Associations between diabesity and all-cause mortality: a prospective analysis of the Chilean National Health Survey 2009-2010

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Abstract

Objective. To investigate whether patients with diabesity (the combination of both conditions) have a higher mortality risk than isolated obesity or type 2 diabetes (T2D), particularly when waist-circumference (WC) is used as a criterion for obesity. **Materials and methods.** This longitudinal study included 4 514 Chilean participants from the Chilean National Health Survey 2009 and 2010. Participants were categorized into four groups based on WC and diagnosis of diabetes: a) normal, b) abdominal obesity-only, c) T2D-only, and d) diabesity. Cox proportional hazard models were performed to

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Asociaciones entre diabesidad y mortalidad por todas las causas: un análisis prospectivo de la Encuesta Nacional de Salud de Chile 2009-2010.
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Resumen

Objetivo. Investigar si los pacientes con diabesidad (la combinación de ambas condiciones) tienen un mayor riesgo de mortalidad que la obesidad aislada o la diabetes tipo 2, especialmente cuando se utiliza la circunferencia de la cintura (CC) como criterio para la obesidad. **Material y métodos.** Este estudio longitudinal incluyó a 4 514 participantes chilenos de la Encuesta Nacional de Salud de Chile 2009 y 2010. Los participantes se categorizaron en cuatro grupos según la CC y el diagnóstico de diabetes: a) normal; b) sólo obesidad abdominal; c) sólo diabetes tipo 2, y d)

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investigate the associations between diabesity and all-cause mortality. Analyses were also replicated using body mass index (BMI) categories. **Results.** After a median follow-up of 10.9 years, 445 (9.9%) participants died. In the fully-adjusted model, compared with participants with normal-conditions, those with diabesity had 1.37 (95%CI: 1.01,1.85) times higher all-cause mortality risk. **Conclusions.** Individuals with diabesity had a higher mortality risk compared to their counterparts. The WC instead of BMI can be a more sensitive predictor of mortality risk in the Chilean population.

Keywords: diabesity; diabetes mellitus; overnutrition; central obesity; mortalities

diabesidad. Se realizaron modelos de riesgos proporcionales de Cox para investigar las asociaciones entre la diabesidad y la mortalidad por todas las causas. También, se replicaron los análisis utilizando categorías de índice de masa corporal (IMC). **Resultados.** Después de un seguimiento mediano de 10.9 años, fallecieron 445 (9.9%) participantes. En el modelo completamente ajustado, en comparación con los participantes con condiciones normales, aquellos con diabesidad tenían 1.37 (IC95%: 1.01,1.85) veces mayor riesgo de mortalidad por todas las causas. Además, esta asociación fue significativa únicamente en el grupo de solo diabetes tipo 2 dentro de las categorías de IMC de la diabesidad (HR: 1.62 [IC95%: 1.07,2.45]), pero no fue significativa para la diabesidad basada en el IMC (HR: 0.98 [IC95%: 0.66,1.45]). **Conclusiones.** Las personas con diabesidad tenían un mayor riesgo de mortalidad en comparación con sus pares. La CC, en lugar del IMC, puede ser un predictor más sensible del riesgo de mortalidad en la población chilena.

Palabras clave: diabesidad; diabetes mellitus; hipernutrición; obesidad central; mortalidad

Both the presence of pre-diabetes and type 2 diabetes (T2D) have massively increased worldwide.[1] By 2030, the global population with diabetes is projected to reach 643 million, with 40 million (6.2%) in South and Central America, which is expected to increase to 49 million by 2045.[2] In parallel, obesity has nearly tripled since 1975[3] and projections estimate a sixfold increase in the number of adults with obesity in 40 years.[4] Moreover, obesity and overweight play an important role in predicting the development of diabetes and other comorbidities such as cardiovascular disease and some types of cancer. A large body of evidence relates obesity and T2D as to be important chronic diseases related to mortality.[5-7] However, the literature is scarce when studying whether having both "diabesity" would yield a higher mortality risk than having each of them alone.

In 1973 by Sims and colleagues, coined the term 'diabesity' to describe the combined adverse health effects of obesity and diabetes, and it is emerging again as a powerful tool for reinforcing prevention and treatments.[8] Over the past two decades, there has been a substantial increase in the number of people diagnosed with diabesity, which results in a burden on healthcare systems and is expected to continue growing for decades to come.[9]

In prior studies, both obesity and diabetes have been identified as significant chronic diseases associated with increased mortality risk.[5-7] However, there is a need for further investigation to determine if the concurrent presence of both conditions, termed "diabesity," results in a heightened risk of mortality compared to each condition independently.

A recent prospective study cohort of Iranian adults found that diabesity phenotypes were not associated with death from cardiovascular disease (CVD) or all-causes, but they did increase the risk of incident CVD.[10] However, a study conducted in older Mexican adults showed that having diabetes, regardless of body mass index (BMI), was associated with an increased mortality risk, whereas being overweight or obese was associated with a reduced mortality risk.[11]

To our knowledge, no evidence from prospective cohort studies in Chile or South America has investi-

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gated the link between diabesity and all-cause mortality. Therefore, this study aimed to investigate the associations between diabesity categories considering waist circumference (WC) as a measurement of central or abdominal adiposity and all-cause mortality in the Chilean population. The secondary aim was to investigate whether these associations differed when considering BMI as a measurement of general adiposity.

Materials and methods

Design

This longitudinal study included participants aged ≥15 years, who underwent baseline assessments during the Chilean National Health Survey 2009-2010 (CNHS 2009-2010). The CNHS 2009-2010 was a large cross-sectional, nationally representative population-based study comprised by 5 293 participants.[12] They were selected through a stratified multistage sampling of non-institutionalized individuals from urban and rural regions of the country. Trained interviewers collected data in two home visits, in which individuals were administered questionnaires (e.g. lifestyles), and measurements were taken, including anthropometric, and physiological measures, as well as biological samples. All clinical measures were conducted by trained nurses. From the original sample size (5 293 participants), and after removing individuals with missing data on the exposure and covariates (n= 779), the final analytical sample was comprised by 4 514 participants (figure 1).

The CNHS 2009-2010 was funded by the Chilean Ministry of Health and led by the Department of Public Health, The *Pontificia Universidad Católica de Chile*. The CNHS 2009-2010 was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Ethics Research Committee of the Faculty of Medicine at the *Pontificia Universidad Católica de Chile*. Written informed consent was obtained from all subjects (≥ 18 years) or from the caregivers of those younger than 18 years. Data are available on the Ministry of Chile webpage.[13]

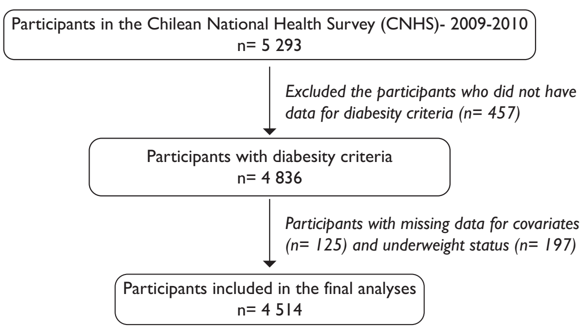


Figure 1. Participants included in the formal analysis. Chile, CNHS 2009-2010

Diabesity

According to World Health Organization (WHO), diabetes was diagnosed by fasting plasma glucose concentration equal to or more than 126 mg/dL (7.0 mmol/L). In addition, participants who self-reported diabetes using the following question: 'Has a doctor, nurse, or another health professional ever told you that you have had or have: diabetes?' were also classified.

Concerning WC, and its application as a diagnostic measure for central obesity, we used the new cut-off points proposed by Petermann-Rocha and colleagues for the Chilean population.[14] They identified that 92.3 cm for men and 87.6 cm for women could be better cut-off points for WC in the definition of metabolic syndrome (using data from CNHS) compared to WHO/IDF recommendations. As reference points, the current ATP-III recommendation for women (88.0 cm) and for men (94.0 cm) for Caucasian or European and other Chilean studies are closer to the Chilean reality.[14-16]

Then, using the diabetes and central obesity classification, four groups were created: a) normal; b) abdominal obesity-only; c) T2D-only, and d) abdominal obesity with T2D (diabesity). As a secondary analysis, BMI was used instead of WC. Thus, BMI was calculated as weight/height^2 and classified using the WHO criteria for adults (normal: 18.5 to 24.9 kg/m^2; overweight: 25.0 to 29.9 kg/m^2; obese: ≥30.0 kg/m^2)[17] and the Pan American Health Organization (PAHO) criteria for older adults (normal: 23.0 to 27.9 kg/m^2; overweight: 28.0 to 31.9 kg/m^2; obese: ≥32.0 kg/m^2).[18] Participants who were underweight were excluded due to the potential for reverse causality (n= 197). The BMI-categories were created: a) normal; b) overweight and obesity; c) T2D-only; d) T2D and overweight, and e) diabesity.

All-cause mortality

The outcome of the current study was all-cause mortality. The date of death was obtained at follow-up from death certificates linked to the Chilean Civil Registry and Identification. Mortality data were available until the 31st of December 2020. Therefore, mortality status was censored on this date or the date of death if this occurred earlier.

Covariates

Sociodemographic data were collected at baseline, and included age, sex, zone of residence (rural or urban), education level (elementary: <8 years [low], secondary: 8-12 years [middle], and higher education: ≥12 years [high]), income level (< 305 US Dollars [low]; 305-560 [middle]; >560 [high], approximately), using nationally validated questionnaires.[12] Baseline health-related data including hypertension, high cholesterol, peripheral artery disease and previous CVD events such as acute myocardial infarction, and stroke, were self-reported using the following question: 'Has a doctor, nurse, or another health professional ever told you that you have had or have: hypertension, high cholesterol, peripheral artery disease or previous CVD events?'. The clinical history or the presence of one of these conditions could potentially mediate the analysis of the relationship between diabesity and all-cause mortality associations. For this reason, we did not include them in the regression models.

Alcohol consumption was self-reported and collected using the 'Alcohol Use Disorders Identification Test' (AUDIT) questionnaire developed by WHO and adopted for the Chilean population.[19] Tobacco status (non-smoker, ex-smoker or smoker) and sleep duration (in hours/day) were self-reported using nationally validated questionnaires. Physical activity levels, including moderate and vigorous intensities and transport-related physical activity, were determined using the Global Physical Activity Questionnaire version 2 (QPAQ v2).[20] Physical activity was categorized into: inactive individuals (<600 MET/min/week) and active individuals (≥600 MET/min/week).[21] Sedentary behaviour was derived using the following question: 'how much time do you usually spend sitting or reclining on a typical day?'.[21] We stratified the lifestyle variables according to their recommendation criteria, which included alcohol consumption (AUDIT score <8 points), tobacco status (never smoking), sleep duration (between 7-9 hours/day of sleep), physical activity ((≥600 MET/min/week), and sitting time (<4 hours/day). These criteria were described elsewhere.[21,22]

Statistical analyses

Descriptive characteristics by diabesity categories are presented as means with standard deviations (SD) for continuous variables and as frequencies and percentages for categorical variables.

Associations between diabesity categories and all-cause mortality were investigated using Cox proportional hazard models. Individuals in the normal category (without high WC and T2D) were used as the referent. The results are reported as hazard ratios (HR) with their 95% confidence intervals (95%CI). Duration of follow-up was used as the time-dependent variable.

Analyses were adjusted for confounders based on previous literature,[23,24] using the following three models: model 1 was adjusted by age; model 2: as per model 1 but additionally for sex, zone of residency, income and educational level; model 3: as per model 2 but additionally for the lifestyle variables (alcohol consumption, tobacco status, sleep duration, physical activity and sitting time). Crude Kaplan-Meier curves were constructed to estimate 11-year survival for categories of diabesity. In addition, sensitivity analyses was conducted in the full adjusted model, using a 2-year landmark that excluded all participants who died within the two first years of follow-up (n= 70).

Finally, we also investigated whether the association between the diabesity categories and all-cause mortality differed by subgroups. We tested for interactions, and all of them were found to be non-significant in the fully adjusted model. Nevertheless, we stratified the analyses based on well-established insights from previous studies,[24,25] considering factors such as age (≥ and < 60 years), sex (men and women), zone of residence (urban and rural) within the context of the diabesity approach, including for WC and BMI-categories (supplementary table I and II, respectively).[26] The significance level was defined as $p< 0.05$. IBM SPSS 29.0 was used for statistical analyses. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cohort studies.

Results

Over a median follow-up of 10.9 years (interquartile range 10.6 to 11.0 years), 445 (9.9%) participants died. Baseline characteristics according to diabesity categories are shown in table I. From the total sample, 41.6% had a normal status, 49.4% abdominal obesity, 1.7% had only T2D and 8.0% had diabesity. The mean age for normal participants was 45.6 (17.8) years, which increased across all diabesity categories, with the highest mean age observed in the diabesity group (60.7 [12.0]).

Participants with diabesity were more likely to live in rural areas, had a low income and low education level. Additionally, they showed lower adherence to healthy lifestyle variables such as physical activity or sitting time. All participants with diabetes, irrespective of their central obesity status, had a higher prevalence of hypertension, hypercholesterolemia and history of previous CVD event than those without diabetes (table I).

Crude Kaplan-Meier survival estimates by diabesity categories are shown in figure 2 and for diabesity BMI-categories are presented in supplementary figure 1.[26] In

Table I

General characteristics of the study population by total and diabesity categories at baseline. Chile, CNHS 2009-2010 (n = 4 514)

	All	*Normal*	*Abdominal obesity-only*	*T2D-only*	*Diabesity*
n (%)	4 514 (100)	1 880 (41.6)	2196 (48.6)	76 (1.7)	362 (8.0)
Age (years) mean (SD)	45.6 (17.8)	37.9 (16.7)	49.4 (16.7)	53.7 (15.2)	60.7 (12.0)
Sex, n (%)					
Women	2 699 (59.8)	1 118 (59.5)	1 322 (60.2)	35 (46.1)	224 (61.9)
Men	1 815 (40.2)	762 (40.5)	874 (39.8)	41 (53.9)	138 (38.1)
Zone of residence n (%)					
Urban	3 854 (85.4)	1 627 (86.5)	1 853 (84.4)	67 (88.2)	307 (84.4)
Rural	660 (14.6)	253 (13.5)	343 (15.6)	9 (11.8)	55 (15.2)
Education level (years), n (%)					
Low < 8	1 145 (25.4)	304 (16.2)	644 (29.3)	18 (23.7)	179 (49.4)
Middle 8-12	2 490 (55.2)	1 107 (58.9)	1 193 (54.3)	44 (57.9)	146 (40.3)
High > 12	874 (19.4)	466 (24.8)	358 (16.3)	14 (18.4)	36 (9.9)
Income level (USD) n (%)					
Low (< 305)	2 391 (53.0)	923 (49.1)	1 207 (55.0)	37 (48.7)	224 (61.9)
Middle (305-560)	1 457 (32.3)	632 (33.6)	701 (31.9)	25 (32.9)	99 (27.3)
High (>560)	494 (10.9)	235 (12.5)	217 (9.9)	11 (14.5)	31 (8.6)
Tobacco status (never smoking) n (%)	1 810 (40.1)	766 (40.7)	842 (38.3)	28 (36.5)	174 (48.1)
Physical activity (active) n (%,)	3 470 (76.9)	1 538 (81.8)	1 637 (74.5)	57 (75.0)	238 (65.7)
Sleep (7-9 h day) n (%)	2 389 (52.9)	1 027 (54.6)	1 142 (52.0)	38 (50.0)	182 (50.1)
Sitting time (<4h/day) n (%)	2 792 (61.9)	1 176 (62.6)	1 370 (62.4)	45 (59.2)	201 (55.5)
AUDIT score (<8 pts) n (%)	4 071 (90.2)	1 664 (88.5)	2 002 (91.2)	66 (86.8)	339 (93.6)
BMI (kg/m^2), mean (SD)	28.1 (5.2)	24.3 (2.6)	30.8 (4.5)	24.4 (2.2)	32.4 (6.0)
Hypertension (yes), n (%)	1 913 (42.4)	451 (24.0)	1 127 (51.3)	38 (50.0)	297 (82.0)
High cholesterol (yes), n (%)	998 (22.1)	259 (13.8)	538 (24.5)	27 (35.5)	174 (48.1)
CVD -AMI, Stroke-, (yes) n (%)	266 (5.9)	52 (2.8)	159 (7.2)	9 (11.8)	46 (12.7)

n: number; SD: standard deviation; USD: United States dollar; AUDIT: Alcohol Use Disorders Identification Test; AMI: acute myocardial infarction; BMI: body mass index; CVD: cardiovascular diseases; T2D: type 2 diabetes; CNHS: Chilean National Health Survey

brief, participants with diabesity had lower survival rates, followed by those in the T2D-only category. Conversely, within the BMI-categories, lower survival rate were higher in participants with T2D-only or T2D overweight, as compared to the rates observed in the diabesity group.

Associations between diabesity categories and all-cause mortality are presented in table II. In model 3, the fully adjusted model, participants with diabesity had 1.37 (95%CI: 1.01,1.85) times higher mortality risk due to any cause compared to those in the normal group. This trend persisted across all models, including 2-year landmark analysis. No significant association were found for the participants in the abdominal obesity only and T2D-only categories.

Associations between diabesity BMI-categories and all-cause mortality are presented in table III. Interesting, participants with T2D-only (HR: 1.50 [95%CI: 1.02,2.21]) or T2D overweight (HR: 1.50 [95%CI: 1.00,2.24]) had higher mortality risk due to any cause compared to those in the normal group (model 2). However, this previously observed associations was attenuated in model 3 but remained significant in 2-year landmark analysis for T2D-only category (HR: 1.62 [95%CI: 1.07,2.45]).

Finally, associations between diabesity BMI-categories and all-cause mortality by subgroups are presented in supplementary tables I and II.[26] Notably, despite the absence of significant interactions, it's worth highlighting that diabesity by WC remained significant only among older participant (HR: 1.60 [95%CI: 1.10,2.34]), whereas diabesity by BMI which showed a non-significant but an inverse trend (HR: 0.80 [95%CI: 0.50,1.26]).

Table II
Associations between diabesity and all-cause mortality in Chilean adults. Chile, CNHS 2009-2010 (n = 4 514)

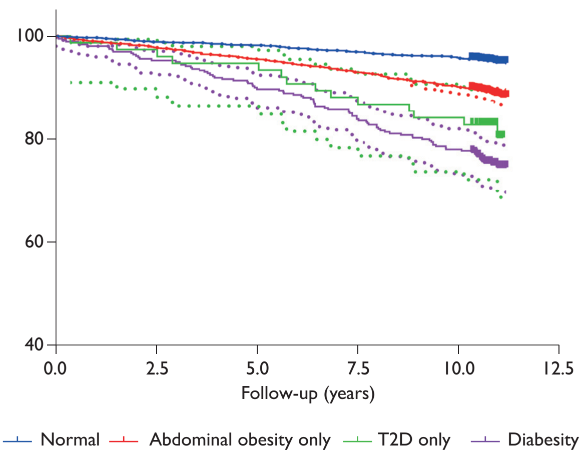
All-cause mortality	Total cases/events	Normal HR (95%CI)	Abdominal obesity-only HR (95%CI)	Abdominal obesity-only p-value	T2D-only HR (95%CI)	T2D-only p-value	Diabesity HR (95%CI)	Diabesity p-value
Model 1	4 514/442	1.00 (Ref.)	1.06 (0.83,1.35)	0.611	1.64 (0.94,2.89)	0.081	1.55 (1.15,2.07)	0.003
Model 2	4 514/442	1.00 (Ref.)	1.08 (0.85,1.38)	0.489	1.61 (0.91,2.83)	0.097	1.56 (1.16,2.10)	0.003
Model 3	4 514/442	1.00 (Ref.)	1.01 (0.79,1.29)	0.902	1.49 (0.84,2.62)	0.167	1.37 (1.01,1.85)	0.038
2-year landmark*	4 444/373	1.00 (Ref.)	1.06 (0.81,1.39)	0.634	1.58 (0.85,2.91)	0.142	1.47 (1.06,2.04)	0.020

CNHS: Chilean National Health Survey; HR: hazard ratio; T2D: type 2 diabetes; Analyses are presented as HR and their 95%CI. Individuals in the normal category were used as the referent. Model 1: was adjusted by age; model 2: as per model 1 but additionally for age, sex, zone of residency, income and educational level; model 3: as per model 2 but additionally for alcohol consumption, tobacco status, sleep duration, physical activity and sitting time. A 2-year landmark was carried out as a sensitivity analysis, excluding people who died during the first 2-year of follow-up. * Using covariates from model 3.

Table III
Associations between diabesity (BMI-categories) and all-cause mortality by subgroups. Chile, CNHS 2009-2010 (n = 4 365)

All-cause mortality	Total cases/ events	Normal HR (95%CI)	Overweight/Obesity HR (95%CI)	Overweight/Obesity p-value	T2D-only HR (95%CI)	T2D-only p-value	T2D overweight HR (95%CI)	T2D overweight p-value	Diabesity HR (95%CI)	Diabesity p-value
n, (%)	4 365/413	1 321 (29.3)	2 635 (58.4)		95 (2.1)		131 (2.9)		193 (4.3)	
Model 1	4 365/413	1.00 (Ref.)	0.85 (0.66,1.10)	0.225	0.91 (0.68,1.21)	0.534	1.55 (1.06,2.27)	0.023	1.52 (1.02,2.26)	0.040
Model 2	4 365/413	1.00 (Ref.)	0.89 (0.71,1.12)	0.349	1.50 (1.02,2.21)	0.0.037	1.50 (1.00,2.24)	0.046	1.23 (0.83,1.81)	0.284
Model 3	4 365/413	1.00 (Ref.)	0.79 (0.63,1.00)	0.053	1.41 (0.96,2.09)	0.077	1.32 (0.88,1.97)	0.176	0.98 (0.66,1.45)	0.941
2-year land-mark*	4 307/355	1.00 (Ref.)	0.89 (0.69,1.15)	0.387	1.62 (1.07,2.45)	0.021	1.50 (0.97,2.32)	0.068	1.03 (0.66,1.58)	0.895

CNHS: Chilean National Health Survey; HR: hazard ratio; T2D: type 2 diabetes; Analyses are presented as HR and their 95%CI. Individuals in the normal category were used as the referent. Model 1: was adjusted by age; model 2: as per model 1 but additionally for age, sex, zone of residency, income and educational level; model 3: as per model 2 but additionally for alcohol consumption, tobacco status, sleep duration, physical activity and sitting time. A 2-year landmark was carried out as a sensitivity analysis, excluding people who died during the first 2-year of follow-up. * Using covariates from model 3.



CHNS: Chilean National Health Survey.

Figure 2. Crude Kaplan-Meier curve to estimates 11-year survival for diabesity categories. Chile, CNHS 2009-2010

Discussion

Our findings suggest that participants with diabesity had a higher mortality risk due to any cause, independently of confounders, as compared with participants with normal status. Although T2D-only showed a positive non-statistically significant trend with all-cause mortality, no significant associations were found. Furthermore, when examining diabesity by BMI-categories, there was a notable difference in risk across the categories compared to WC. Both overweight/obesity and diabesity showed an inverse, non-statistically significant trend with all-cause mortality. In contrast, T2D-only and T2D overweight showed a positive, non-statistically significant trend with all-cause mortality.

In this study, we used WC as a criterion for abdominal obesity to build the diabesity categories instead of the traditional BMI. The latter is associated with the well-known limitations of BMI as a measure of adiposity, including its inability to accurately delineate body fatness and its susceptibility to misclassification, particularly in individuals with higher muscle mass;[27] however, it provides a useful population-level measure of overweight and obesity in both sexes and covers an important range of ages. The use of WC instead of BMI is a better and more adequate measure to assess the association between obesity and mortality.[28] Indeed, a substantial body of evidence highlights the significance of fat distribution. For instance, individuals who develop a "pear" or gynecoid appearance, characterized by a waist much smaller than the hips, could be associated with those having metabolically healthy obesity.[29,30] The BMI and mortality in adults have been related to U-shaped or J-shaped curves.[31,32] It is interesting to mention that in older ages, the increased BMI or higher WC might be protective,[33] a phenomenon known as the obesity paradox. Contrarily, associations between BMI and mortality were stronger at younger ages (26). For example, a systematic review showed that obesity (grades 2 and 3) was associated with higher all-cause mortality, but grade 1 obesity was not, while overweight was associated with lower all-cause mortality (similar trend observed in our results). In fact, recent studies suggest that obesity itself may not be associated with an increased risk of mortality. However, rapid weight changes (e.g. gain) are a risk factor for mortality among patients with T2D.[34,35]

Diabesity and mortality have been widely explored in Europe and USA.[36-39] Yet, evidence from Latin American countries is limited. For instance, in a Mexican health and aging study, participants with diabetes, compared to those without, had an increased mortality risk (Relative Risk Reduction, RRR: 2.28, 95%CI: 1.98,2.63). Conversely, participants with overweight or obesity showed a reduced risk of mortality (RRR: 0.74, 95%CI: 0.65,0.86; RRR: 0.79, 95%CI: 0.66,0.95, respectively) compared to those with a normal BMI. Furthermore, individuals with a normal BMI and diabetes (RRR: 2.01, 95%CI: 1.40,2.87), those who were overweight and had diabetes (RRR: 1.42, 95%CI: 1.02,1.97), or individuals with diabesity (RRR: 1.70, 95%CI: 1.16,2.48) faced an elevated risk of mortality. These results are consistent with other studies that have shown that both diabetes and obesity are associated with an increased risk of all-cause mortality.[25,40] However, the risk is higher when diabetes is present with normal adiposity or severe obesity.[25,40,41]

In order to explore potential explanatory mechanisms and causal associations other types of studies, such as Mendelian Randomization or large randomized controlled trials (RCTs), are needed to enhance our understanding of the association between diabesity and mortality.[27] For instance, one RCT examined the long-term effects of an intensive lifestyle intervention focused on weight loss in individuals with T2D and overweight/obesity. They found no statistically significant differences in all-cause mortality between the intervention and control groups over a median follow-up period of 16.7y. However, the study highlighted that participants who lost ≥10% of their body weight at one year had lower subsequent mortality. Relying solely on weight reduction, glucose management or pharmacologic-therapies as a unique strategy may not be sufficient at present. The weight reduction it could also lead to harmful long-effects (i.e. behavior, adherence, residual risk).[27]

Furthermore, to successfully avert premature deaths in people with a high T2D risk (or diagnosed), we need to maximize the cost-effective impact of health programs, especially in normal weight participants or extreme obesity (non-pharmacological or pharmacological interventions, respectively). Furthermore, according to age-related variation, preventive strategies should target the most influential attributable risk factors (e.g. blood pressure) for mortality at the population level.[24] For instance, several studies support the beneficial effect of exercise modalities[42] and healthy diets (e.g. plant-based diets) on cardiovascular risk factors in diabetes[43,44] and have been associated with a lower T2D risk.[45]

A strength of this study is the use of the CNHS 2009-2010, a nationally representative sample of the Chilean population >15 years, who additionally have follow-up data up to 2022 years. Moreover, including a wide range of variables (e.g. demographic, health, lifestyles) allowed for a comprehensive adjustment of the effects of confounding factors. Moreover, using specific-populations cut-off points is a strong recommendation[46] supported by clinical consensus. However, this study is not exempt from limitations. Firstly, the diagnosis of diabetes was established by combining self-report and fasting plasma glucose concentration, with only one measurement. Secondly, lifestyle exposures such as physical activity were self-reported, which are prone to bias. As with all observational studies, causal conclusions cannot be derived from this study. Finally, even though we accounted for several confounding factors, residual confounding cannot be ruled out.

In conclusion, individuals with diabesity experienced a higher mortality risk as compared to their counterparts. Recognizing the significance of excess adipose tissue in diabetes and risk of mortality, WC proved to be a more sensitivity tool for predicting mortality risk within diabesity categories. Therefore, public, private, and government health policies and strategies should be aligned and focused on preventing diabetes or CVD risk factors, such as high WC, particularly during the early stages of life.

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