Original article

Prevalence of self-reported diabetes mellitus in women and associated factors: a population-based study in São Leopoldo, Rio Grande do Sul, Brazil, 2015*

doi: 10.5123/S1679-49740003000025

Juvenal Soares Dias-da-Costa[1] – orcid.org/0000-0003-3160-6075
Cassiane Silocchi[1] – orcid.org/0000-0002-8538-9849
Sheila Cristiane Schwendler[1] – orcid.org/0000-0001-7483-0400
Tissiani Morimoto[1] – orcid.org/0000-0001-5722-2163
Vitoria Hana Muller Mottin[1] – orcid.org/0000-0002-0428-6128
Vera Maria Vieira Paniz[1] – orcid.org/0000-0003-3186-9991
Fernanda Souza de Bairros[2] – orcid.org/0000-0002-8611-058X
Maria Teresa Anselmo Olinto[1] – orcid.org/0000-0002-3950-4594

[1]Universidade do Vale do Rio dos Sinos, Programa de Pós-Graduação em Saúde Coletiva, São Leopoldo, RS, Brazil
[2]Universidade Federal do Rio Grande do Sul, Departamento de Saúde Coletiva, Porto Alegre, RS, Brazil

Abstract

Objective: to analyze the prevalence of Diabetes Mellitus (DM) and associated factors in women aged 20 to 69 years in São Leopoldo, RS, Brazil. **Method**: this was a population-based cross-sectional study, the outcome of which was self-reported medical diagnosis of DM. Poisson regression was used. **Results**: 1,128 women took part, 8.16% (95%CI2.56;13.74) reported DM diagnosis; in the adjusted analysis association was found between the outcome and the 50-59 years age group (PR=15.73 – 95%CI4.84;71.00) and the over 60s (PR=8.95 – 95%CI1.98;40.49), economic classes D/E (PR=2.37 – 95%CI1.17;4.83), obesity (PR=1.41 – 95%CI0.85;2.32), arterial hypertension (PR=2.78 – 95%CI1.73;4.46), common mental disorders (PR=1.47 – 95%CI1.04;2.05), dyslipidemia (PR=2.16 – 95%CI1.45;3.23), regular/poor self-perception of health (PR=2.80 – 95%CI1.20;6.56), and not working (PR=1.98 – 95%CI1.11;3.53). **Conclusion**: DM was associated with situations of economic and social vulnerability, such as poverty and being outside the labor market, as well as with the presence of other diseases.

Keywords: Diabetes *Mellitus*; Women; Prevalence; Cross-Sectional Studies; Multimorbidity.

*This study received financial support from the National Council for Scientific and Technological Development (CNPQ) / Ministry of Science, Technology, Innovation and Communication (MCTIC): Process No. 457235/2014-4 (Call for Proposals MCTI/CNPQ/ UNIVERSAL 14/2014).

Correspondence:
Juvenal Soares Dias-da-Costa – Universidade do Vale do Rio dos Sinos (Unisinos), Programa de Pós-Graduação em Saúde Coletiva, Av. Unisinos, no. 950, São Leopoldo, RS, Brazil. Postcode: 93022-000
E-mail: episoares@terra.com.br.

Introduction

Population aging and the increase in overweight people can lead to growth in diabetes mellitus (DM) prevalence.[1] A review article of population-based studies on DM in different parts of the world found that age-standardized diabetes prevalence among adults increased or, at the best, remained unchanged between 1980 and 2014. The study also found that this condition increased more rapidly in low and middle-income countries when compared to high-income countries. In 2014, half the adults with DM lived in five countries: China, India, United States, Brazil and Indonesia.[2] In 2017, the global disease burden study found that DM had become the world's fourth leading cause of disability.[3]

A study on diabetes conducted in nine large Brazilian cities at the end of the 1980s found prevalence of 7.6% among the population.[4] This result is similar to the 7.5% prevalence rate found by the Social Dimensions of Inequalities (*Dimensões Sociais das Desigualdades*) study conducted in 2008; however, DM frequency was seen to increase among individuals over 65 years old and reached 16.7%.[5] The 2013 National Health Survey found that 6.2% of the total population had DM and that this rate was above 19.0% in those over 65 years old. The Survey also found that prevalence was higher among females (7.0%) than among males (5.4%).[6]

> *Population aging and the increase in overweight people can lead to growth in diabetes mellitus (DM) prevalence.*

DM complications have been classified as both microvascular and macrovascular disorders and can cause retinopathy, nephropathy, neuropathy, coronary disease, cerebrovascular disease and peripheral artery disease. DM can also contribute directly or indirectly to complication of other health conditions.[7]

With regard to its economic impact, a systematic review of articles published between 1990 and 2015 found that the individual economic burden of the disease and its complications was considerably high, despite government subsidies of some supplies, such as medication and laboratory tests.[8]

Population-based epidemiological studies can contribute to health sector planning and management, by providing representative information about health-related events. Estimates enable the magnitude of problems to be identified, thus allowing realistic provision of supplies.[9] In turn, determining factors associated with diseases enables identification of more vulnerable population groups and informs preparation of policies and actions aimed at minimizing their consequences.[10]

The objective of this study was to analyze diabetes mellitus (DM) prevalence and associated factors among women aged 20-69 living in the municipality of São Leopoldo, Rio Grande do Sul, Brazil.

Methods

This was a population-based cross-sectional study of a representative sample of women between 20 and 69 years old living in the urban area of São Leopoldo, RS.

The study was part of a research project conducted by the Universidade do Vale do Rio dos Sinos (Unisinos) between February and October 2015, entitled 'Living and health conditions of adult women: a population-based study in the Vale do Rio dos Sinos –Evaluation after 10 years', which investigated lifestyle habits, nutritional aspects, psychological aspects, preventive procedures, contraceptive methods, morbidity and use of health services.

Initially the sample size for the research mentioned above was calculated using Epi Info 6.0 based on the female population of São Leopoldo (109,845 females, according to the 2010 Demographic Census 2010)[11], as well as being based on several of the project's outcomes. A 5.7% prevalence rate for late cytopathology examinations[12] was the outcome that required the largest sample size. This sample size was used to calculate a 3% sampling error, plus 10% for losses and 15% for controlling confounding factors, resulting in a total of 1,281 women. Later, once field work had been done to check that the sample size was sufficient – taking into account a 95% confidence interval %, 80% statistical power, a 50% exposed/unexposed ratio, 4.6% prevalence among unexposed women (DM prevalence in economic classes A/B) and a 2.1 risk ratio –, we concluded that 1.022 participants were needed.

Sampling was conducted in multiple stages. The 371 urban census tracts in São Leopoldo were classified in descending order, starting with the sector with the highest *nominal monthly income of people aged 10 or over* (*with or without income*). In order to randomly select 40 tracts, first of all the 371 tracts were divided by 40,

resulting in 9.275; this number was rounded down to 9 and this was the number adopted for the intervals between the tracts. Using the *Sorteador* website (www.sorteador.com.br), the following random selection was performed: all numbers from 1 to 9 were input in order to draw a number that would be the first tract to be selected. The result of the draw (from 1 to 9) was number 9, i.e. the study began in census tract number 9 (in the ascending numerical order of the tracts). Taking this number, a further 9 were added, so that the next tract was tract number 18, and so on until 40 tracts were reached. At the end of the field work, the number of participants was found to be insufficient, so a further five tracts were added using the same process.

For each tract the block and street corner for starting the study were selected at random. Following the first household visit, the study jumped two households before the next household visit, until 36 households per sector were included. All women living in the households visited were invited to take part.

Women in the households at the time of the visit but who did not live there were excluded, as were pregnant women and those unable to answer the questionnaire. If women who lived in the household were absent at the time of the visit, two further attempts were made on different days and at different times, including weekends and at night.

Standardized pre-coded and pre-tested questionnaires were used. The following measurements were also taken: weight, height and blood pressure, using scales, stadiometers and digital automatic arm sphygmomanometers (Omron, model HEM 720).

The interviewers were trained in order to standardize instrument use and they took part in a pilot study in a census tract that had not been included in the sample. Quality was also assessed, by means of administering a shortened version of the questionnaire via telephone interview with a random sample of 10% of the people included in the study.

The study outcome was 'self-reported medically diagnosed DM' and it was measured by the answers to the following question:

"Has a doctor ever told you that you have diabetes?"

The independent variables assessed by the study were classified as demographic, socio-economic, reproductive, lifestyle habits, morbidities (not all) and self-perception of health:

a) Demographic variables
- age (in years: 20-29; 30-39; 40-49; 50-59; 60-69);
- self-reported race/skin color (White; non-White [Black/brown/indigenous/yellow]);
- marital status (single; married/partner; separated/divorced/widowed).

b) Socio-economic variables
- schooling (years of study: 15 or more; 11-14; 8-10; 5-7; 0-4);
- employment situation (works; retired/out of work; does not work);
- per capita family income in minimum wages (>3.0; 1.0-3.0; <1.0) – the regional minimum wage at the time of the study was R$868.00;
- economic class (A/B; C; D/E).

According to the criterion proposed by the Brazilian Association of Survey Companies (ABEP), this classification of economic class is based on ownership of material goods, head of family schooling and number of household employees.

c) Reproductive variables
- age at first menstruation (years: 8-11; 12-13; 14 or over);
- number of children (none; 1-3; 4 or more);
- menopause (no; yes).

d) Lifestyle habits
- tobacco smoking (never smoked; former smoker; smoker);
- excessive alcohol consumption (no; yes).

Degree of alcohol consumption was defined by frequency, type of drink and amount consumed, classified as excessive when equal to or greater than 30g of ethanol/day.[13]
- physical activity during leisure (yes; no).

Physical activity was assessed according to short version of the International Physical Activity Questionnaire and was taken to be 150 minutes of activity a week.[14]

e) Nutritional status (normal weight; overweight; obese)

Nutritional status was classified based on body mass index (BMI), i.e. weight divided by height squared. BMI of up to 24.9kg/m^2 was considered to be normal weight, 25.0-29.9kg/m^2 as overweight and 30.0kg/m^2 or more as obesity.

f) Morbidities
- systemic arterial hypertension (no; yes).

Women were considered to be hypertensive when average blood pressure readings were equal to or greater than 140 x 90 mmHg and/or women whose readings were below this level but who reported using antihypertensive medication.[15]

- common mental disorders (no; yes).

These were rated using the Self Reporting Questionnaire (SRQ-20), comprised of 20 dichotomous questions, whereby participants with a score of 7 or more were considered to have common mental disorders.[16]

- dyslipidemia (no; yes).

Prescribed use of lipid-modifying medication was used as a proxy dyslipidemia variable, estimated by the following question:

"Are you currently taking any medication prescribed by a doctor?"

Medication used was classified according to the respective pharmacological groups defined by the Anatomical Therapeutic Chemical Classification System (http://www.whocc.no/atc_ddd_index/).[17] Participants were categorized as 'yes' when their reply to the above question stated continuous use of the following medication: simvastatin, atorvastatin, rosuvastatin, gemfibrozil, ciprofibrate or fenofibrate.

g) Common mental disorders (no; yes).
h) Self-perception of health (excellent/very good; good; regular/poor).

The data were input twice, so that any typing errors could be corrected afterwards. The analyses were performed using Stata version 13.0 (StataCorp, College Station, TX, USA), taking the ample design effect into account by means of the *svy* command. The crude analysis provided prevalence ratios (PR), with their respective 95% confidence intervals (95%CI); dichotomous and nominal categorical variables were analyzed using Pearson's chi-square test with a p-value for proportion heterogeneity, while ordinal categorical variables were analyzed according to linear trend p-value. The adjusted analysis was performed by means of Poisson regression using an analysis model.

The first block of the analysis model was comprised of the demographic variables (age; race/skin color; marital status) and the socio-economic variables (schooling; employment status; per capita family income in minimum wages; economic class). The second block contained the reproductive variables (age at first menstruation; number of children; menopause), the behavioral variables (tobacco smoking; excessive alcohol consumption; physical activity during leisure) and morbidities (obesity; arterial hypertension; common mental disorders; dyslipidemia). Self-perception of health was analyzed in the third block. All the variables determined the outcome. The ABEP 'economic class' variable was chosen in the analysis to explore association between economic status and diabetes, due to colinearity with schooling, given that 51,8% of the women stated that they were heads of household.

Variables obtaining a p-value of up to 0.20 in the crude analysis were selected for the adjusted analysis and only those variables with statistical significance with a p-value <0.05 were kept in the model.

The study project was approved by the Research Ethics Committee of the Universidade do Vale do Rio dos Sinos: Protocol No. 653.394, issued on May 20th 2014. All participants signed a Free and Informed Consent form.

Results

We interviewed 1,128 of the 1,281 women visited, representing 11.9% losses or refusals. Among the study participants, 92 (8.16% – 95%CI2.56;13.74) self-reported medical diagnosis of DM.

With regard to the demographic variables, approximately a quarter of the women were 40-49 years old (24.5%), the majority reported being of White race/skin color (74.5%) and were married or had a partner (63.8%). In relation to the socio-economic variables, 32.0% of the respondents had between 11 and 14 years of schooling, 56.1% had a job, 44.8% received less than a minimum wage per month and 53.1% fell into ABEP class C. Regarding the reproductive variables, 45.7% of the women menstruated for the first time when they were between 12 and 13 years old, and 67.6% had between 1 and 3 children; 79.4% had not reached the menopause. When assessing lifestyle habits, 18.5% were found to be smokers, 97.0% reported not consuming alcohol excessively and 85.6% were not classified as being physically active during leisure. The majority of the participants (66.1%) were overweight, systemic arterial hypertension prevalence was 35.8%, 39.9% had common mental disorders and 8.9% had dyslipidemia. In addition, 33.7% classified their health as regular/poor (Table 1).

In the crude analysis, association was found between DM prevalence and the following variables: 'age', 'marital status', 'schooling', 'employment status', 'economic class', 'number of children', 'nutritional status', 'arterial hypertension', 'common mental disorders', 'dyslipidemia' and 'self-perception of health' (Table 2). Direct linearity was found when analyzing by age: DM prevalence increased as age increased. Separated/divorced/widowed women and married women / women with partners had higher DM prevalence rates compared to single women (13.8% and 8.5%, respectively). Women with lower schooling levels had higher DM prevalence (18.1%), compared to those with 15 or more years of schooling (2.7%) and linearity was found for this variable. Retired / out of work women and those who did not work had DM prevalence rates of 20.3% and 10.1% respectively. These rates were higher than that found for women who worked (4.3%). Higher DM prevalence rates were found in women belonging to economic classes C (9.4%) and D/E (13.2%), compared to class A/B women (4.6%). Women who had four or more children had higher DM prevalence (12.2%) compared to those who had no children (4.2%). Obese women had higher DM prevalence (14.2%) compared to those whose weight

Table 1 – Participant characteristics and self-reported diabetes *mellitus* prevalence among women (n=1128), São Leopoldo, Rio Grande do Sul, 2015

Variable	n (%)	Prevalence
Age (years)		
20-29	216 (19.2)	0.9
30-39	244 (21.6)	2.9
40-49	276 (24.5)	6.2
50-59	228 (20.2)	18.4
60-69	164 (14.5)	14.6
Race/skin color		
White	840 (74.5)	7.4
Non-White	288 (25.5)	10.4
Marital status		
Single	227 (20.1)	2.6
Married/partner	720 (63.8)	8.5
Separated/divorced/widowed	181 (16.1)	13.8
Schooling (years of study)		
≥15	110 (9.8)	2.7
11-14	360 (32.0)	3.6
8-10	199 (17.7)	4.5
5-7	253 (22.4)	11.9
0-4	204 (18.1)	18.1
Employment status		
Working	633 (56.1)	4.3
Retired/out of work	148 (13.1)	20.3
Does not work	347 (30.8)	10.1
Per capita family income in minimum wages (MW)		
>3.0 MW	129 (11.8)	4.7
1.0-3.0 MW	473 (43.4)	7.4
<1.0 MW	489 (44.8)	9.8
Economic class		
A/B	390 (34.8)	4.6
C	596 (53.1)	9.4
D/E	136 (12.1)	13.2
Age at first menstruation (years)		
8-11	259 (23.2)	7.0
12-13	510 (45.7)	8.0
≥14	348 (31.1)	9.5
Number of children		
None	217 (19.3)	4.2
1-3	761 (67.6)	8.5
≥4	148 (13.1)	12.2

to be continue

continuation

Table 1 – Participant characteristics and self-reported diabetes *mellitus* prevalence among women (n=1128), São Leopoldo, Rio Grande do Sul, 2015

Variable	n (%)	Prevalence
Menopause		
No	896 (79.4)	8.5
Yes	232 (20.6)	6.9
Tobacco smoking		
Never smoked	661 (58.9)	7.3
Former smoker	253 (22.6)	11.1
Smoker	208 (18.5)	7.2
Excessive alcohol consumption		
No	1.087 (97.0)	8.3
Yes	34 (3.0)	2.9
Physical activity during leisure		
Yes	162 (14.4)	6.2
No	966 (85.6)	8.5
Nutritional status		
Normal weight	380 (33.9)	4.2
Overweight	373 (33.2)	6.2
Obese	369 (32.9)	14.2
Systemic arterial hypertension		
No	722 (64.2)	2.9
Yes	403 (35.8)	17.6
Common mental disorders		
No	678 (60.1)	6.1
Yes	450 (39.9)	11.3
Dyslipidemia		
No	1.028 (91.1)	5.8
Yes	100 (8.9)	32.0
Self-perception of health		
Excellent/very good	233 (20.7)	1.7
Good	515 (45.6)	5.8
Regular/poor	380 (33.7)	15.3

was considered to be adequate (4.2%). Participants classified as having arterial hypertension and common mental disorders had higher diabetes prevalence than those who did not have these conditions, 17.6% and 11.3% respectively. DM prevalence was 32.0% in women who had dyslipidemia. DM prevalence was also higher among women who classified their health as being regular/poor (15.3%) (Table 1).

In the adjusted analysis of the first block, the 'age', 'employment status' and 'economic class' variables continued to be associated with the diabetes mellitus outcome. With effect from 40, age was found to be associated with DM, whereby women in the 50-59 age group were 15.73 times more likely to report having DM when compared to the reference category. Retired / out of work participants and those who did not work had higher DM prevalence rates compared to those who worked. Women belonging to economic classes D/E were 2.37 times more likely to report having DM compared to those in class A/B (Table 2).

The second block variables were adjusted for each other and for the variables that remained in the first block. 'Nutritional status', 'arterial hypertension', 'common mental disorders' and 'dyslipidemia' continued to be associated with DM. DM prevalence was 41% higher among obese women than among women with adequate weight. Women with arterial hypertension were 2.78 times more likely to have DM; while those with common mental disorders were 1.47 times more likely to have DM than the reference categories. Women with dyslipidemia were 2.16 time more likely to report DM than women without this condition (Table 2).

Following adjustment by the two preceding blocks, the 'self-perception of health' variable remained associated with the outcome, and women who considered their health to be regular/poor were 2.80 times more likely to report DM (Table 2).

Table 2 – Crude and adjusted analysis of self-reported diabetes *mellitus* prevalence among women (n=1128), São Leopoldo, Rio Grande do Sul, 2015

Variable	Crude PR[a] (95%CI)[b]	p-value	Adjusted PR[a] (95%CI)[b]	p-value
Age (years)		<0.001[c]		<0.001[d]
20-29	1.00		1.00	
30-39	3.10(0.60;16.11)		2.70(0.48;15.18)	
40-49	6.66(1.61;27.66)		6.32(1.46;27.37)	
50-59	19.89(4.61;85.85)		15.73(4.84;71.00)	
60-69	15.80(3.65;68.50)		8.95(1.98;40.49)	
Race/skin color		0.151		0.154[d]
White	1.00		1.00	
Non-White	1.41(0.88;2.27)		1.41(0.88;2.27)	
Marital status		0.003		0.052[d]
Single	1.00		1.00	
Married/partner	3.21(1.17;8.77)		2.06(0.78;5.44)	
Separated/divorced/widowed	5.23(1.87;14.59)		1.95(0.73;5.25)	
Schooling (years of study)		<0.001[c]		
≥15	1.00			
11-14	1.32(0.42;4.16)			
8-10	1.66(0.46;6.02)			
5-7	4.35(1.33;14.22)			
0-4	6.65(2.18;20.29)			
Employment status		<0.001		0.013[d]
Working	1.00		1.00	
Retired/out of work	4.75(2.62;8.63)		2.55(1.32;4.94)	
Does not work	2.36(1.32;4.25)		1.98(1.11;3.53)	
Per capita family income in minimum wages (MW)		0.186		0.497[d]
>3.0 MW	1.00		1.00	
1.0-3.0 MW	1.59(0.64;3.96)		1.21(0.51;2.90)	
<1.0 MW	2.11(0.87;5.11)		1.30(0.55;3.07)	
Economic class		<0.001[c]		0.019[d]
A/B	1.00		1.00	
C	2.04(1.13;3.67)		1.71(0.95;3.09)	
D/E	2.87(1.48;5.55)		2.37(1.17;4.83)	
Age at first menstruation (years)		0.462		
8-11	1.00			
12-13	1.16(0.68;1.98)			
≥14	1.36(0.83;2.24)			
Number of children		0.044		0.743[e]
None	1.00		1.00	
1-3	2.06(0.95;4.44)		1.02(0.51;2.06)	
≥4	2.93(1.26;6.80)		0.95(0.43;2.10)	
Menopause		0.399		
No	1.00			
Yes	0.81(0.50;1.33)			
Tobacco smoking		0.186		0.751[e]
Never smoked	1.00		1.00	
Former smoker	1.52(0.95;2.45)		1.06(0.66;1.72)	
Smoker	0.99(0.50;1.99)		0.84(0.45;1.55)	

to be continue

a) PR: prevalence ratio.

b) 95%CI: 95% confidence interval.

c) Linear trend test; p-value <0.05 significant; Wald test, logistic regression.

d) Variables adjusted between each other.

e) Variables adjusted for first block variables and between each other.

f) Variable adjusted for first and second block variables.

Note:

Design effect was taken into consideration in the estimates.

continuation

Table 2 – Crude and adjusted analysis of self-reported diabetes *mellitus* prevalence among women (n=1128), São Leopoldo, Rio Grande do Sul, 2015

Variable	Crude PR[a] (95%CI)[b]	p-value	Adjusted PR[a] (95%CI)[b]	p-value
Excessive alcohol consumption		0.277		
No	1.00			
Yes	0.36(0.05;2.36)			
Physical activity during leisure		0.356		
Yes	1.00			
No	1.38(0.69;2.74)			
Nutritional status		<0.001		0.048[e]
Normal weight	1.00		1.00	
Overweight	1.46(0.86;2.48)		0.81(0.47;1.39)	
Obese	3.35(2.07;5.40)		1.41(0.85;2.32)	
Systemic arterial hypertension		<0.001		<0.001[e]
No	1.00		1.00	
Yes	6.05(3.97;9.25)		2.78(1.73;4.46)	
Common mental disorders		<0.001		<0.001[e]
No	1.00		1.00	
Yes	1.87(1.33;2.64)		1.47(1.04;2.05)	
Dyslipidemia		<0.001		<0.001[e]
No	1.00		1.00	
Yes	5.48(3.86;7.80)		2.16(1.45;3.23)	
Self-perception of health		<0.001		0.002[f]
Excellent/very good	1.00		1.00	
Good	3.40(1.17;9.83)		1.95(0.71;5.38)	
Regular/poor	8.90(3.52;22.44)		2.80(1.20;6.56)	

a) PR: prevalence ratio.

b) 95%CI: 95% confidence interval.

c) Linear trend test; p-value <0.05 significant; Wald test, logistic regression.

d) Variables adjusted between each other.

e) Variables adjusted for first block variables and between each other.

f) Variable adjusted for first and second block variables.

Note:

Design effect was taken into consideration in the estimates.

Discussion

DM prevalence was greater among women who were elderly, poor and who did not work. DM was also found to be associated with obesity, arterial hypertension, common mental disorders, dyslipidemia and regular/poor self-perception of health.

The DM prevalence rate found was higher than the 7.6% frequency found by Malebri & Franco in 1992,[4] and higher than the 7.0% identified in women by the 2013 National Health Survey.[6] However, it should be highlighted that the proportion of women aged 20-29 was slightly higher in the sample investigated by this study when compared to the female population of São Leopoldo as per the 2010 Demographic Census. Higher DM prevalence among the population assessed could be expected, given that the population is aging and being overweight has been increasing in Brazil in recent years. Notwithstanding, the study confirmed increased DM prevalence with effect from being 50 years old, to the extent of becoming a common event in clinical practice.

As in other studies, association was also found in São Leopoldo between presence of DM and increase in age. Reduction in insulin sensitivity during the course of maturity and aging, especially in those over 50, appears to be associated with changes to and distribution of adipose tissue.[18,19]

Evidence was found of DM association with belonging to lower social classes. DM prevalence was also higher among women who did not work and retired / out of work women. Other studies have demonstrated association between DM and socio-economic conditions. A systematic review of case-control and cohort studies found that low levels of schooling, income and employment increased DM likelihood in other countries regardless of whether the population's average income was classified as high,

middle or low.[20] In Brazil, studies have indicated that people with less schooling have higher DM prevalence.[5,6]

Corroborating the findings of other studies, association was proven between DM and obesity.[21] It is known that obese people are at high risk of developing type 2 DM and, although they have not been elucidated, there are two determining hypotheses for this fact: (i) continuous production of insulin by the pancreas, due to cell inability to absorb glucose, leading to what is referred to as insulin resistance; and (ii) reduction in insulin secretion because of hyperglicemia.[22]

The study also revealed association between DM and other diseases, such as arterial hypertension, common mental disorders and dyslipidemia, indicating its importance in relation to the presence of other diseases. Evidence of association between DM and arterial hypertension has been found, with possible common environmental and genetic factors: both conditions have shown insulin resistance and increased tissue inflammation.[23] One study revealed the relationship between DM and depression, indicating risk two times greater of people with DM developing depression. In addition, depression has also been associated with increased risk of DM: the authors of a study published in Portugal indicate that more than being a causal relationship, there is a bidirectional relationship between these variables.[24] It should also be highlighted that women who used lipid-modifying medication had greater DM prevalence in this study. Dyslipidemia is common among patients with DM and there is evidence that reduction in cholesterol levels promotes better prognosis, even in patients with a normal lipid profile.[25]

The limitations of this study include the definition of the outcome in which blood glucose measurements were not used. Nevertheless, the question asked in the instrument we used has been used in other epidemiological studies.[6,26] Moreover, this study detected that only two women who were taking medication for DM did not report having DM, confirming the sensitivity of the question, and as such they were not recategorized. Another limitation was the impossibility of distinguishing whether the women had type 1 or type 2 DM. It is known, however, that type 2 DM prevalence among people aged over 20 is much higher.[27] The proportion of losses and refusals was higher than expected but nevertheless the sample size needed to established associations with DM was achieved. It should be highlighted that the study sample was representative of São Leopoldo (except for the 20-29 age group) and that the study was conducted so as to faithfully follow data collection techniques.

The study was conducted rigorously and its main findings support some suggestions with regard to addressing DM. The disease was found to be more associated with a poorer economic situation, thus reinforcing the need to build public policies aimed at reducing poverty and promoting healthier living conditions, especially in the case of individuals aged 50 or over. Specific intervention strategies can effectively address the burden imposed by chronic noncommunicable diseases, such as DM. Such interventions include measures involving the population to reduce tobacco, alcohol and salt consumption, greater awareness about healthy lifestyles, increased special taxation and greater regulation of products that are harmful to health.[28] Health-related behaviors reflect social determinants that require incentives, involving diet changes, such as reducing consumption of red meat and sugar, and increasing consumption of healthy food, such as nuts, fruit and vegetables,[29] as well as formulating and implementing multisectoral policies to encourage physical activity.[30]

Similarly, the association of diabetes mellitus with obesity, arterial hypertension, common mental disorders and dyslipidemia made evident the question of multimorbidity and its challenges to a comprehensive approach to health, building new clinical and therapeutic paradigms.

Authors' contributions

Dias-da-Costa JS, Silocchi CS, Schwendler SC, Morimoto T, Mottin VHM, Paniz VMV, Bairros FS and Olinto MTA contributed to the conception of the study, review of the analysis, critical review and final approval of the manuscript. Dias-da-Costa JS, Silocchi CS, Schwendler SC, Morimoto T, Mottin VHM contributed to data analysis and interpretation, as well as writing the draft versions of the manuscripts. All the authors have approved the final version and are responsible for all aspects of this work, including guaranteeing its accuracy and integrity.

References

1. Huang HL, Pan CC, Hsiao YF, Chen MC, Kung CY, Kung PT, Tsa WC. Associations of body mass index and diabetes with hip fracture risk: a nationwide cohort study. BMC Public Health [Internet]. 2018 Nov [cited 2020 Mar 27];18(1325):1-12. Available from: https://doi.org/10.1186/s12889-018-6230-y

2. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. Lancet [Internet]. 2016 Apr [cited 2020 Mar 27];387(10027):1513-30. Available from: https://doi.org/10.1016/S0140-6736(16)00618-8

3. Institute for Health Metrics and Evaluation. Findings from the global burden of disease study 2017 [Internet]. Seattle, WA: Institute for Health Metrics and Evaluation; 2018 [cited 2020 Mar 27]. 25 p. Available from: http://www.healthdata.org/sites/default/files/files/policy_report/2019/GBD_2017_Booklet.pdf

4. Malerbi DA, Franco LJ. Multicenter study of the prevalence of diabetes mellitus and impaired glucose tolerance in the urban Brazilian population aged 30-69 yr. The Brazilian cooperative group on the study of diabetes prevalence. Diabetes Care [Internet]. 1992 Nov [cited 2020 Mar 27];15(11):1509-16. Available from: https://doi.org/10.2337/diacare.15.11.1509

5. Flor LS, Campos MR. Prevalência de diabetes mellitus e fatores associados na população adulta brasileira: evidências de um inquérito de base populacional. Rev Bras Epidemiol [Internet]. 2017 mar [citado 2020 mar 27];20(1):16-29. Disponível em: http://dx.doi.org/10.1590/1980-5497201700010002

6. Iser BPM, Stopa SR, Chueiri PS, Szwarcwald CL, Malta DCM, Monteiro HOC, et al. Prevalência de diabetes autorreferido no Brasil: resultados da Pesquisa Nacional de Saúde 2013. Epidemiol Serv Saúde [Internet]. 2015 abr-jun [citado 2019 dez 27];24(2):305-14. Disponível em: https://doi.org/10.5123/S1679-49742015000200013.

7. Gregg EW, Sattar N, Ali MK. The changing face of diabetes complications. Lancet [Internet]. 2016 Jun [cited 2020 Mar 27];4(6):537-47. Available from: https://doi.org/10.1016/S2213-8587(16)30010-9

8. Coutinho WF, Silva Júnior WSS. Diabetes care in Brazil. Ann Glob Health [Internet]. 2015 Nov-Dec [cited 2020 Mar 27];81(6):735-41. Available from: https://doi.org/10.1016/j.aogh.2015.12.010

9. Langlois EV, Montekio VB, Young T, Song K, Alcalde-Rabanal J, Tran N. Enhancing evidence informed policymaking in complex health systems: lessons from multi-site collaborative approaches. Heal Res Policy Syst [Internet]. 2016 Mar [cited 2020 Mar 27];14(1):20. Available from: https://doi.org/10.1186/s12961-016-0089-0

10. Marinho AWGB, Penha AP, Silva MT, Galvão TF. Prevalência de doença renal crônica em adultos no Brasil: revisão sistemática da literatura. Ciênc Saúde Coletiva [Internet]. 2017 out [citado 2020 mar 27];25(3):379-88. Disponível em: http://dx.doi.org/10.1590/1414-462x201700030134

11. Instituto Brasileiro de Geografia e Estatística. Censo: São Leopoldo 2010 [Internet]. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2010 [citado 2020 mar 27]. Disponível em: https://cidades.ibge.gov.br/brasil/rs/sao-leopoldo/panorama

12. Muller DK, Dias da Costa JS, Luz AMH, Olinto MTA. Cobertura do exame citopatológico do colo do útero na cidade de São Leopoldo, Rio Grande do Sul, Brasil. Cad Saúde Pública [Internet]. 2008 nov [citado 2020 mar 27];24(11):2511-20. Disponível em: https://doi.org/10.1590/S0102-311X2008001100006

13. Pai JK, Mukamal KJ, Rimm EB. Long-term alcohol consumption in relation to all-cause and cardiovascular mortality among survivors of myocardial infarction: the Health Professionals Follow-up Study. Eur Heart J [Internet]. 2012 Jul [cited 2020 Mar 27];33(13):1598-605. Available from: https://doi.org/10.1093/eurheartj/ehs047

14. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC, et al. Questionário Internacional de Atividade Física (Ipaq): estudo de validade e reprodutibilidade no Brasil. Rev Bras Ativ Fís Saúde [Internet]. 2012 out [citado 2020 mar 27];6(2):5-18. Disponível em: https://doi.org/10.12820/rbafs.v.6n2p5-18

15. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 2000 [citado 2018 dez 6]. (Technical report series, nº 894). Available from: https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/

16. Gonçalves DM, Stein AT, Kapczinski F. Avaliação de desempenho do Self-Reporting Questionnaire como instrumento de rastreamento psiquiátrico: um estudo comparativo com o Structured Clinical Interview for DSM-IV-TR. Cad Saúde Pública

[Internet]. 2008 fev [citado 2020 mar 27];24(2):380-90. Disponível em: http://dx.doi.org/10.1590/S0102-311X2008000200017

17. World Health Organization. Collaborating Centre for Drug Statistics Methodology. Anatomical Therapeutic Chemical (ATC) classification index with Defined Daily Doses (DDD's) [internet]. Geneva: World Health Organization; 2017 [cited 2018 Dec 6]. Available from: https://www.whocc.no/atc_ddd_index/

18. Lalia AZ, Dasari S, Johnson ML, Robinson MM, Konopka AR, Distelmaier K, et al. Predictors of whole-body insulin sensitivity across ages and adiposity in adult humans. J Clin Endocrinol Metab [Internet] 2016 Feb [cited 2020 Mar 27];101(2):626-34. Available from: https://doi.org/10.1210/jc.2015-2892

19. Walsh EI, Shaw J, Cherbuin N. Trajectories of BMI change impact glucose and insulin metabolism. Nutr Metab Cardiovasc Dis [Internet]. 2018 Mar [cited 2020 Mar 27];28(3):243-51. Available from: https://doi.org/10.1016/j.numecd.2017.12.003

20. Agardh E, Allebeck P, Hallqvist J, Moradi T, Sidorchuk A. Type 2 diabetes incidence and socioeconomic position: a systematic review and metaanalysis. Int J Epidemiol [Internet]. 2011 Jun [cited 2020 Mar 27];40(3):804-18. Available from: https://doi.org/10.1093/ije/dyr029

21. Malta DC, Bernal RTI, Iser BPM, Szwarcwald CL, Duncan BB, Schmidt MI. Fatores associados ao diabetes autorreferido segundo a Pesquisa Nacional de Saúde, 2013. Rev Saúde Pública [Internet]. 2017 jun [citado 2020 mar 27];51(1):12s. Disponível em: http://dx.doi.org/10.1590/s1518-8787.2017051000011

22. Samuel VT, Shulman GI. The pathogenesis of insulin resistance: integrating signaling pathways and substrate flux. J Clin Invest [Internet]. 2016 Jan [cited 2020 Mar 27];126(1):12-22. Available from: https://doi.org/10.1172/JCI77812

23. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, Chiuve SE, et al. Heart disease and stroke statistics - 2018 update: a report from the American Heart Association. Circulation [Internet]. 2018 Mar [cited 2020 Mar 27];137(12):e199-e213. Available from: https://doi.org/10.1161/CIR.0000000000000558

24. Felisberto V, Saavedra T, Santos M, Nunes M. Depressão na diabetes mellitus tipo 2 ou diabetes mellitus tipo 2 na depressão? – Uma revisão. Rev Portug Diabetes [Internet]. 2017 set [citado 2020 mar 27];12(3):112-7. Disponível em: http://www.revportdiabetes.com/wp-content/uploads/2017/11/RPD-Vol-12-n%C2%BA-3-Setembro-2017-Artigo-de-Revis%C3%A3o-p%C3%A1gs-112-117.pdf

25. Schofield JC, Liu Y, Rao-Balakrishna P, Malik RA, Soran H. Diabetes dyslipidemia. Diabetes Ther [Internet]. 2016 Jun [cited 2020 Mar 27];7(2):203-19. https://doi.org/10.1007/s13300-016-0167-x

26. Malta DC, Stopa SR, Szwarcwald CL, Gomes NL, Silva Júnior JB, Reis, AAC. A vigilância e o monitoramento das principais doenças crônicas não transmissíveis no Brasil – Pesquisa Nacional de Saúde, 2013. Rev Bras Epidemiol [Internet]. 2015 dez [citado 2020 mar 27];18(2):3-16. http://dx.doi.org/10.1590/1980-5497201500060002

27. Xu G, Liu B, Sun Y, Du Y, Snetselaar LG, Hu FB, et al. Prevalence of diagnosed type 1 and type 2 diabetes among US adults in 2016 and 2017: population based study. BMJ [Internet]. 2018 Sep [cited 2020 Mar 27];362:k1497. Available from: https://doi.org/10.1136/bmj.k1497

28. World Health Organization. World Economic Forum. From burden to "Best Buys": reducing the economic impact of non-communicable diseases in low-and middle-income countries [Internet]. Geneva: World Health Organization; 2011 [cited 2020 Mar 27]. 12 p. Available from: https://apps.who.int/medicinedocs/en/m/abstract/Js18804en/

29. Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. Lancet [Internet]. 2019 Jan [cited 2020 Mar 27];393(10170):447-92. Available from: http://dx.doi.org/10.1016/ S0140-6736(18)31788-4

30. World Health Organization. Let´s be active. Everyone. Everywhere. Everyday [Internet]. Geneva: World Health Organization; 2018 [cited 2020 Mar 27]. Available from: https://www.who.int/ncds/prevention/physical-activity/gappa/

Received on 02/11/2019
Approved on 04/03/2020

Associate Editor: Doroteia Aparecida Höfelmann – orcid.org/0000-0003-1046-3319