] The focus of the NCCDMP is to develop community-based lay health promotion programs to reduce the risk of chronic disease in NZF communities. This approach will require linking together primary, secondary, and tertiary care sectors, and coordinating community-based health promotion and disease prevention efforts with existing treatment and management activities. Our study found relatively low levels of diabetes prevalence among residents aged ≤50 years. For example, diabetes prevalence was 7.1% among 40- to 49-year-olds compared with 25.4% among those aged ≥70 years. Health professionals at all levels of care need to coordinate efforts and funding from government and nongovernment sources to prevent higher levels of diabetes prevalence among NZF residents as they age.

Limitations

This study was subject to several limitations. First, we examined the level of diabetes, associated risk factors, and HRQOL in a single NZF community in northern China. As such, our sample may not be representative of other NZF communities. Furthermore, our sample included only induced migrants whose land was purchased by the government; we did not examine diabetes prevalence among migrants who had left their homes in search of more opportunities in urban areas. The prevalence of diabetes and risk factors for diabetes among active migrants may differ from those of induced migrants. Finally, our study was cross-sectional and did not examine changes in behaviors, associated risks, and diabetes prevalence over time.

CONCLUSION

This study is the first English-language article to identify and report the prevalence of diabetes among induced migrants in a Chinese NZF community. According to the International Diabetes Federation, China now has

Table 4. Comparison of SF-36 scores for Golden Star Community residents aged ≥40 years with and without diabetes, in a study of diabetes prevalence among 1,150 rural-to-urban migrants in Songbei District, Harbin, China, 2013

Risk factor	*Age (in years)*	*Residents with diabetes, score ± SD*	*Residents without diabetes, score ± SD*	*P-value*
Physical functioning	40–59	89.9 ± 15.9	93.2 ± 9.2	0.228
	≥60	82.6 ± 19.9	84.8 ± 18.7	0.316
Role-physical	40–59	73.8 ± 44.4	81.8 ± 38.6	0.134
	≥60	47.7 ± 50.3	70.2 ± 45.8	0.001
Role-emotional	40–59	80.3 ± 40.1	89.5 ± 30.7	0.035
	≥60	76.9 ± 42.5	89.7 ± 30.5	0.006
Vitality	40–59	78.3 ± 15.6	78.3 ± 16.5	0.793
	≥60	76.8 ± 17.6	76.6 ± 17.1	0.998
Mental health	40–59	77.9 ± 15.6	78.5 ± 15.7	0.767
	≥60	82.1 ± 14.6	79.7 ± 16.3	0.353
Social functioning	40–59	90.6 ± 17.8	94.1 ± 12.4	0.104
	≥60	84.6 ± 25.5	89.5 ± 19.2	0.143
Bodily pain	40–59	85.7 ± 18.0	87.1 ± 16.1	0.768
	≥60	79.7 ± 18.4	84.9 ± 16.8	0.021
General health	40–59	61.9 ± 23.8	69.2 ± 20.6	0.029
	≥60	60.4 ± 22.8	64.2 ± 21.1	0.169
Physical composite	40–59	77.8 ± 19.8	82.8 ± 16.1	0.064
	≥60	67.6 ± 22.8	76.0 ± 20.6	0.015
Mental composite	40–59	81.8 ± 15.8	85.1 ± 14.2	0.174
	≥60	80.1 ± 19.8	83.9 ± 16.1	0.311

[a]Overall scores and subscale scores ranged from 0 to 100, with higher scores indicating better health. Source: Maruish ME. User's manual for the SF-36v2 Health Survey. Eden Prairie (MN): Optum; 2011.

SF-36 = Short-Form 36 Health Survey

SD = standard deviation

about the same number of adults with diabetes as the next three countries with the most cases combined: India, the United States, and Brazil. Diabetes prevalence in China is a significant public health problem, and NZF residents in China may be at risk of developing higher levels of diabetes as they transition very rapidly from a rural to an urban lifestyle.

The authors thank the people and leaders of the Golden Star Community in Songbei District for their partnership and hospitality and for working with them on this project. The authors also thank Grace Ngugi for her contribution to performing preliminary data analysis in Charlotte, North Carolina, as well as Xiaojing Wan, Xingyan Zhang, and Lin Li for assisting with data collection in Harbin, China.

The study and all data collection procedures were approved by the Harbin Medical University 4th Affiliated Hospital Study Institutional Review Board.

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