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Falls, hospitalizations, and poor self-rated health in older people with diabetes and frailty: a secondary analysis of SABE-Colombia

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Abstract

Background Diabetes and frailty, together, have been related to adverse events such as increased risk of hypoglycemia, functional decline, disability, hospital admissions, and worsening quality of life. We estimated the prevalence of diabetes and frailty and their association with hospitalization, poor self-rated health, recurrent falls, and fear of falling.

Methods Data came from the "Salud, Bienestar y Envejecimiento" (SABE) Colombia Survey 2015, a cross-sectional study of 23694 community-dwelling adults aged 60 years or older living in rural or urban areas, a representative sample from the total population. A modified version created of the frailty phenotype proposed by Fried, was used to measure frailty. Diabetes prevalence was considered by self-report. We evaluated the association between diabetes and/or frailty with hospitalization, poor self-rated health, recurrent falls and fear of falling.

Results Three thousand eight hundred seventy-three older people were analyzed, 16.2% had diabetes, were more likely to be women, younger age (≤ 69 years), lived in urban areas and had lower economic income. Geriatric syndromes, chronic illnesses, hospitalization in the last year and poor self-rated health were also significantly associated with diabetes. The prevalence of older adults having diabetes and frailty was 22.4%. Diabetes and frailty were not associated with dependent variables, but people with frailty did find a significant association with poor self-rated health, recurrent falls and fear of falling, associations that were higher than analysis with elderly with diabetes.

Conclusions Findings provide additional evidence supporting association between elderly with frailty and unfavorable outcomes independently of chronic diseases.

Keywords Diabetes mellitus, Aged, Frailty, Accidental falls, Hospitalization

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Introduction

Demographics transition through the last years has increased chronic non-communicable diseases like diabetes, which prevalence in older adults in Latin America has been estimated between 13 % and 22 % [1]. In Colombia, studies have described a prevalence of 18.5 % by self-report [2]. Diabetes has become the fourth leading cause of disability-adjusted life-years (DALYs) by 2019 [3].

Diabetes guidelines around the world have established recommendations for older people management during the last years, such as a multidimentional assessment (nutritional, functional, mental, affective, and social components), early referral to a geriatrician, and frailty assessment. This is with the aim of guiding therapeutic goals and determine the best treatment option according to the functional state [4–8]. Since the objectives of diabetes management in the elderly differ from those younger, the frailty assessment takes a greater relevance. Due to the wide definition and diagnostic criteria of physical frailty in recent years, the prevalence varies worldwide between 8 % and 20.4 % [9–13], being described in Colombia between 9.4 % and 12.1 % in studies from different cities [9, 14].

Physical frailty is a geriatric syndrome that is part of the functional continuum and is defined as a state before disability that is associated with a decrease in the functional reserve and a high vulnerability to stressors and with risk of adverse outcomes including mortality [15]. Frailty has been related to diabetes, as there are common physiopathological pathways [16], suggesting a bidirectional association [17, 18]. Studies have reported that frailty in older people with diabetes are associated to geriatric syndromes such as gait disorders, falls, increased disability risk, cognitive impairment and poor health outcomes like hypoglycemia, hospitalizations, cardiovascular complications and mortality [19–22].

The present study aims to describe the association between falls, fear of falling, hospitalizations, and poor self-rated health status in older people with diabetes and frailty in Colombia.

Methodology

Data came from SABE (Salud, Bienestar y Envejecimiento) Colombia Survey carried out between 2014 and 2015, a cross-sectional study realized in rural and urban areas, using a probabilistic sample scheme by clusters (housing segments) with block stratification. A total of 23694 with 60 or more years were interviewed, from 244 municipalities, being a representative sample from the total population by the type of sampling.

SABE Colombia Survey included a modified instrument and adapted to the context from that created by the Panamerican Health Organization to Latin American countries [23]. The survey had three components: 1) A survey that evaluated active aging determinants such as anthropometry, blood pressure, physical functions, and biochemical and hematological measures; 2) A survey with a sub-sample of caregivers; 3) A qualitative study that evaluated the quality of life from gender and cultural perspective to assess more dimensions of people.

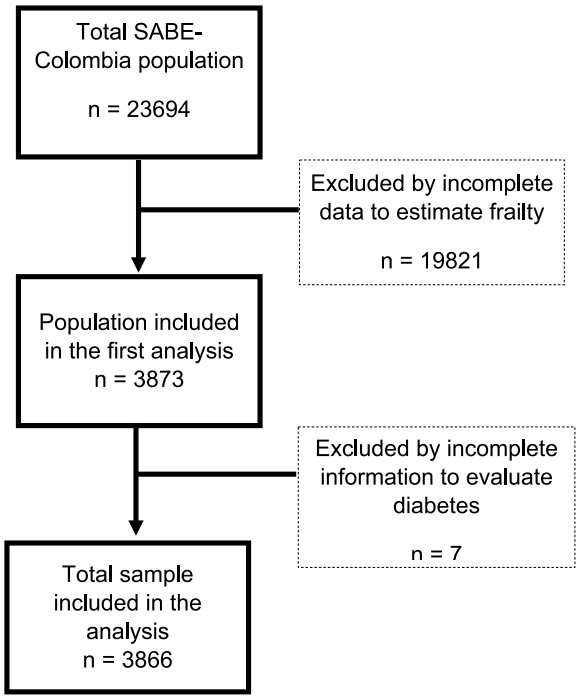


Fig. 1 Exclusion criteria and sample design

Sample selection

From 23694 people on Colombia SABE study, 19821 were initially excluded since they did not contain complete data to estimate frailty, so 3873 people surveyed were finally selected by convenience sampling and analyzed, among these, 3866 had complete information to evaluate the characteristics of interest of people with diabetes (Fig. 1).

Dependent variables

As dependent variables, we evaluated history of hospitalization in the last year, poor self-rated health (It was assessed by this question: "In general would you describe your health as" and there were five possible answers: "excellent", "very good", "good", "fair" or "poor". Poor self-rated health was defined by any of the last two). Recurrent falls was defined as 2 or more falls in the last year and fear of falling was assessed with de following question: Due to fear of falling, have you ever suspended any activity you usually did?

Table 1 Modified version of the Frailty Phenotype proposed by Fried and colleagues

Frailty phenotype criterias	Variables used in SABE Colombia
Weight loss	Significant weight loss (≥ 5%) {Actual weight – (Actual weight – Weight loss) x 100}/Actual weight
Grip strenght	Lowest quintil Grip strength from dominant hand. Adjusted to a sex and BMI Women Strenght ≤ 12 for BMI ≤ 22,7 Strenght ≤ 12 for BMI 22,8–25,6 Strenght ≤ 12 for BMI 25,7–28,1 Strenght ≤ 12 for BMI 28,2–31,2 Strenght ≤ 13 for BMI ≥ 31,3 Men Strenght ≤ 13 for BMI ≤ 21,6 Strenght ≤ 16 for BMI 21,7 - 24 Strenght ≤ 16 for BMI 24,1–26 Strenght ≤ 19 for BMI 26,1–28,6 Strenght ≤ 20 for BMI ≥ 28,7
Walking time	Lowest quintil Men Time to walk 3 mts ≥ 5 for Height ≤ 157 cm Time to walk 3 mts ≥ 5 for Height > 157 cm Women Time to walk 3 mts ≥ 6 for Height ≤ 155 cm Time to walk 3 mts ≥ 6 for Height > 155 cm
Exhaustion	Negative answer for ¿Are you feeling full of energy? in Yesavage or and affirmative answer to weakness
Physical activity	Physical inactivity: negative answer to ¿Do you walk, at least three times a week about 8 blocks (0.5 kilometers –0.31 miles) without resting?

Adapted and modified from Samper-Ternent R, et al. Frailty and sarcopenia in Bogotá: results from the SABE Bogotá Study. Aging Clin Exp Res. 2017 [14].

BMI Body mass index

Exposure variables

Diabetes was evaluated by self-report with the question: Have a doctor or a nurse told you that you have diabetes or high blood glucose level?

A modified version of the Frailty Phenotype proposed by Fried and colleagues in 2001 [24] was created and used to measure frailty (see Table 1), similar to a version previously described [14]. We took into consideration 5 criteria: 1) Weight loss, 2) grip strength, 3) walking speed, 4) exhaustion, 5) physical activity. We determined as well, non-frail the older people with no component altered, pre-frail if they had 1 o 2 positive components, and frail if they had 3 or more positive components [14, 24]. See Additional file 1 (Supplementary material), for more details related to the creation of the modified version of the Frailty Phenotype proposed by Fried and colleagues with SABE Colombia Survey variables.

Independent variables

We evaluated sociodemographic variables as age, sex, geographic area of living (rural or urban), educational level (high educational level defined as having completed secondary or university). Likewise, we evaluated monetary poverty that was defined as personal income less than 241,673 COP (Colombian pesos) by 2015 [25] and if the older person lived alone.

Additionally, we evaluated comorbidities and geriatric syndromes such as sarcopenia following the recommendation of the revised European consensus on definition and diagnosis of sarcopenia [26] (calf circumference less than 31 cm and reduced gait speed adjusted for sex and height), malnutrition (Mini Nutritional Assessment-Short form ≤ 7), poor oral health (Geriatric Oral Health Assessment Index ≤ 57), and polypharmacy (defined as consumption of 5 or more medications).

At the mental level, severe depressive symptoms (Geriatric Depression Scale ≥ 10) [27, 28] and mild cognitive impairment, defined as Clinical Dementia Rating Score (CDR) of 0.5 without dementia diagnosis [29, 30] including the evaluation of the following domains: memory, orientation, judgment and problem solving, function in community affairs, home and hobbies, and personal care.

Statistical analysis

Univariate analyses were initially used to explore extreme values, distribution and to describe the variables included in the study. Categorical variables were presented as percentages. Continuous variables were presented in means and standard deviation. Differences between the group

of individuals with and without diabetes were analyzed using the Chi-square test for categorical variables and the Student's T-test for continuous numerical variables.

Considering each of the outcomes of interest (hospitalization in the last year, poor self-rated health, fear of falling, repeated falls), we proceeded to carry out binomial logistic regression model considering the presence or not of exposure variables (diabetes, frailty) and their interaction (diabetes and frailty). The model was adjusted for the variables that showed significance in the bivariate models. The association was reported as an odds ratio with a 95% confidence interval. The analysis was carried out assuming a confidence level of 95%, testing all the hypotheses with two tails. For the statistical procedures, we used STATA 16 and R studio software for Windows.

Ethical considerations

The SABE Colombia 2015 survey was endorsed by the Institutional Committee for the Review of Human Ethics of the Faculty of Health of the Universidad del Valle (minutes No 09–014 and O11-015) and the Bioethics Committee of the Universidad de Caldas (code CBCS-021-14). The study protocol was also approved by the ethics committee of the Hospital Universitario San Ignacio and the Pontificia Universidad Javeriana, under number 201845.

Results

The baseline characteristics and the bivariate analysis of the older people with or without diabetes can be seen in Table 2.

The prevalence of diabetes in this evaluated population was 16.2% (628), the prevalence of frailty was 16.4% (636) and the prevalence of diabetes and frailty was 22.4% (142 people), as can be seen in Fig. 2.

Most of the older people with diabetes were female, more than half (54.1%) between 60 and 69 years, followed by those between 70 and 79 years (36.1%). There were also living more frequently in urban than rural areas (84.1% vs 76.2%, p <0.01) and had monetary poverty (23.4% vs 22.4%, $p = 0.03$). Within geriatric syndromes, sarcopenia was more frequent in older people with diabetes (50% vs 41.8%, p <0.01), likewise frailty (22.6% vs 15.2%, p <0.01). More than half (51.7%) of the older people who had diabetes also had fear of falling, and approximately one in five reported recurrent falls. 75.6% of those with diabetes, had poor oral health according to GOHAI ($p = 0.014$) and 41.1% had polypharmacy (Table 2).

Regarding comorbidities, older people with diabetes had a higher prevalence of cardiocerebrovascular disease (78.1%), osteoarticular disease (40.2%), chronic obstructive pulmonary disease (13.3%), and mental illness (11.2%). A greater chance of presenting hospitalizations in the last year (15.6%) and poor self-rated health (11.3%) were found in older people with diabetes compared to those without diabetes.

In the multivariate logistic regression (Table 3), the confounding variables (sex, age, rural, mental illness, osteoarthritis, polypharmacy, GOHAI, CDR 0.5) were controlled and we found that people with diabetes but not frailty was significantly associated with poor self-rated health and fear of falling. In the group of no diabetic but frail, there was an association with poor self-rated health, recurrent falls and fear of falling. And in the group of people with diabetic and frailty, there was not association with all dependent variables evaluated.

Discussion

Frailty has become a highly relevant geriatric syndrome in older people with diabetes since it constitutes a variable that defines treatment goals and can influence adherence to diabetes management and their quality of life [5–7, 31]. Literature have described that the coexistence of diabetes and frailty increases the risk of cardiovascular complications, hypoglycemia, deterioration in the quality of life, functional disability, increased risk of falls and fractures, and cognitive deterioration [20], in addition to being associated with greater use of the health system, risk of hospitalization for all causes and mortality [21, 22]. Few studies evaluated the prevalence of frailty in older people with diabetes, finding in the present study a prevalence of 22.4%, considered within data reported in other studies (20 and 30%) [32, 33].

In this study, we didn't find a significant association in older people that had diabetes and frailty with dependent variables, but still there was a significant association in people with diabetes without concurrent frailty with poorer self-rated health and fear of falling. Similarly, frail elderly without diabetes, was consistently associated with poorer self-rated health, recurrent falls, and fear of falling. This unexpected finding may suggest potential measurement bias, or a limited sample size within this subgroup (people with diabetes and frailty) limiting the statistical power to detect associations and demanding further investigation and longitudinal studies. Additionally, our findings highlight the association of frailty and adverse health outcomes, independently of chronic diseases such as diabetes [24, 34].

Older people with diabetes in the present study were predominantly women, between 60 and 69 years old, which is striking in addition to the fact that there was a greater chance of having some geriatric syndrome. Within geriatric syndromes, fear of falling and recurrent falls had been highly associated to older people with diabetes, possibly related to the micro and macrovascular complications of diabetes, such as peripheral

Table 2 Bivariate analysis of socioeconomic factors, geriatric syndromes and comorbidities in older people with or without diabetes

Variables *n*= 3866	Without diabetes n (%)	Diabetes n (%)	*p*-value
Socioeconomic factors			
Female	1800 (55.6)	393 (62.6)	0.001
60–69 y	1918 (59.2)	340 (54.1)	0.018
70–79 y	1015 (31.3)	227 (36.1)	0.018
> 80 y	305 (9.4)	61 (9.7)	0.818
Urban áreas	2468 (76.2)	528 (84.1)	<0.01
Low income [a]	724 (22.4)	147 (23.4)	0.030
High educational level [b]	827 (25.5)	176 (28.0)	0.194
Alone living	319 (9.9)	59 (9.4)	0.724
Geriatric syndromes			
Sarcopenia [e]	1354 (41.8)	314 (50.0)	< 0.01
Frailty [f]	492 (15.2)	142 (22.6)	< 0.01
Fear of falling	925 (28.6)	265 (42.2)	< 0.01
Recurrent falls	479 (14.8)	123 (19.6)	< 0.01
Malnutrition [c]	74 (2.3)	18 (2.9)	0.409
Poor oral health GOHAI [d]	2293 (70.8)	475 (75.6)	0.014
Polypharmacy [g]	475 (14.7)	258 (41.1)	< 0.01
Depressive severe symptoms[h]	171 (5.3)	38 (6.1)	0.435
Mild cognitive impairment CDR=0.5	874 (27.0)	185 (29.5)	0.205
Comorbidities			
Cardiovascular disease (coronary heart and cerebrovascular disease, hypertension)	1725 (53.3)	490 (78.0)	< 0.01
Chronic pulmonary disease	291 (9.0)	83 (2.56)	< 0.01
Cancer	166 (5.1)	26 (4.1)	0.294
Mental diseases	258 (8.0)	70 (11.1)	< 0.01
Osteoarticular diseases (arthrosis, arthritis, rheumatological disease, osteoporosis)	961 (29.7)	251 (40.0)	< 0.01
Hospitalizations in the last year	311 (9.6)	98 (15.6)	< 0.01
Poor self-rated health	217 (6.7)	71 (11.3)	< 0.01

[a] Defined as a personal income less than 241.673 COP (Colombian pesos) – 76.73 US dollars by 2015

[b] Defined as completed high or college

[c] Mini Nutritional Assessment-Short form ≤ 7

[d] Defined as Geriatric Oral Health Assessment Index ≤ 57

[e] Defined as calf perimeter < 31 cm and low speed walking adjusted by sex and height

[f] Defined in Table 1

[g] Polypharmacy: ≥ 5 medications

[h] Defined as Geriatric Depression Scale ≥ 10

neuropathy that is poorly screened in the diabetic population, in addition to visual impairment due to refractive problems or retinopathy. Additionally, fear of falling has recently been described as a manifestation of anxiety disorder [35, 36], which can even occur in people who have not previously had falls, and had been related to the life-space limitation, promoting a sedentary lifestyle, greater chronic non-communicable diseases, and poor adherence to their management, also, feeling of loneliness and deterioration in the quality of life. Additionally, the fear of falling has been linked lately as one of the possible predictors of cognitive deterioration [37, 38], which in the context of older people with diabetes, could be one of the early markers for their referral to geriatrics and for adjustments in diabetes management, being more flexible with the goals and to simplify treatment scheme, to have a cognitive and affective evaluation and supporting older people in multidimensional management.

A poor perception of oral health in older people with diabetes was obtained using the GOHAI scale. It is noticeable that those with diabetes did not show a significant association with malnutrition, and this may suggest

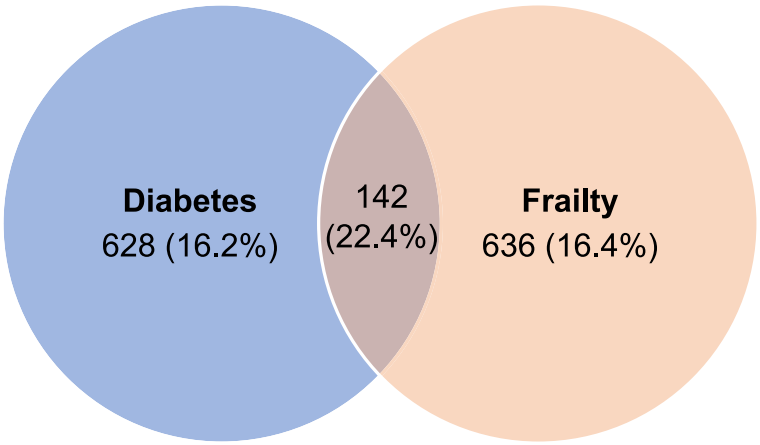


Fig. 2 Behavior between diabetes and frailty in the sample. *n*=3873

Table 3 Logistic regression about hospitalizations, poor self-rated health and falls

	Hospitalizations in the last year OR (IC 95%)	Poor self-rated health OR (IC 95%)	Recurrent falls OR (IC 95%)	Fear of falling OR (IC 95%)
No diabetic nor frail	Ref.			
Diabetic not frail	1.29 (0.94–1.73)	1.79 (1.22–2.57)	1.23 (0.93–1.61)	1.45 (1.15–1.83)
No diabetic but frail	1.37 (0.99–1.88)	3.69 (2.65–5.10)	1.48 (1.14–1.91)	1.66 (1.33–2.08)
Diabetic and frail	1.44 (0.82–2.53)	0.75 (0.40–1.38)	0.94 (0.56–1.56)	1.50 (0.93–2.46)

Adjusted by sex, age, rural areas, mental disease, arthrosis, polypharmacy, GOHAI, CDR 0.5

that the score of poor self-rated of oral health could be related to a greater extent with the swallowing capacity, perception of teeth and social behavior, considering that the mininutritional assessment has limitations to evaluate people with overweight and obesity. Polypharmacy continues to be present in older people with diabetes, a geriatric syndrome that may be necessary to achieve metabolic control and the rest of comorbidities, always individualizing management and avoiding inappropriate prescription of them.

Additionally, results from this study related to social domain, describe that people with diabetes had a greater association with having low personal income, which could increase the incidence of multimorbidity, geriatric syndromes, unhealthy diets, low protein consumption promoting incidence of diabetes and influencing diabetes' control and development of sarcopenia and frailty. This allows for future research ideas and the creation of public health policies in this vulnerable population.

This work highlights the creation of a modified version of the Frailty Phenotype proposed by Fried and colleagues for cross-sectional studies, using questions from the SABE Colombia Study. Moreover, included the assessment of diabetes and frailty status, allowing to explore their independent and combined effects. Early identification and intervention of frailty may reduce the risk of adverse outcomes regardless of diabetes status. There is important to promote worldwide a comprehensive and individualized management of the older people with diabetes and the screening, diagnosis, and early management of frailty in this population, as well as proper and timely referral for a geriatric assessment.

Likewise, this study has some limitations, data were obtained and analyzed from a cross-sectional study, therefore, causality cannot be established. Also, the prevalence of diabetes and comorbidities were obtained by self-report, therefore, could exist memory bias related to study design, we couldn't know about diabetes severity and specified pharmacological treatment and potential residual confounding couldn't be ruled out despite adjustments. Additionally, anthropometric measurements and information to assess sarcopenia and frailty were obtained from a subsample of the surveyed population. Even so, statistically significant associations were obtained between the variables evaluated.

Finally, we consider it is relevant to promote the development of longitudinal observational studies to explore causal pathways, verify the associations found and based

on the results obtained, there is a necessity to improve education in the identification and early intervention of frailty in older people with diabetes and others chronical conditions at different levels of care in health, to make a timely referral to geriatricians, promoting an individualized and comprehensive assessment, determine real metabolic goals, adjust diabetes management, reduce adverse outcomes, and promote quality of life.

Conclusions

Older people with diabetes and frailty didn't have association with recurrent falls, fear of falling, poor self-rated health, or hospitalization in the last year, but people with frailty independently did with the first three dependent variables. The prevalence of frailty in older adults with diabetes is high, therefore it's imperative to prevent, identify and treat frailty in this population.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12877-025-06077-3.

Supplementary Material 1.

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Authors' contributions
EM-G, LCV-S: To put forward the idea, conceptualization, database creation, statistical analysis, writing. EC-V, MPV-B: Collection of information, organization of results, writing, critical review. AMG, DC-C, CC-G: Conceptualization, writing, critical review, and supervision. LCV-S: Conceptualization, database creation, statistical analysis, writing, critical review and supervision.

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Data availability
The datasets generated and analysed during the current study are available in the Zenodo repository: https://zenodo.org/record/8015041.

Declarations

Ethics approval and consent to participate
The SABE Colombia 2015 survey was endorsed by the Institutional Committee for the Review of Human Ethics of the Faculty of Health of the Universidad del Valle (minutes No 09-014 and O11-015) and the Bioethics Committee of the Universidad de Caldas (code CBCS-021-14). The study protocol was also approved by the ethics committee of the Hospital Universitario San Ignacio and the Pontificia Universidad Javeriana, under number 201845. Informed consent was obtained from all subjects and/or their legal guardian(s), all methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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