

## Knowledge and attitude towards type 2 diabetes among older adults: a population-based study

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**Abstract** *The aim of this study was to identify the factors associated with knowledge and attitude towards type 2 diabetes mellitus among older adults with the disease. A cross-sectional population-based study was conducted on 204 older adults from the public healthcare network of Passo Fundo, RS. Sociodemographic data were collected and the DKN-A, ATT-19 and IPAQ were used for the assessment of diabetes knowledge, psychological attitudes towards diabetes and physical activity, respectively. Logistic regression was applied to evaluate the association with sociodemographic and health variables and indicators of body adiposity. Crude and adjusted analyses were performed with a 95% confidence interval. The results showed that good knowledge is associated with age  $\geq 70$  years (OR = 0.44; 95%CI: 0.18-1.08), having a positive attitude towards diabetes treatment (OR = 8.9; 95%CI: 4.3-18.9), and being physically active (OR = 10.1; 95%CI: 6.34-20.1). In conclusion, good knowledge and a positive attitude towards diabetes are associated with age older than 70 years and being physically active.*

**Key words** *Health education, Demographic aging, Healthcare levels*

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## Introduction

Recurring diseases are associated with the demographic transition that occurs in the population, with an increasing incidence of chronic diseases such as diabetes mellitus (DM) and levels of obesity at older ages<sup>1</sup>.

There is an ongoing DM epidemic due to the large number of affected individuals<sup>2</sup>. Diabetes is among the leading world health emergencies of the 21st century. More than 415 million adults have DM and there are 318 million adults with altered glucose levels, which pose a risk of developing the disease in the future. In countries with a high per capita income, up to 91% of diabetic adults have type 2 DM (DM2). A higher prevalence is observed among men (215.2 million) compared to women (199.5 million)<sup>3</sup>. In Brazil, a national health survey estimated that 6.2% of the population aged 18 years or older had a medical diagnosis of diabetes. The highest prevalence was observed in the age group of 65 to 74 years and this percentage reached 19.6% in those aged 75 years or older<sup>4</sup>.

Diabetes is one of the most common incurable diseases, which is characterized by poor knowledge and a negative attitude towards care with the disease in patients with DM2. Factors associated with aggravation of the disease include advanced age, physical inactivity, and other diseases that require greater healthcare<sup>5</sup>. Knowledge and attitude are markers of awareness that must be studied in different population and cultural groups. Increasing awareness of the population is an important determinant for preventing DM, its complications, and related metabolic disorders such as overweight and obesity<sup>6</sup>.

Overweight and obesity have become a series public health problem and are associated with an increase of 61.8% in the incidence of DM in the Brazilian population<sup>7</sup>. In the 27 Brazilian capitals, more than half the population is above the recommended weight. Overweight has increased by 26.3% in 10 years, from 42.6% in 2006 to 53.8% in 2016, and is more prevalent among men (57.7%). Obesity has increased by 60% in 10 years, from 11.8% in 2006 to 18.9% in 2016, with a similar frequency in women and men (19.6% and 18.1%, respectively)<sup>7</sup>.

Many diseases can be prevented by the acquisition of healthy behaviors, including health education combined with physical activity and good nutrition in order to improve quality of life<sup>1</sup>. Appropriate health education should be a long-term program in order to obtain positive effects

on glycemic control, knowledge, and promotion of healthy lifestyles in the population with DM2<sup>8</sup>. Public health studies aimed at evaluating and raising the awareness of older adults to improve their knowledge and attitude towards DM are needed. Within this context, the evaluation of body adiposity using anthropometric markers and their association with diabetes knowledge and attitude are of fundamental importance for the promotion of health education programs and the prevention of possible risk factors associated with the development of chronic diseases<sup>9,10</sup>.

The aim of the present study was to identify factors associated with knowledge and attitude towards DM2 in older adults from Passo Fundo, Rio Grande do Sul.

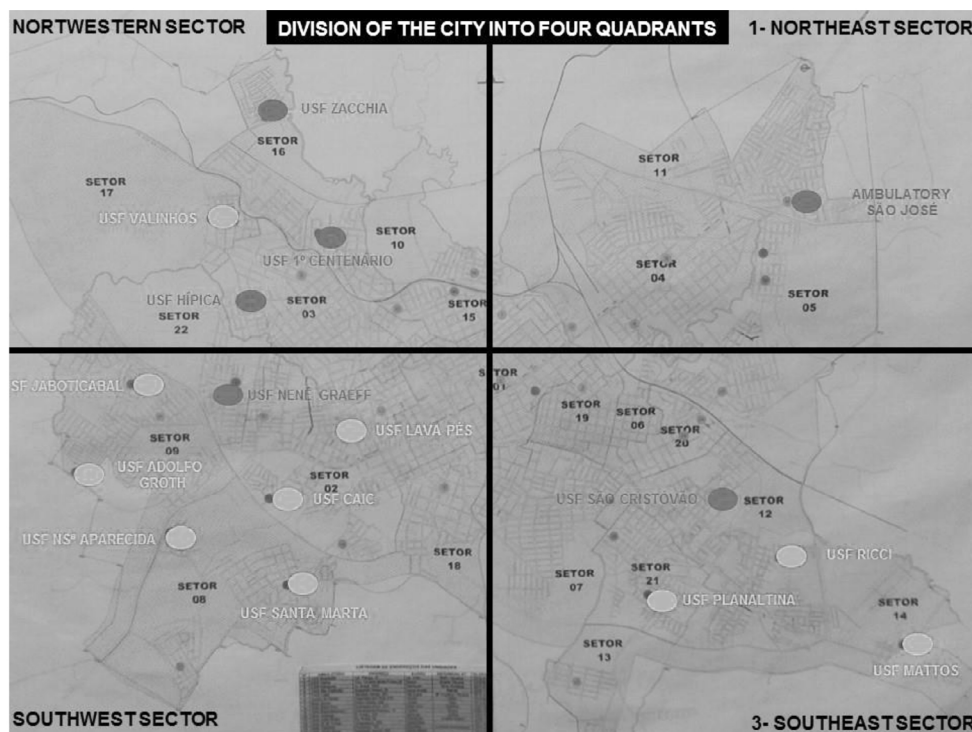
## Methods

A quantitative, cross-sectional, population-based study was conducted in 4 Basic Family Health Units (USF in the Portuguese acronym) with follow-up programs for older adults elderly with DM2. The study was carried out from February to May 2015 using 1 month of data collection for each USFE.

In the public health system of the city of Passo Fundo, the Family Health Strategy is the main regulator of the basic healthcare system, which covers a population of 2,500 to 4,000 individuals per team and is defined by mapping the areas of greatest vulnerability. The teams provide home visits and training of specific groups such as hypertensive and diabetic patients, pregnant women and the older adults, as well as basic outpatient care, referring patients to specialties as needed. The municipality of Passo Fundo has 15 USFs located in 15 different neighborhoods, as illustrated in Figure 1<sup>11</sup>.

Passo Fundo is located on the Rio Grande do Sul plateau at 690 m above sea level. The municipality comprises a territorial area of 783.421 km<sup>2</sup>, with a population density of 235.92 inhabitants/km<sup>2</sup>. The 2015 census estimated its population at 196,749<sup>12</sup>. There were 23,352 older adults, corresponding to 12.63% of the total population of the municipality. Only 3,542 older adults were registered in the USFs, i.e., most older adults (16,521) did not use the health services of the Unified Health System<sup>13</sup>.

The urban territorial division demarcated by the Coordination of Basic Social Protection of Passo Fundo was used for selection of the sample<sup>11</sup>. This body stipulated the areas of activity of



**Figure 1.** Map of the urban space of Passo Fundo divided into four quadrants with 15 Family Health Units (USF in the Portuguese acronym), adapted by the author<sup>11</sup>.

Legend: black - USF without diabetes programs for the older adults; white - USF with diabetes programs for the older adults.

each Social Service Referral Center, divided into four major sectors: Sector 1 - northeast region; Sector 2 - northwest region; Sector 3 - southeast region; Sector 4 - southwest region.

The first quadrant (northeast region), which consists of neighborhoods and is divided into three sectors, has a population of 31,081 inhabitants, including 3,250 older adults<sup>13</sup>. There are no USF in this quadrant, but the São José ambulatory attends on average 150 older adults per month and has 12 employees that form a team composed of nursing technicians, nurses, nutritionists, physiotherapists and physicians who provide outpatient care, immunization, nutritional monitoring, physiotherapy, geriatric, gynecology and obstetrics services to the following groups: children, pregnant women, the older adults, hypertensives, and diabetics, among others. It should be noted that the São José ambulatory was included in this study because of

the services provided and because it meets the criteria required for a USF, including a program for the older adults with diabetes.

The second quadrant (northwest region) has a population of 35,402 inhabitants, with 1,142 older adults registered in the USF<sup>13</sup>. There are four USFs in this quadrant and three offer programs for people with diabetes and attend 630 older adults with the disease. The programs are conducted in these USFs through monitoring and control by the Family Health Strategy and provide the following services: nutritional control, periodic examinations, and diabetes information about daily care through weekly visits scheduled in the units.

The third quadrant (southeast region) has a population of 19,022 inhabitants and the number of older adults registered in the USF is 2,017<sup>13</sup>. There are four USFs in this sector but only one offers a program for diabetics. The program

comprises weekly meetings and interventions by the family health team, including lectures and control of glucose levels.

The fourth quadrant (southwest region) has a population of 56,519 inhabitants and 3,542 older adults are registered in the USF<sup>13</sup>. This region has the largest number of USFs, totaling seven. However, only one USF offers a program for diabetics, which consists of follow-up by healthcare workers of the USF and preventive laboratory tests with the physicians, as well as health education through weekly meetings, lectures, laboratory tests and monitoring by the team.

It should be noted that Passo Fundo has a population of 23,352 older adults; however, the sum of older adults registered in the USFs of this study was 3,542<sup>13</sup>. This difference is explained by the number of older adults registered in the USFs, i.e., the remaining older adults population is covered by basic healthcare programs.

After all procedures of localization and description of the USFs and their respective services provided to society, one USF per quadrant was included in the sample. The São José ambulatory was included in the first quadrant because of the lack of a USF and since it attends diabetic older adults. Based on this strategy, only the second quadrant in the northwest region required drawing lots because it possessed three USFs attending diabetic older adults. The USF Hípica was randomly selected for the study.

Sample size calculation with an acceptable error ( $p \leq 0.05$ ) resulted in a total sample of 185 users with DM. An additional 10% was added to account for losses (not eligible, refusals, etc.) and it was necessary to interview 204 older adults with DM2. Sample size calculation was based on a prevalence of diabetes among older adults of 20% according to a national health survey<sup>4</sup>.

After approval of the study by the Ethics Committee on Research Involving Humans of University of Passo Fundo, all users signed two copies of the free informed consent form and one copy was given to the participant.

Data collection was started and a questionnaire was applied to obtain the sociodemographic data and health conditions of the participants. The questionnaire was elaborated to meet the objectives of this study and was submitted to construct validation by three professors from different higher education institutions with knowledge in the area of this research. The theoretical basis of national guidelines and of studies already conducted on this topic was used as a reference<sup>2,1#4,1#5,24</sup>. The following sociodemographic

variables were included: age (60 to 69 years,  $\geq 70$  years), gender (male and female), marital status (married, single, widowed, and divorced), occupation (with occupation and no occupation), schooling (0 to 4 years,  $> 5$  years), and income (retirement, pension/others). The health condition variables included smoking (yes or no for the last year), alcohol consumption (yes or no for the last year), falls (yes or no), and diseases other than DM2 (yes or no).

For assessment of the knowledge and attitude towards DM, diabetes knowledge (DKN-A) and attitude (ATT-19) questionnaires already validated for Brazil were applied by interview<sup>1#7</sup>. The DKN-A scale consists of 15 multiple-choice items on different aspects related to general diabetes knowledge, divided into five broad categories: a) basic physiology, including the action of insulin; b) hypoglycemia; c) food groups and their substitutions; d) management of diabetes in the presence of another disease; e) general principles of diabetes care. The measurement scale ranges from 0-15 and each item is scored as 1 for the correct answer or 0 for the wrong answer. Items 1 to 12 require a single correct answer, while two answers are correct for questions 13 to 15 and both must be checked to obtain score 1. Thus, a score of 0 to 8 indicates poor knowledge and a score  $> 8$  indicates good diabetes knowledge.

The ATT-19 attitude questionnaire is a measure of psychological adjustment in people with diabetes. The instrument was developed in response to the need to evaluate psychological and emotional aspects of the disease. It consists of 19 items divided into six factors: a) stress associated with diabetes; b) treatment receptiveness; c) treatment confidence; d) personal efficacy; e) health perception; f) social acceptance. Questions 11, 15, and 18 begin with the reverse score. The main application of the attitude scale is related to the evaluation of educational interventions. For the classification of attitude, each response of the ATT-19 is rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The total score ranges from 19 to 95 points, with a score  $< 70$  indicating a poor attitude and  $> 70$  indicating a positive attitude towards the disease.

All questionnaires used in this study were applied by interview, i.e., the evaluator asked the question verbally and the respondent (older adult with DM2) answered according to his/her knowledge. The questions were repeated and clarified whenever the participant had doubts or could not hear the question correctly to minimize errors.

The long form of the International Physical Activity Questionnaire (IPAQ) in the leisure domain, tested and validated for the population of Brazilian older adults<sup>1#8,1#9</sup>, was used for assessing physical activity levels. The questionnaire is easy to apply and inexpensive and shows acceptable validity for this type of assessment. For analysis, the data were summed in minutes per week spent in activities of moderate or vigorous intensity. Older adults performing less than 150 minutes per week of moderate or vigorous physical activity were classified as insufficiently active and those performing 150 minutes or more per week were classified as active<sup>2#0</sup>.

For evaluation of anthropometric indicators, height and body weight were measured on a mechanical scale equipped with a stadiometer in the orthostatic position. The body mass index (BMI) was calculated and classified using the following cut-off points for older adults:  $\leq 20 \text{ kg/m}^2$  – low weight;  $20 - 24.9 \text{ kg/m}^2$  – adequate or eutrophic;  $25 - 29.9 \text{ kg/m}^2$  – overweight, and  $\geq 30 \text{ kg/m}^2$  – obesity<sup>2#1</sup>. Waist circumference (WC) was measured during normal expiration at the midpoint between the last rib and iliac crest. A waist circumference  $\geq 102 \text{ cm}$  for men and  $\geq 88$  for women was classified as a risk factor<sup>2#2</sup>. Hip circumference was measured over the widest part of the buttocks and the waist-to-hip ratio (WHR) was calculated<sup>2#2</sup>. A WHR cut-off of 1.0 for men and 0.8 for women was used as a risk factor in this study<sup>2#2</sup>. The waist-to-height ratio (WHtR) was calculated by dividing the waist circumference (cm) by height (cm). The cut-off point used for risk classification was 0.52 for men and 0.53 for women<sup>2#3</sup>.

Body fat percentage was determined by bipolar (hand-to-hand) bioelectrical impedance using a Body Fat EF 201-SL digital monitor, which applies a weak and imperceptible electric current through the body. The sex, age, weight and height of the subject were entered into the device. The participants were asked to stand upright and to hold the monitor in front of their chest with dry and clean hands. Next, the device displays on the screen the body fat percentage (BF), followed by body water (BW). The classification proposed by Lohman<sup>2#4</sup> was used to evaluate the body fat percentage of older adults; below the average, 9 to 22%; average, 23%; 24 to 31% above the average; very high, > 32%.

The distribution of absolute and relative frequencies and the chi-squared test for proportions were used for description of the variables stratified by sex. After bivariate analysis, the associa-

tion of knowledge and attitude with the variables studied (sex, age, marital status, educational level, occupation, income, smoking, alcohol consumption, falls, other diseases, physical activity level, attitude, knowledge, BMI, waist circumference, WHR, WHtR, and body fat percentage) was tested. Logistic regression was used, and crude and adjusted values were calculated (a positive attitude and good knowledge were adjusted for all variables cited above). A level of significance of  $p \leq 0.05$  was adopted. All calculations were performed with the Stata 10.0 program.

## Results

The final sample consisted of 204 older adults with DM2 from the municipality of Passo Fundo-RS. There were no losses. Table 1 shows the characteristics of the sample. There was a difference between sexes, age group of 60 to 69 years, single/widowed women, being a smoker, alcohol consumer, and increased WHR.

Table 2 shows the association analysis of knowledge and attitude towards diabetes with the different factors investigated. Good diabetes knowledge, age of 60 to 69 years, being physically active and having a positive attitude towards diabetes treatment were found to be associated. A statistically significant association was observed between a positive attitude towards diabetes treatment and the following variables: age of 60 to 69 years, being physically active, and having good diabetes knowledge.

Crude and adjusted analyses between good diabetes knowledge and the anthropometric, sociodemographic and health indicators are shown in Table 3. The significant variables in the adjusted model for good diabetes knowledge were age  $\geq 70$  years, being single/widow, absence of falls, and being physically active. The variables remained associated in the adjusted model for positive attitude.

## Discussion

The results of this study showed that good knowledge about DM2 is associated with age of 70 years or older, having a positive attitude towards treatment of the disease, and being physically active. Age of 70 years or older, having good diabetes knowledge and being physically active remained in the statistical association with a positive attitude. These findings agree with the study of

**Table 1.** Characteristics of older adults with type 2 diabetes from Passo Fundo – RS, 2015 (n = 204).

Variable	Men		Women		X <sup>2</sup>	P
	n	%	n	%		
Age					4.726	0.030*
60 to 69 years	56	73.7	75	58.6		
≥ 70 years	20	26.3	53	41.4		
Marital status					33.370	< 0.001*
Married	64	84.2	55	43.0		
Single/widow	12	15.8	73	57.0		
Schooling					0.815	0.367
0 to 4 years	39	51.3	74	57.8		
≥ 5 years	37	48.7	54	42.2		
Occupation					3.233	0.072
With occupation	50	65.8	99	77.3		
No occupation	26	34.2	29	22.7		
Income					0.112	0.738
Retirement	58	76.3	95	74.2		
Pension/others	18	23.7	33	25.8		
Smoking					15.854	<0.001*
Yes	51	67.1	49	38.3		
No	25	32.9	79	61.7		
Alcohol consumption					22.869	<0.001*
Yes	29	38.2	13	10.2		
No	47	61.8	115	89.8		
Falls					0.574	0.449
Yes	41	53.9	76	59.4		
No	35	46.1	52	40.6		
Other diseases					0.390	0.532
Yes	66	86.8	107	83.6		
No	10	13.2	21	16.4		
PAL					1.457	0.227
Insufficiently active	62	81.6	95	74.2		
Active	14	18.4	33	25.8		
DM knowledge					0.108	0.742
Poor	51	67.1	83	64.8		
Good	25	32.9	45	35.2		
Attitude towards DM					1.217	0.270
Negative	61	80.3	94	73.4		
Positive	15	19.7	34	26.6		
BMI					2.438	0.118
No risk	8	10.5	24	18.8		
Risk	68	89.5	104	81.3		
Waist circumference					0.450	0.502
No risk	14	18.4	19	14.8		
Risk	62	81.6	109	85.2		
WHR					4.640	0.031*
No risk	39	51.3	46	35.9		
Risk	37	48.7	82	64.1		
WHtR					0.268	0.605
No risk	5	6.6	11	8.6		
Risk	71	93.4	117	91.4		
BF%					0.041	0.840
No risk	2	2.6	4	3.1		
Risk	74	97.4	124	96.9		

PAL: physical activity level; DM: diabetes mellitus; BMI: body mass index; WHR: waist-to-hip ratio; WHtR: waist-to-height ratio; BF%: body fat percentage. \* p < 0.05: statistically significant difference.

**Table 2.** Association of anthropometric, sociodemographic and health indicators with knowledge and attitude towards treatment of type 2 diabetes in older adults from Passo Fundo – RS, 2015 (n = 204).

Variable	Knowledge				p*	Attitude				p*
	Poor		Good			Negative		Positive		
	n	%	N	%		n	%	n	%	
Sex					0.742					0.270
Male	51	67.1	25	32.9		61	80.3	15	19.7	
Female	83	64.8	45	35.2		94	73.4	34	26.6	
Age					0.002*					0.010*
60 to 69 years	76	58.0	55	42.0		92	70.2	39	29.8	
≥ 70 years	58	70.5	15	20.5		63	86.3	10	13.7	
Marital status					0.397					0.638
Married	81	68.1	38	31.9		89	74.8	30	25.2	
Single/widow	53	62.4	32	37.6		66	77.6	19	22.4	
Schooling					0.087					0.777
0 to 4 years	80	70.8	33	29.2		85	75.2	28	24.8	
≥ 5 years	54	59.3	37	40.7		70	76.9	21	23.1	
Occupation					0.480					0.655
With occupation	100	67.1	49	32.9		112	75.2	37	24.8	
No occupation	34	61.8	21	38.2		43	78.2	12	21.8	
Income					0.609					0.219
Retirement	102	66.7	51	33.3		113	73.9	40	26.1	
Pension/others	32	62.7	19	37.3		42	82.4	9	17.6	
Smoking					0.428					0.508
Yes	63	63.0	37	37.0		78	78.0	22	22.0	
No	71	68.3	33	31.7		77	74.0	27	26.0	
Alcohol consumption					0.830					0.971
Yes	27	64.3	15	35.7		32	76.2	10	23.8	
No	107	66.0	55	34.0		123	75.9	39	24.1	
Falls					0.125					0.530
Yes	82	70.1	35	29.9		87	74.4	30	25.6	
No	52	59.8	35	40.2		68	78.2	19	21.8	
Other diseases					0.279					0.264
Yes	111	64.2	62	35.8		129	74.6	44	25.4	
No	23	74.2	8	25.8		26	83.9	5	16.1	
PAL					<0.001*					<0.001*
Insufficiently active	125	79.6	32	20.4		154	98.1	3	1.9	
Active	9	19.1	38	80.9		1	2.1	46	97.9	
Attitude towards DM					<0.001*					<0.001*
Negative	122	78.7	33	21.3		122	91.0	12	9.0	
Positive	12	24.5	37	75.5		33	47.1	37	52.9	
BMI					0.691					0.888
No risk	22	68.8	10	31.3		24	75.0	8	25.0	
Risk	112	65.1	60	34.9		131	76.2	41	23.8	
Waist circumference					0.352					0.391
No risk	24	72.7	9	27.3		27	81.8	6	18.2	
Risk	110	64.3	61	35.7		128	74.9	43	25.1	
WHR					0.517					0.599
No risk	58	68.2	27	31.8		63	74.1	22	25.9	
Risk	76	63.9	43	36.1		92	77.3	27	22.7	

it continues

**Table 2.** Association of anthropometric, sociodemographic and health indicators with knowledge and attitude towards treatment of type 2 diabetes in older adults from Passo Fundo – RS, 2015 (n = 204).

Variable	Knowledge				p*	Attitude				p*
	Poor		Good			Negative		Positive		
	n	%	N	%		n	%	n	%	
WHR					0.169					0.481
No risk	8	50.0	8	50.0		11	68.8	5	31.3	
Risk	126	67.0	62	33.0		144	76.6	44	23.4	
BF%					0.959					0.669
No risk	4	3.0	2	2.9		5	3.2	1	2.0	
Risk	130	97.0	68	97.1		150	96.8	48	98.0	

PAL: physical activity level; DM: diabetes mellitus; BMI: body mass index; WHR: waist-to-hip ratio; WHtR: waist-to-height ratio; BF%: body fat percentage. \* p < 0.05: statistically significant difference (Pearson's chi-squared test).

Seramin et al.<sup>1#4</sup> that evaluated the knowledge and attitude of 44 basic healthcare users in Bebedouro-SP. The age of the participants ranged from 30 to 80 years, there was a predominance of female (68.2%) and married subjects (61.4%), and the mean BMI was 25.6 kg/m<sup>2</sup>. The authors found scores higher than those obtained in the present study (88.2% with poor knowledge) for good diabetes knowledge, indicating satisfactory results for self-care, and scores < 70 for attitude, indicating difficulties in coping with the disease. In that study, 99% of the participants had a negative attitude.

Although the present study identified significant associations of knowledge and attitude with age ≥ 70 years and being physically active, most older adults had scores below the average. This finding might be explained by the lack of information and knowledge of the participants about the prevention, treatment and quality of life related to DM2. In the study of Busnello et al.<sup>1#5</sup> evaluating 78 older adults aged 60 to 80 years, including 89.7% females, negative scores were obtained for diabetes knowledge.

The low educational level of the participants was another finding of this study. The fact that living in rural areas as young people prevented the older adults from completing school may explain the negative knowledge and attitude scores. A low educational level was also observed by Oliveira and Zanetti<sup>24</sup> who analyzed 79 basic healthcare users in Ribeirão Preto-SP ranging in age from 30 to 80 years. Most participants were women (63.3%), married (63.3%), overweight based on BMI (29.1%), and had a mean waist circumference of 107.06 cm.

The identification of poor knowledge and a negative attitude towards diabetes treatment in the present study should take into consideration

associated factors such as the low educational level and health and living conditions that these older adults had during aging. Based on this information, different findings have been reported by Fatema et al.<sup>6</sup> These authors identified a medium level of general knowledge about DM and a good attitude towards treatment of the disease in 18,697 adults from Bangladesh with a mean age of 46 years. According to the authors, there is an urgent need for educational campaigns primarily focusing on poorer groups living in rural areas and with a low educational level in order to prevent DM and its complications.

In addition to the below average scores for knowledge and attitude, this study found that few programs provide health education to older adults with DM. Binh et al.<sup>25</sup> analyzed the knowledge of 2,580 patients of both sexes with DM aged 40 to 64 years in Vietnam. The authors observed a low level of diabetes knowledge among the general population and highlighted the need to improve the knowledge of this population about the disease. According to the authors, cognitive ability at an advanced age, residence (hygiene and infrastructure), encouragement of learning (educational level), and having some occupation should be taken into account to minimize the health problems caused by the disease.

Poor knowledge and a negative attitude have also been demonstrated among patients in Nepal by Gautam et al.<sup>10</sup> who studied factors associated with diabetes. Among the 244 diabetic patients, 52.5% were females, 18% were illiterate, and the most cited risk factor was a low physical activity level in 17.6%. These results may contribute to the present study by identifying that physical activity is associated with knowledge and attitude towards diabetes, i.e., if the patient is unaware of the benefits of non-pharmacological interven-



**Table 3.** Crude and adjusted association of the anthropometric indicators of adiposity, sociodemographic variables and health indicators with good knowledge and positive attitude towards treatment of type 2 diabetes in older adults from Passo Fundo - RS, 2015 (n = 204).

Variable	Good knowledge		Crude analysis		Adjusted analysis		Positive attitude		Crude analysis		Adjusted analysis	
	n	%	OR	95%CI	OR	95%CI	n	%	OR	95%CI	OR	95%CI
Sex												
Male	45	35.2	1		1		15	19.7	1		1	
Female	25	32.9	0.90	0.49-1.65	0.91	0.38-2.20	34	26.6	1.47	0.74-2.96	1.45	0.70-2.80
Age												
60 to 69 years	55	42.0	1		1		39	29.8	1		1	
≥ 70 years	15	20.5	0.35	0.18-0.69	0.44	0.18-1.08	10	13.7	0.37	0.17-0.80	0.35	0.15-0.78
Marital status												
Married	38	31.9	1		1		30	25.1	1		1	
Single/widow	32	37.6	1.28	0.72-2.30	2.79	1.16-6.69	19	22.4	0.85	0.44-1.64	0.93	0.70-2.49
Schooling												
0 to 4 years	33	29.2	1		1		28	24.8	1		1	
≥ 5 years	37	40.7	1.66	0.93-2.97	1.86	0.82-4.34	21	23.1	0.91	0.47-1.74	0.47	0.37-3.45
Occupation												
With occupation	49	32.9	1		1		37	24.8	1		1	
No occupation	21	38.2	1.26	0.66-2.39	1.23	0.52-2.90	12	21.8	0.85	0.40-1.71	0.90	0.41-1.76
Income												
Retirement	37	37.0	1		1		22	22.0	1		1	
Pension/other	33	31.7	0.79	0.44-1.41	0.54	0.24-1.20	27	26.0	1.24	0.65-2.37	2.10	0.20-4.78
Smoking												
Yes	15	35.7	1		1		10	23.8	1		1	
No	55	34.0	0.93	0.45-1.88	0.71	0.28-1.83	39	24.1	1.01	0.45-2.25	1.02	0.30-2.40
Alcohol consumption												
Yes	35	29.9	1		1		30	25.6	1		1	
No	35	49.2	1.58	0.88-2.83	2.58	1.18-5.65	19	21.8	0.81	0.42-1.56	0.76	0.34-1.78
Falls												
Yes	62	35.8	1		1		44	25.4	1		1	
No	8	25.8	0.62	0.26-1.47	0.70	0.23-2.11	5	16.1	0.56	0.20-1.55	0.27	0.10-1.45
Other diseases												
Yes	33	21.3	1		1		12	9.0	1		1	
No	37	75.5	11.4	5.35-24.2	10.4	4.20-18.70	37	52.9	11.4	5.35-24.28	8.9	4.30-18.9
PAL												
Insufficiently active	32	20.4	1		1		3	1.9	1		1	
Active	38	80.9	16.4	7.23-37.5	12.7	6.8-30.10	46	97.9	14.9	8.9-35.9	10.1	6.34-20.1
Attitude towards DM												
Negative	10	31.3	1		1							
Positive	60	34.9	1.17	0.52-2.65	1.03	0.32-3.33						
DM knowledge												
Poor							6	18.2	1		1	
Good							43	25.1	1.51	0.58-3.90	1.37	0.45-3.45
BMI												
No risk	9	27.3	1		1		8	25.0	1		1	
Risk	61	35.7	1.47	0.64-3.38	2.81	0.69-11.4	41	23.8	0.93	0.39-2.24	0.87	0.40-2.45
Waist circumference												
No risk	27	31.8	1		1		22	25.9	1		1	
Risk	43	36.1	1.21	0.67-2.19	1.16	0.51-2.62	27	22.7	0.84	0.44-1.60	1.00	0.60-1.69

it continues

**Table 3.** Crude and adjusted association of the anthropometric indicators of adiposity, sociodemographic variables and health indicators with good knowledge and positive attitude towards treatment of type 2 diabetes in older adults from Passo Fundo - RS, 2015 (n = 204).

Variable	Good knowledge		Crude analysis		Adjusted analysis		Positive attitude		Crude analysis		Adjusted analysis	
	n	%	OR	95%CI	OR	95%CI	n	%	OR	95%CI	OR	95%CI
WHR												
No risk	8	50.0	1		1		5	31.3	1		1	
Risk	62	33.0	0.49	0.17-1.37	0.24	0.05-1.12	44	23.4	0.67	0.22-2.03	0.80	0.11-2.39
WHtR												
No risk	2	2.9	1		1		1	2.0	1		1	
Risk	68	97.1	1.05	0.19-5.86	0.45	0.88-0.96	48	98.0	1.60	0.18-14.03	0.67	1.70-2.64
BF%												
No risk	2	2.9	1		1		15	19.7	1		1	
Risk	68	97.1	1.05	0.19-5.86	0.45	0.88-0.96	34	26.6	1.47	0.74-2.96	1.45	0.70-2.80

OR: odds ratio; 95%CI: 95% confidence interval; PAL: physical activity level; DM: diabetes mellitus; BMI: body mass index; WHR: waist-to-hip ratio; WHtR: waist-to-height ratio; BF%: body fat percentage.

tions such as physical activity in terms of prevention and healthcare, he will not perform the self-care necessary for his health.

Physical activity was significantly associated with good diabetes knowledge and a positive attitude, i.e., patients that have knowledge about diabetes and a positive attitude towards its treatment are more likely to be physically active. The adoption of physically active lifestyles may minimize the risks of chronic diseases such as DM, as demonstrated by Santana et al.<sup>26</sup> in a study on 1,473 older adults in Bambuí-MG with a mean age of 69.1 years. The authors suggested that encouraging physical activity should be a universal strategy to combat chronic noncommunicable diseases of public health interest. Within this context, the promotion of physical activity is fundamental for the prevention and treatment of DM and should be encouraged by professionals working at all public healthcare levels in order to promote behavioral changes and to increase the number of physically active individuals<sup>27,28</sup>.

Although not significantly associated with knowledge and attitude towards DM, it is of fundamental importance that anthropometric indicators remain within the normal range. An association of anthropometric indicators with the incidence of DM cases has been reported in the literature, for example in two German cohorts involving 1,324 women and 1,278 men ranging in age from 31 to 83 years<sup>29</sup>.

The present study has some limitations. Its cross-sectional design does not permit a specific analysis of the cause and effect relationship of the associated variables and the data must therefore be analyzed with caution. In addition, few studies with the same objective as the present one are

available in the literature for a more reliable comparison with other realities.

Taken together, the results show that good diabetes knowledge and a positive attitude are associated with age  $\geq 70$  years and being physically active. However, caution is necessary when trying to establish the cause and effect relationship of this association. It should be pointed out that it is important for this population to be involved in programs aiming at health education of a larger number of people with the disease in order to improve the knowledge and attitude towards diabetes and its treatment. Within this context, factors associated with knowledge and attitude should be considered especially by the public health sector. The professionals involved should be aware of and provide the necessary information about self-care, treatment and prevention of DM2 in order to minimize health problems.

There is a need for new public policies favoring a multidisciplinary approach to raising the awareness of older adults with DM2 through programs, lectures, and other types of intervention such as physical activity in order to improve the attitude and knowledge about the treatments of this disease. Within this context, physical education professionals have an important role in public health, contributing to the prevention of chronic diseases such as DM and to the improvement of quality of life of the population.

In conclusion, further studies employing methodologies other than that used in this study and investigating different populations should be conducted to evaluate the association of diabetes knowledge and attitude with indicators of body adiposity and other health-related variables.

## Collaborations

AP Lima participated in all stages of this work since the conception of the study; TRB Benedetti supervised all stages of this work and assisted in the writing of the article; CR Rech participated in the analysis of the data and the final writing of the article; FB Cardoso participated in the writing and correction of the final version of the manuscript; MR Portella participated in all stages of this work and supervised the final writing.

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