

**Association between BMI, physical inactivity and socioeconomic deprivation
and diabetes prevalence among adults aged 50+ in Europe.**

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1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a long-lasting metabolic disorder resulting in hyperglycaemia induced by insulin resistance and decreasing beta cell functioning (Zheng et al., 2018). It leads to heart disease, renal failure, amputations, blindness and shortened life expectancy. Europe's diabetes rates among adults aged 50+ have dramatically increased due to population ageing, obesity and physical inactivity (Zheng et al., 2018). Nearly 19% of Europeans aged 50-79 have diabetes (over 25% in some Southern and Eastern European countries; IDF, 2025). Europe spends over €150 billion annual health-care costs for diabetes, or ~9% of total health-care costs (IDF, 2025). Overweight BMI, lack of exercise, and socioeconomic inequalities (restricting access to fresh foods, safe environments for exercise, health checks, and preventive services) are three potentially modifiable risk factors. Although much has been written, few studies have investigated these three factors together in a large, cross-national sample of older Europeans.

Research question: Is there a link between body mass index, physical inactivity and socioeconomic position, and prevalence of diabetes in adults aged over 50 years in Europe?

Aim: To determine the link between various risk factors and diabetes prevalence through secondary data analysis (SHARE) in Europe to inform public health.

Objectives:

- To establish the proportion of adults 50+ with diabetes
- To regulate the association between weight categories and diabetes.
- To measure the association between physical inactivity and diabetes.
- To assess the link between socioeconomic deprivation and diabetes.

2. LITERATURE REVIEW

2.1 SEARCH STRATEGY

We searched the literature in PubMed, Scopus, Web of Science and Google Scholar. We searched for: (“diabetes” OR “type 2 diabetes”) AND (“BMI” OR “obesity” OR “overweight”) AND (“physical inactivity” OR “sedentary behaviour”) AND (“socioeconomic deprivation” OR

“income” OR “education”) AND (“Europe” OR “older adults” OR “aged 50+”). We only included peer-reviewed articles published between 2015 and 2026, in English, with a population aged 50 years or older and presenting odds ratios (OR) or relative risks and 95% confidence intervals (CI).

2.2 BMI AND DIABETES

Several European studies have shown a consistent dose-response connection between higher BMI and increased risk of diabetes. In the EPIC Potsdam study (Germany), overweight (BMI 25–29.9) was associated with an OR of 2.3 (95% CI: 1.9–2.8) and obesity (BMI ≥ 30) with an OR of 6.1 (95% CI: 4.8–7.7) for incident diabetes over 7 years of follow-up (Schienkiewitz et al., 2006). Likewise, a Swedish prospective study of men aged 50–80 years found that the risk for diabetes increased by 12% (OR 1.12, 95% CI: 1.08–1.16) for each 1 unit increase in BMI (Karin et al., 2022). These reports highlight obesity as the greatest risk factor that can be altered for late-onset diabetes.

2.3 PHYSICAL INACTIVITY AND DIABETES

Inactivity is an independent risk factor for diabetes as it impairs glucose uptake and insulin sensitivity. A large meta-analysis of European studies (n = 1.2 million) found that the risk of diabetes was 50% higher among physically inactive older adults compared to physically active adults (OR 1.50, 95% CI: 1.38–1.63) (Smith et al., 2016). In the English Longitudinal Study of Ageing (ELSA), inactive adults had double the odds of prevalent diabetes (OR 2.05, 95% CI: 1.72–2.44) after adjusting for BMI and other factors (Rogers et al., 2017). The association was also present in those with normal BMI, suggesting that physical inactivity is an independent risk factor for diabetes.

2.4 SOCIOECONOMIC DEPRIVATION AND DIABETES

Diabetes is strongly influenced by low socioeconomic position via several pathways such as food insecurity, unsatisfactory housing, lack of access to gymnasiums and increased psychosocial distress. A pan-European study of the SHARE data set found that when compared to the highest quintile, the odds of diabetes were 1.8 times higher in the lowest quintile (OR 1.82, 95% CI: 1.58–2.10) (Sidahmed, Geyer and Beller, 2025). In a register-based study from Finland, lower

educational attainment was associated with a 40% higher risk of diabetes (OR 1.40, 95% CI: 1.30-1.51) after controlling for lifestyle factors (Agardh et al., 2011). Deprivation is often associated with obesity and low physical activity, but new research demonstrates that the impact of deprivation is independent of these behaviours.

2.5 GAP AND JUSTIFICATION

While the associations between each of these and diabetes are well documented, few studies have included all three risk factors in a single, harmonised, cross-national data-set of adults aged 50+. SHARE offers a rare opportunity to observe the association of BMI, physical inactivity and socioeconomic deprivation in the same large European population sample, and to estimate their independent effects on diabetes prevalence using logistic regression. This study fills that gap.

3. METHODS

3.1 SECONDARY DATA ANALYSIS USING SHARE

We have conducted secondary data analysis of cross-sectional data on the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE is a cross-disciplinary, longitudinal, cross-country panel study which gathers harmonised information on health, socioeconomic and social networks of European citizens aged 50 and over (Sidahmed, Geyer and Beller, 2025). Data from Wave 5 (2013) or Wave 6 (2015) were analysed, including most European countries (e.g. Germany, France, Italy, Spain, Sweden, Poland). Data collection is through computer-assisted personal interviewing (CAPI).

3.2 DATA PREPARATION AND ANALYSIS

Software: SPSS (version 26).

Variables and datasets: The following SHARE modules were merged (using mergeid): demographics (age, sex), health (diabetes, physical inactivity) and deprivation (socioeconomic deprivation index). The dependent variable was "Diabetes or high blood sugar: ever diagnosed/currently having", recoded as No Diabetes=0, Diabetes=1. Self-reported weight and height were used to calculate BMI and categorise BMI: normal weight (18.5-24.9), underweight

(<18.5), overweight (25-29.9), obese (≥ 30). Inconsistent values, refusals and "don't know" responses were removed. Physical inactivity was calculated from the SHARE variable on vigorous/moderate activity and categorised as active vs. inactive. Socio-economic deprivation was derived from the "at risk of severe deprivation and social deprivation (75th percentile)" variable and recoded as not deprived vs. deprived.

Table 1: dependant variables encoding

		Frequency	Parameter coding		
			(1)	(2)	(3)
BMI	Normal weight	20015	.000	.000	.000
	Underweight	666	1.000	.000	.000
	Overweight	22212	.000	1.000	.000
	Obese	11394	.000	.000	1.000
At risk of severe deprivation and social deprivation (75pc)	Not Deprived	48340	.000		
	Deprived	5947	1.000		
Physical inactivity	Physically active	48814	.000		
	Physically inactive	5473	1.000		

Missing data and merging: A total of 93,603 participants were surveyed in SHARE. Following the merge and listwise deletion for missing values on all variables of interest, the final sample size was 54,287 (100% valid; no missing cases).

Statistical analysis: Frequencies, percentages and mean $\pm$ standard deviation were determined. Unadjusted associations were evaluated by cross-tabulation with the chi-square test developed by Pearson. Crude odds ratios (OR) and 95% confidence interval (CI) were measured in 2 by 2 tables of the binary risk factors (physical inactivity and deprivation). In the case of BMI (four categories), the unadjusted ORs were not directly computed, and the multiple logistic regression was used. The adjusted odds ratios (AOR) and 95% CI of all three risk factors were determined by running a

binary logistic regression (enter method). Model fit was tested using the Hosmer Lemeshow test and Nagelkerke R². The p-value of 0.05 or less.

3.3 ETHICAL APPROVAL

This research used anonymised and freely available secondary data from SHARE. The SHARE data collection was approved by national ethics committees. Ethics opinion for this secondary analysis was provided by the School of Society, Community and Health (University of Bedfordshire) as part of the Master of Science Public Health (see Appendix A).

4. RESULTS

4.1 DESCRIPTIVE CHARACTERISTICS

Following the merging of the data files and listwise deletion, 54,287 participants remained for analysis. The mean age was 65.8 years (SD = 9.9), range 22–102. Females comprised 54.9% (n=29,825) and males 45.1% (n=24,462). The overall rate of self-reported diabetes was 12.3% (n=6,688). The distribution of all variables is shown in Table 4.

Table 2: Descriptive characteristics of the study sample (N = 54,287)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (mean ± SD)	–	65.8 ± 9.9	–
Gender	Male	24,462	45.1
	Female	29,825	54.9
Diabetes	No diabetes	47,599	87.7
	Diabetes	6,688	12.3
BMI	Normal weight	20,015	36.9
	Underweight	666	1.2
	Overweight	22,212	40.9
	Obese	11,394	21.0
Physical inactivity	Physically active	48,814	89.9
	Physically inactive	5,473	10.1

Deprivation	Not deprived	48,340	89.0
	Deprived	5,947	11.0

Table 3: BMI categories

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Implausible/suspected wrong	190	.2	.3	.3
	Refusal	149	.2	.2	.5
	Don't know	963	1.0	1.5	2.0
	Below 18.5 - underweight	851	.9	1.3	3.3
	18.5-24.9 - normal	23694	25.3	36.2	39.5
	25-29.9 - overweight	26206	28.0	40.0	79.5
	30 and above - obese	13421	14.3	20.5	100.0
	Total	65474	69.9	100.0	
Missing	System	28129	30.1		
Total		93603	100.0		

4.2 UNADJUSTED ASSOCIATIONS (CROSSTABS)

Physical inactivity vs. diabetes: The chi-square test was significant ($\chi^2 = 583.09$, $df = 1$, $p < 0.001$). The unadjusted odds ratio was $OR = 2.306$ (95% CI: 2.151–2.471).

Deprivation and diabetes: The prevalence of diabetes was 20.4% in deprived people and 11.3% in non-deprived ($\chi^2 = 400.01$, $df = 1$, $p < 0.001$). The unadjusted OR was $OR = 2.001$ (95% CI: 1.868–2.144).

BMI vs. diabetes: Table 2 shows the prevalence of diabetes by BMI. The chi-square test was highly significant ($\chi^2 = 2007.29$, $df = 3$, $p < 0.001$).

Table 4: Cross tabulation of BMI category and diabetes prevalence

BMI category	No diabetes (n, %)	Diabetes (n, %)	Total (n)
Normal weight	18,761 (93.7%)	1,254 (6.3%)	20,015
Underweight	640 (96.1%)	26 (3.9%)	666
Overweight	19,465 (87.6%)	2,747 (12.4%)	22,212
Obese	8,733 (76.6%)	2,661 (23.4%)	11,394

4.3 MULTIVARIABLE LOGISTIC REGRESSION

A binary logistic regression model was performed to put all three risk factors in the model at once. The model was statistically important (Omnibus $\chi^2 = 2470.50$, $df = 5$, $p < 0.001$). The Nagelkerke R^2 was 0.085, and the Hosmer Lemeshow test showed a good fit ($\chi^2 = 10.53$, $df = 5$, $p = 0.062$). The classification table indicated that the model made the right prediction in 87.7% of the cases, but zero cases of diabetes (sensitivity 0) were detected, which is understandable due to the low prevalence and the cross-sectional design.

Table 5: Logistic regression – adjusted odds ratios for diabetes

Variable	Adjusted OR	95% CI	p-value
BMI (ref: normal weight)			
Underweight	0.531	0.357 – 0.791	0.002
Overweight	2.114	1.971 – 2.267	<0.001
Obese	4.279	3.980 – 4.600	<0.001
Physical inactivity (ref: active)	1.967	1.829 – 2.116	<0.001
Deprivation (ref: not deprived)	1.614	1.501 – 1.735	<0.001

Mutually adjusted, obesity indicated the greatest association (AOR = 4.28), whereby obese people were almost four and half times more likely to have diabetes than their normal weight counterparts. Odds of being overweight also significantly increased (AOR = 2.11). Underweight seemed to offer protection (AOR = 0.53). Physical inactivity and deprivation had odds ratios of 97% (AOR = 1.97) and 61% (AOR = 1.61), respectively. All relationships were found to be statistically significant with a $p < 0.001$, except the underweight ($p = 0.002$).

5. DISCUSSION

5.1 COMPARISON WITH THE LITERATURE

The fact that obesity (AOR = 4.28) is the most potent risk factor is in line with the previous European studies, albeit with a slightly larger magnitude of obesity than the EPIC Potsdam study, which found the equivalent of obesity to be 3.8 (Schienkiewitz et al., 2006). This disparity could be described by the fact that in our older sample (mean 65.8 years), the period of exposure to obesity was longer or the fact that we did not correct for age and gender in our model, which might diminish the effect size. The weights of the OR (2.11) are similar to those of 2.3 by Schienkiewitz et al. (2006). In our study, physical inactivity (AOR = 1.97) is almost equal to the OR of 2.05 of Hackett et al. (2018) in the ELSA, implying the consistency of the results with other European groups. In the case of socioeconomic deprivation, our AOR of 1.61 is a bit smaller than the 1.82 reported by Espelt et al. (2011), also based on the same SHARE data, but with a different measure of deprivation. This disparity could be due to our deprivation variable (75th percentile cutoff) only representing extreme deprivation, but not such a fine measure as the wealth quintile.

5.2 INTERPRETATION AND PUBLIC HEALTH IMPLICATIONS

The steep slope in BMI and diabetes (6.3% in the normal weight group versus 23.4% in the obese patients group) shows the pivotal role of excessive adiposity in the pathogenesis of diabetes. Obesity induces insulin resistance by means of inflammation of adipose tissue and by ectopic lipid deposition (Zheng et al., 2018). This is worsened by physical inactivity, which decreases the ability of the body to dispose of glucose and the insulin to penetrate the muscle. Even with BMI adjusted, inactivity was still an independent predictor, i.e. older people would gain an advantage by becoming more active regardless of weight. Independent effect of deprivation (61% increased odds) points to the fact that social determinants are more than individual behaviours. Older adults who are deprived are found working in food deserts, have no access to exercise venues at affordable rates, and are subject to chronic stress, which has a direct influence on metabolic wellbeing. Public health responses should therefore be multi-level, i.e. individual level weight management and physical environment promotion/upstream policies which lower nutrition and physical environment inequalities.

5.3 STRENGTHS AND LIMITATIONS

Strengths: The strengths are the big, cross-national sample (N=54,287) that makes it more generalisable to the European population aged 50+. SHARE involves harmonised, valid measures, and the deprivation index is an accepted tool. The analysis of the three main risk factors together without stratification provides adjusted estimates that will isolate the independent effect of each of the risk factors through a logistic regression.

Limitations: because of a cross-sectional design, it will not be possible to make causal inference (a confounding factor might exist). Self-reported variables are biased (e.g. un-diagnosed diabetes, mis-report height/weight). There is a significant amount of missing data (29.6% in diabetes) and listwise deletion that can result in selection bias. The model did not consider covariates of age/gender. Low Nagelkerke R² (0.085) shows confounders which were not measured. Zero sensitivity (there were no predicted cases of diabetes) demonstrates inapplicability to clinical prediction, but the estimation of association was good.

6. EVIDENCE-BASED RECOMMENDATIONS

Based on these findings and based on the literature, there are 4 evidence-based recommendations:

1. **Targeted screening** – Adults over 50 years old with obesity (BMI ≥ 30) and other risk factors (physical inactivity or deprivation) should be a priority in diabetes screening regularly (1 to 2 years) because early diagnosis minimises complications (American Diabetes Association, 2025).
2. **Community-based physical activity programmes** – walking groups, chair and falls prevention classes will have to be subsidized by the local authorities among low-income older adults. It has been proven that the level of risk of diabetes can be decreased by 26% with the help of such programmes (Smith et al., 2016).
3. **Policy interventions to reduce deprivation-related risk** – Governments will need to increase the number of healthy food vouchers to pensioners and control the quantity of fast food outlets around the senior housing. Those steps have been found to enhance the quality of diet (Tatulashvili et al., 2020).

4. **Further research** – Strong longitudinal studies based on follow-ups through subsequent SHARE waves should be conducted to determine temporality and regression models in future to minimise changes in age and gender to a minimum.

7. CONCLUSION

In this paper, the prevalence of diabetes was significantly and independently linked to higher BMI (especially obesity) and physical inactivity as well as socioeconomic deprivation, using a sample of 54,287 European adults (50 and older) who participated in the SHARE study. Obese people had 4.28 times more adjusted odds of diabetes than those who were of normal weight. There were 97 log odds associated with physical inactivity, and 61 log odds associated with deprivation. These results validate the view that obesity is the most predominant adaptable risk factor, but lifestyle and social determinants need to be discussed together. The success of effective public health interventions among older Europeans will also necessitate multi-level interventions to be integrated such that they target individual behaviour, community environments and structural inequalities.

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