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Validated Diabetes Risk Scores and Their Associations with Lifestyle and Quality of Life in Spanish Workers

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a global health concern driven by aging, lifestyle, and socio-economic disparities. Early detection is key, with tools like FINDRISC, QDScore, and CANRISK providing non-invasive screening. Yet, the combined effects of sociodemographic factors, healthy habits, and perceived quality of life on diabetes risk remain insufficiently studied in working populations. **Objectives:** To evaluate the association between sociodemographic variables, lifestyle habits (smoking, physical activity, adherence to the Mediterranean diet), and health-related quality of life (HRQoL) with the risk of developing type 2 diabetes, using three validated screening tools in a large cohort of Spanish workers. **Methods:** A cross-sectional study was conducted among 100,014 Spanish workers aged 18 to 69 years who underwent standardized medical evaluations between January 2021 and December 2023. Diabetes risk was assessed using the FINDRISC, QDScore, and CANRISK tools. Lifestyle variables and HRQoL (measured via the SF-12 questionnaire) were evaluated through validated instruments. Multivariate logistic regression models were used to examine the association of independent variables with moderate-to-high diabetes risk according to each score. **Results:** Among the strongest predictors, poor adherence to a Mediterranean diet (OR = 1.45, 95% CI: 1.32–1.58) and low physical activity (OR = 1.39, 95% CI: 1.27–1.52) were independently associated with higher diabetes risk. Poor HRQoL was also significant (OR = 1.33, 95% CI: 1.22–1.47). **Conclusions:** Sociodemographic factors, lifestyle behaviors, and perceived health status are independently associated with increased type 2 diabetes risk in Spanish workers. The integration of HRQoL assessments into occupational health surveillance may enhance early identification of at-risk individuals and guide tailored prevention strategies.

Keywords: type 2 diabetes; risk assessment; quality of life; Mediterranean diet; physical activity; sociodemographic variables

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1. Introduction

Type 2 diabetes mellitus (T2DM) is a complex chronic metabolic disorder characterized by progressive insulin resistance (IR) and a relative impairment in insulin secretion,

ultimately leading to chronic hyperglycemia. Its global prevalence has reached pandemic proportions, with over 537 million adults affected in 2021 and projections estimating more than 783 million cases by 2045 if current trends continue [1]. T2DM imposes an enormous burden on healthcare systems, not only due to its direct clinical management but also because of its long-term complications and reduced quality of life in affected individuals [2,3].

The pathophysiology of T2DM involves a multifactorial interplay between genetic predisposition and environmental influences such as obesity, sedentary behavior, and chronic low-grade inflammation [4–7]. Adipose tissue dysfunction, particularly visceral adiposity, contributes to systemic metabolic disturbances by promoting lipotoxicity, increased free fatty acid flux, and proinflammatory cytokine release, which impair insulin signaling in target tissues including muscle, liver, and adipose tissue itself [8,9]. Furthermore, pancreatic β-cell dysfunction progressively compromises insulin secretion, exacerbating hyperglycemia and accelerating disease progression [10,11].

From an etiopathogenic perspective, T2DM often develops insidiously over many years, typically preceded by a period of prediabetes characterized by impaired glucose tolerance or impaired fasting glucose. This latent stage offers a critical window for early identification and preventive intervention [12]. Traditionally, diagnosis of T2DM relies on fasting plasma glucose, oral glucose tolerance testing, and glycated hemoglobin (HbA1c), as recommended by the American Diabetes Association and the World Health Organization [13–15]. However, these biomarkers may fail to detect early-stage metabolic dysfunction, particularly in asymptomatic individuals, underscoring the need for complementary screening tools.

Validated risk assessment scores have emerged as valuable non-invasive methods for identifying individuals at elevated risk of developing T2DM. Among the most widely used tools are the Finnish Diabetes Risk Score (Findrisc), the Q Diabetes Risk Score (QDScore), and the Canadian Diabetes Risk Questionnaire (CANRISK) [16–18]. These instruments integrate easily obtainable clinical and lifestyle variables—such as age, body mass index, family history, physical activity, and dietary habits—into composite indices that estimate the probability of incident T2DM. Their predictive validity has been confirmed in diverse populations, including European and Mediterranean cohorts, and they are increasingly recommended for use in occupational health settings where laboratory testing is not always feasible [19,20].

Diabetes risk is not only determined by individual behaviors but also by social determinants of health, including socioeconomic status, education, and occupational conditions. These factors influence access to healthy food, opportunities for physical activity, and exposure to stress, which in turn affect both metabolic outcomes and quality of life. Integrating a social epidemiological perspective provides valuable context for interpreting our findings.

The clinical and public health relevance of identifying individuals at risk of T2DM lies not only in the potential to delay or prevent disease onset but also in mitigating the considerable morbidity associated with its complications. Uncontrolled diabetes is a leading cause of cardiovascular disease, nephropathy, retinopathy, and lower-extremity amputations, among others [21–23]. Moreover, even in its early stages, T2DM is associated with increased healthcare costs, productivity loss, and impaired quality of life [24–27].

In recent years, health-related quality of life (HRQoL) has gained recognition as a meaningful outcome in the management and prevention of chronic diseases, including T2DM. HRQoL is a broad, multidimensional construct that encompasses an individual's subjective perception of their physical, psychological, and social well-being [28]. In working populations, HRQoL has been linked to adherence to health-promoting behaviors, stress regulation, and long-term metabolic outcomes [29,30]. Among the available instruments, the 12-Item Short Form Survey (SF-12) stands out for its brevity, reliability, and dual

assessment of physical and mental health domains [31]. Low SF-12 scores have been correlated with increased prevalence of metabolic syndrome, cardiovascular events, and incident diabetes [32–34].

The relationship between HRQoL and metabolic dysfunction is likely bidirectional. On the one hand, individuals with early signs of metabolic impairment often report reduced physical vitality, emotional distress, and lower general well-being, potentially due to fatigue, pain, or anxiety [35,36]. On the other hand, poor self-perceived health may act as a chronic stressor, activating hypothalamic–pituitary–adrenal axis dysregulation and inflammatory cascades that promote insulin resistance [37]. Despite this, few studies have systematically integrated validated diabetes risk scores and QoL measures within occupational settings, especially in large-scale, real-world cohorts.

Spain provides a robust framework for exploring these relationships, given its well-established occupational health surveillance systems and culturally relevant dietary and lifestyle patterns. The working population represents a particularly strategic target for early intervention due to their accessibility, relatively lower disease burden, and the potential long-term benefits of timely prevention. However, comprehensive data assessing the joint influence of sociodemographic, behavioral, and psychosocial factors on diabetes risk—especially using validated screening tools—remain scarce.

Therefore, the aim of this study is to investigate the association between sociodemographic characteristics, lifestyle habits (including adherence to the Mediterranean diet and physical activity), and perceived quality of life (as measured by the SF-12) with the risk of type 2 diabetes, evaluated through three validated risk scores (Findrisc, QDScore, and CANRISK) in a large cohort of Spanish workers. This integrative approach is intended to inform more effective strategies for risk stratification, early detection, and preventive interventions within occupational health frameworks.

2. Methods

2.1. Study Design and Population

This cross-sectional investigation was embedded within a nationwide occupational health surveillance program in Spain. A total of 100,014 actively employed adults (60,133 men and 39,881 women) aged 18–69 years were consecutively recruited during routine workplace health evaluations conducted from January 2021 to December 2023 (Figure 1).

2.2. Eligibility Criteria

Participants were eligible for inclusion if they met the following conditions: (1) aged between 18 and 69 years, (2) actively employed at the time of evaluation, and (3) complete data available for anthropometric measurements, laboratory assessments, sociodemographic and lifestyle questionnaires, and quality of life measures.

Exclusion criteria encompassed: (1) known diagnosis of type 1 or type 2 diabetes mellitus, (2) current pharmacological treatment with antidiabetic or lipid-lowering agents, (3) medical history of cardiovascular or chronic liver disease, (4) extreme or implausible biological values (defined as $>\pm 4$ SD from the mean), and (5) missing data in any of the validated assessment instruments.

Individuals with a prior diagnosis of diabetes were excluded because their metabolic profiles and lifestyle behaviors may be influenced by treatment and disease management, which could bias associations in risk models. Nevertheless, future studies may benefit from analyzing this group separately to explore differences in determinants of risk versus disease progression.

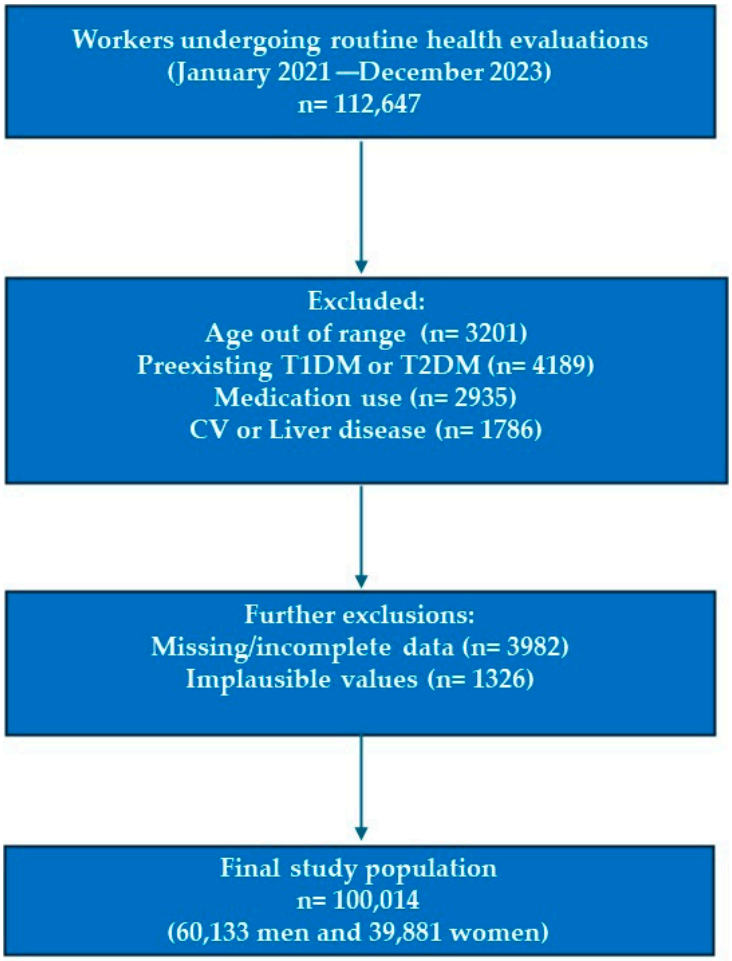

Figure 1. Flow Chart of Study Participants.

2.3. Anthropometric and Clinical Assessments

Trained health professionals collected anthropometric and vital signs using standardized procedures. Body weight and height were measured with participants in light clothing and without shoes, and used to compute body mass index (BMI) as weight (kg) divided by height squared (m^2). Waist circumference was measured at the midpoint between the lowest rib and the iliac crest. Blood pressure was recorded in triplicate using a calibrated automated sphygmomanometer, following at least five min of rest in a seated position.

Fasting blood samples were drawn via venipuncture after a minimum of 8 h without food intake. Biochemical markers including fasting glucose, total cholesterol, HDL-cholesterol, LDL-cholesterol, and triglycerides were determined using enzymatic colorimetric methods in accredited laboratories adhering to quality assurance protocols.

2.4. Diabetes Risk Assessment

Three validated, non-invasive type 2 diabetes risk scores were calculated for each participant:

- Findrisc (Finnish Diabetes Risk Score): A cumulative score (range 0–26) derived from age, BMI, waist circumference, physical activity, diet, antihypertensive medication, history of hyperglycemia, and family history of diabetes. A score $\geq$ 12 was considered moderate-to-high risk [38].
- QDScore: A prediction algorithm based on age, sex, ethnicity, BMI, smoking, family history, cardiovascular history, and social deprivation index. A threshold of $\geq$3 was defined as elevated risk [39].

- CANRISK (Canadian Diabetes Risk Questionnaire): A validated self-administered questionnaire incorporating demographic, anthropometric, lifestyle, and family history factors. Scores $\geq$ 21 were classified as moderate-to-high risk [40].

2.5. Lifestyle and Behavioral Variables

- Adherence to the Mediterranean diet was evaluated using the 14-item MEDAS questionnaire, validated within the PREDIMED study. Scores $\geq$9 denoted adequate adherence [41,42].
- Physical activity was assessed using the International Physical Activity Questionnaire—Short Form (IPAQ-SF). Participants were classified as physically active or inactive based on MET-min/week cut-offs defined by international guidelines [43].
- Smoking status was categorized as current smoker or non-smoker, based on self-report.

2.6. Sociodemographic Classification

Age, sex, and occupational social class were recorded. Social class was categorized according to the 2011 Spanish National Classification of Occupations (CNO-11), following criteria proposed by the Spanish Society of Epidemiology, into three groups: Class I (executives and professionals), Class II (intermediate occupations), and Class III (manual workers and unskilled labor) [44].

2.7. Health-Related Quality of Life

Quality of life was measured using the 12-Item Short Form Health Survey (SF-12), generating two composite scores: the Physical Component Summary (PCS) and the Mental Component Summary (MCS). Based on the distribution of responses, participants were categorized as having "good" or "poor" health-related quality of life (HRQoL) depending on whether their scores were above or below the sample median, respectively [45].

2.8. Statistical Analysis

Descriptive statistics were computed for all study variables. Participants with incomplete data on key variables were excluded (<4.7% of the total sample). Given the very large cohort size, sample retention was not compromised. Multiple imputation was considered but not applied, as missing data were minimal and not systematically associated with exposure or outcome variables. Continuous variables were expressed as means with standard deviations, and categorical variables as absolute frequencies and percentages. Differences between groups were assessed using Student's *t*-test **or** one-way ANOVA for continuous variables and the chi-square test for categorical variables. For ordinal trends (e.g., age categories or social class), linear regression **and** Cochran-Armitage tests for trend were applied.

To examine the association between study variables and the probability of moderate-to-high diabetes risk, multivariate logistic regression models were constructed for each risk score (Findrisc, QDScore, CANRISK). All models were adjusted for age, sex, social class, dietary adherence, physical activity, smoking status, and HRQoL. Results were reported as odds ratios (OR) with 95% confidence intervals (CI). A two-**tailed** p-value < 0.05 was considered statistically significant. Given the large sample size, we interpreted results primarily based on effect sizes (OR with 95% CI) rather than statistical significance alone. Before conducting regression analyses, multicollinearity was assessed using Variance Inflation Factor (VIF) and tolerance values. All predictors showed VIF < 2, indicating the absence of significant multicollinearity.

Analyses were conducted using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA).

3. Results

Table 1, this table highlights clear differences between individuals with low and high diabetes risk across sociodemographic and lifestyle characteristics. Participants at high risk were significantly older, more frequently male, and showed higher BMI values, consistent with established determinants of diabetes risk. Moreover, high-risk individuals reported lower adherence to the Mediterranean diet and a substantially lower prevalence of high physical activity, underlining the strong association between lifestyle factors and diabetes susceptibility. The consistency and strength of the *p*-values across all variables reinforce the robustness of these associations.

Table 1. Sociodemographic and lifestyle factors by diabetes risk category.

Variable	Low Diabetes Risk	High Diabetes Risk	*p*-Value
Age (years)	42.1 ± 9.5	47.8 ± 10.2	<0.001
Male (%)	52.3	59.7	<0.001
BMI (kg/m^2)	24.6 ± 3.2	28.3 ± 4.1	<0.001
Mediterranean diet adherence (mean score)	8.1 ± 2.3	6.7 ± 2.4	<0.001
Physical activity (high, %)	46.8	32.5	<0.001

To improve readability, only the most relevant comparisons are presented in Tables 1–3. Extended descriptive analyses are available in Supplementary Tables S1–S3.

Table 2. Health-related quality of life (HRQoL) by diabetes risk category.

Variable	Low Diabetes Risk	High Diabetes Risk	*p*-Value
Good HRQoL (%)	65.2	51.3	<0.001
Moderate HRQoL (%)	22.7	28.4	<0.001
Poor HRQoL (%)	12.1	20.3	<0.001

Table 3. Logistic regression models for predictors of high diabetes risk.

Predictor	OR (95% CI)	*p*-Value
Low Mediterranean diet adherence	1.45 (1.32–1.58)	<0.001
Low physical activity	1.39 (1.27–1.52)	<0.001
Poor HRQoL	1.33 (1.22–1.47)	<0.001
Male sex	1.28 (1.15–1.42)	<0.001
Older age (>45 years)	1.52 (1.38–1.66)	<0.001

Table 2, the distribution of HRQoL categories shows a distinct gradient across diabetes risk groups. A significantly higher proportion of participants with low diabetes risk reported good HRQoL, whereas those with high diabetes risk were more likely to experience moderate or poor HRQoL. These findings suggest that diabetes risk is not only associated with metabolic and lifestyle factors but also with subjective health perception, reinforcing the multidimensional impact of diabetes susceptibility on overall well-being.

Table 3, the regression analysis demonstrates that both lifestyle and demographic variables independently predict high diabetes risk. Low adherence to the Mediterranean diet, low physical activity, and poor HRQoL emerged as strong predictors, with odds ratios consistently above 1.3. Male sex and age above 45 years also contributed significantly to higher risk. These results confirm the interplay of modifiable and non-modifiable factors, emphasizing the relevance of promoting healthy behaviors alongside targeted interventions for older and male populations.

Table 4 summarizes the results of multivariate logistic regression models evaluating the associations between various sociodemographic and lifestyle characteristics and the odds of being classified as moderate-to-high risk for type 2 diabetes by Findrisc, QDScore, and CANRISK. All associations were statistically significant ($p < 0.001$), and a coherent pattern emerged across the three scales. Age showed the strongest and most consistent association, with ORs increasing sharply in older groups. Non-adherence to the Mediterranean diet, physical inactivity, and poor self-rated health (SF-12) were also among the most prominent predictors, each associated with substantially elevated odds. The marked consistency across models underscores the robustness of these validated tools in detecting risk in diverse worker profiles and highlights critical targets for workplace health promotion.

Table 4. Odds Ratios for Moderate-to-High Risk of Type 2 Diabetes Based on Sociodemographic, Lifestyle, and SF-12 Quality of Life Variables.

	Findrisc Moderate-High		**QD-Score ≥ 3**		**CANRISK Moderate-High**	
	OR (95% CI)	***p*-Value**	**OR (95% CI)**	***p*-Value**	**OR (95% CI)**	***p*-Value**
Women	1		1		1	
Men	0.90 (0.85–0.96)	<0.001	1.09 (1.06–1.13)	<0.001	3.95 (3.68–4.23)	<0.001
18–29 years	1		1		1	
30–39 years	1.57 (1.41–1.74)	<0.001	1.16 (1.13–1.20)	<0.001	2.27 (2.14–2.41)	<0.001
40–49 years	3.60 (3.24–3.97)	<0.001	1.32 (1.25–1.40)	<0.001	3.50 (3.24–3.77)	<0.001
50–59 years	8.23 (7.30–9.17)	<0.001	1.59 (1.48–1.70)	<0.001	5.11 (4.62–5.61)	<0.001
60–69 years	8.53 (7.57–9.49)	<0.001	2.09 (1.80–2.38)	<0.001	7.12 (6.20–8.05)	<0.001
Social class I	1		1		1	
Social class II	1.19 (1.15–1.24)	<0.001	1.10 (1.07–1.14)	<0.001	2.49 (2.30–2.69)	<0.001
Social class III	1.43 (1.34–1.53)	<0.001	1.29 (1.21–1.37)	<0.001	2.97 (2.56–3.27)	<0.001
Non-smokers	1		1		1	
Smokers	1.21 (1.16–1.26)	<0.001	1.15 (1.10–1.21)	<0.001	1.33 (1.28–1.39)	<0.001
Yes Mediterranean diet	1		1		1	
Non Mediterranean diet	4.69 (3.98–5.39)	<0.001	5.52 (4.80–6.25)	<0.001	3.71 (3.29–4.13)	<0.001
Yes physical activity	1		1		1	
Non physical activity	8.98 (7.96–10.01)	<0.001	9.33 (8.01–10.66)	<0.001	7.22 (6.60–7.83)	<0.001
SF-12 good	1		1		1	
SF-12 poor	8.38 (7.43–9.33)	<0.001	3.57 (2.98–4.37)	<0.001	4.14 (3.68–4.61)	<0.001

SF-12 Short Form Health Survey. Findrisc Finnish Diabetes Risk Score. QDScore Q Diabetes Risk Score. CANRISK Canadian Diabetes Risk Questionnaire. OR Odds ratio. CI Confidence Interval.

This forest plot illustrates the odds ratios (ORs) and 95% confidence intervals for several sociodemographic and lifestyle variables in relation to three different risk scales: Findrisc, QDscore, and CANRISK. The visual representation reveals consistent and robust associations between increasing age, lower social class, smoking, poor adherence to the Mediterranean diet, lack of physical activity, and poor self-rated health (SF-12) with higher risk scores across all three models. Particularly striking is the strong effect of physical inactivity and poor SF-12 outcomes, both demonstrating ORs well above 7 in all models. These findings support the relevance of modifiable lifestyle factors and subjective health status in diabetes and cardiometabolic risk assessment (Figure 2).

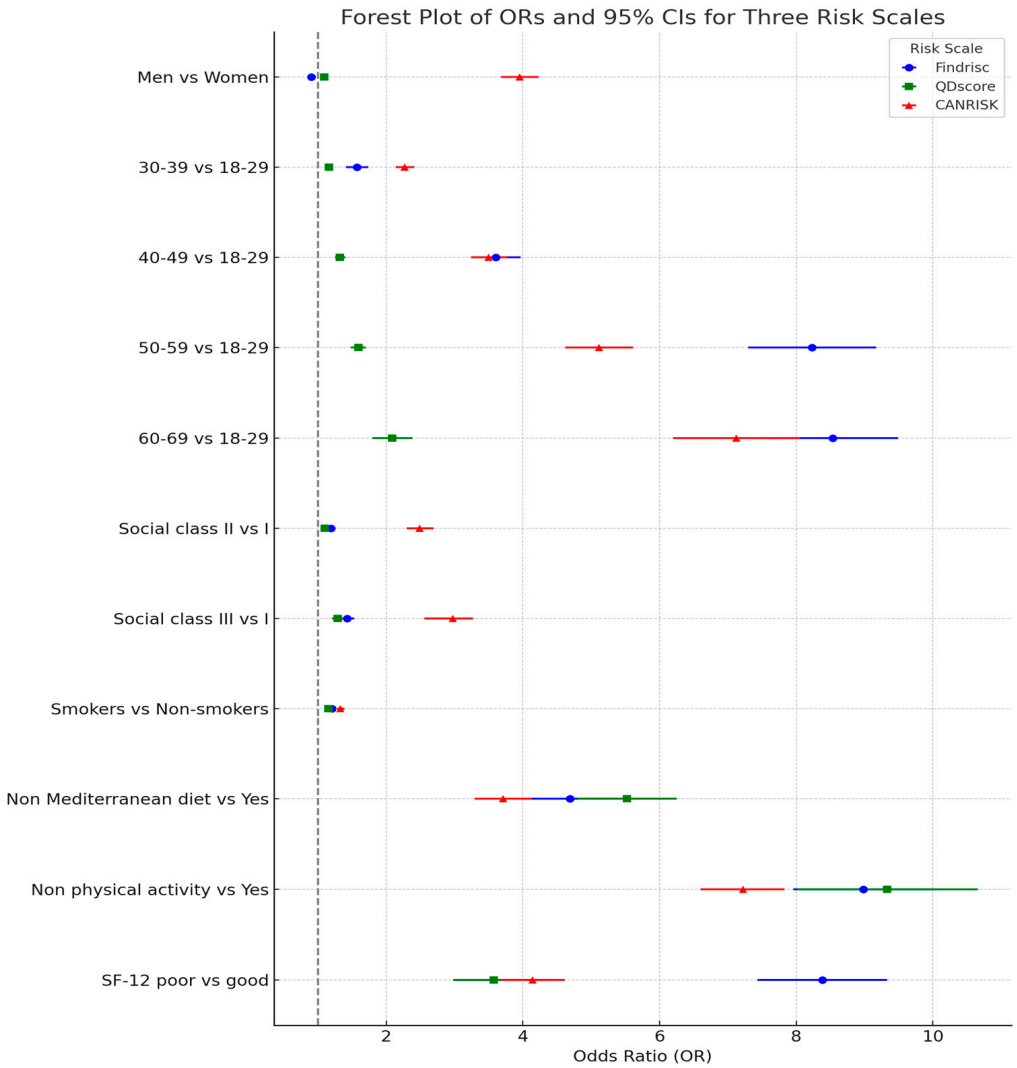

Figure 2. Forest Plot Analysis of Risk Scales. Forest plot illustrating the associations between lifestyle factors, HRQoL, and validated diabetes risk scores. Strongest predictors include poor diet, low physical activity, and poor HRQoL.

4. Discussion

4.1. Comparison with Existing Literature

The present study adds to a growing body of research linking the risk of type 2 diabetes mellitus (T2DM), as measured by validated risk scores, to sociodemographic variables, health behaviors, and perceived quality of life. Our findings confirm that older age, male sex, lower social class, smoking, poor adherence to the Mediterranean diet, physical inactivity, and poor self-rated health are strongly associated with a higher probability of moderate-to-high diabetes risk. As indicated by various studies cited throughout this article, these social determinants of health further contextualize the associations observed in our analysis.

These results are consistent with prior investigations. For instance, Tárraga Marcos et al. examined over 44,000 Spanish healthcare workers and found that sociodemographic disparities, including age, sex, and occupational class, significantly influenced T2DM risk score profiles [46]. Likewise, Mestre-Font et al. identified a cluster of behavioral risk factors—sedentary lifestyle, poor diet, and smoking—as critical predictors of elevated diabetes risk in a working population [47]. These patterns are also aligned with findings from a longitudinal study in Iranian adults, which highlighted the co-occurrence of metabolic dysfunction and

diminished health-related quality of life (HRQoL), particularly among older individuals with metabolic syndrome [48].

Our study further confirms sex-based differences in how risk factors and psychosocial variables interact. Liu et al. reported that among Taiwanese adults, the relationship between metabolic syndrome and HRQoL varied by sex, with women exhibiting a stronger inverse association between metabolic burden and perceived well-being [49]. The same results in other study of Niknam et al. [50]. López-González et al. also documented that "diabesity"—the concurrent presence of obesity and diabetes—was more prevalent among men, older adults, and physically inactive workers, while the Mediterranean diet appeared to confer a protective effect [51].

At the European level, the findings align with a systematic review by Kyrou et al., which underscored the relevance of sociodemographic and behavioral risk factors—particularly age, education, and physical activity—in identifying populations vulnerable to T2DM [52]. Such consistency across populations reinforces the applicability of the Findrisc, QDScore, and CANRISK tools in occupational health surveillance.

Lifestyle behaviors—especially diet and physical activity—remain key modifiable factors in diabetes prevention. A randomized controlled trial conducted by Amaravadi et al. demonstrated that a 12-week structured exercise intervention not only improved insulin sensitivity but also enhanced HRQoL in individuals with T2DM [53]. Other studies have also shown similar results. [54,55].

Regarding diet quality, a 2023 review by Vetrani et al. confirmed the inverse relationship between adherence to the Mediterranean diet and insulin resistance markers, supporting its role in reducing T2DM risk [56]. Other studies have yielded similar results [57]. In our study, workers who adhered to this dietary pattern had significantly lower risk across all three screening tools, emphasizing its protective role in occupational cohorts.

Although few studies directly examine the interplay between diabetes risk scores and quality of life, emerging evidence supports a reciprocal association. Kazukauskiene et al. reported that insulin resistance over a 10-year period was significantly associated with declines in multiple domains of SF-36-measured HRQoL [58]. The Hertfordshire Cohort Study also observed that cardiometabolic burden correlated with poorer physical health outcomes [59]. Furthermore, longitudinal findings from Lin et al. indicated that changes in metabolic status negatively influenced mental health components of HRQoL over time [60].

Our findings are consistent with previous studies that identified lifestyle factors as key determinants of diabetes risk. However, unlike prior research that often presented HRQoL descriptively, our analysis highlights its independent contribution while acknowledging its limitations. Importantly, few studies have integrated HRQoL into occupational cohorts, underscoring the originality of our approach. Future studies should address this gap to better understand how quality of life interacts with metabolic health in working populations.

Collectively, our results provide new insights into how self-rated health, as measured by SF-12, aligns with elevated diabetes risk as assessed by Findrisc, QDScore, and CANRISK. This supports the integration of subjective health metrics into screening strategies for early identification of individuals at high cardiometabolic risk.

4.2. Strengths and Limitations

This study presents several strengths. First, the large and heterogeneous sample of over 100,000 Spanish workers allows for robust statistical analysis and generalizability across occupational sectors. Second, the use of three validated and complementary diabetes risk assessment tools enhances the validity and consistency of the findings. Third, the inclusion of well-established lifestyle (diet, physical activity, smoking) and psychosocial (HRQoL)

variables—measured through standardized instruments—provides a multidimensional framework for understanding diabetes risk.

Nevertheless, certain limitations must be acknowledged. Due to the cross-sectional design, the associations observed cannot be interpreted as causal. The relationships identified should be considered as correlations, and the directionality between lifestyle, HRQoL, and diabetes risk cannot be inferred. Future longitudinal studies are warranted to confirm these findings.

Although the large sample size strengthens the robustness of the findings, the study population consisted exclusively of Spanish workers undergoing occupational health assessments. Therefore, results may not be generalizable to unemployed individuals, retirees, immigrants, or other populations.

Self-reported data may be susceptible to recall and reporting biases, especially for diet, physical activity, and smoking. HRQoL was measured using a self-reported instrument, which may be subject to reporting bias. Moreover, unmeasured confounding factors such as mental health status, occupational stress, or sleep quality could have influenced HRQoL scores. Therefore, these results should be interpreted with caution.

The study period overlapped with the COVID-19 pandemic, during which lifestyle changes such as weight gain and reduced physical activity were common. We were unable to stratify by shorter time intervals (e.g., 6 months) due to dataset limitations. Although this may introduce residual confounding, the large sample size and adjustment for lifestyle variables likely mitigate this effect. Future studies should account for pandemic-related influences.

While the large sample size increased the likelihood of detecting statistically significant associations, interpretation was based on the magnitude and precision of effect estimates rather than *p*-values alone, reducing the risk of overstating minor associations.

Although the risk scores used are validated, they do not replace confirmatory clinical or biochemical diagnostics. Lastly, potential confounders such as sleep quality, work schedules, stress levels, or mental health diagnoses were not evaluated, which may partially mediate the observed associations.

4.3. Key Contributions

This study is among the first to examine the association between three widely used diabetes risk scores and self-perceived health status in a large occupational cohort. The consistent and independent relationships observed between sociodemographic factors, health behaviors, HRQoL, and elevated risk scores emphasize the relevance of integrated screening strategies in workplace settings. These findings underscore the importance of preventive efforts that incorporate not only metabolic and behavioral variables but also subjective health perceptions.

4.4. Future Perspectives

Future research should prioritize prospective longitudinal designs to clarify the causal links between quality of life, lifestyle patterns, and incident diabetes. Interventions aimed at improving physical and mental well-being, diet, and exercise habits should incorporate validated risk scores to evaluate their preventive efficacy. Moreover, systematic inclusion of HRQoL assessment in occupational health protocols could enhance early detection and risk stratification, potentially mitigating long-term cardiometabolic burden in working populations.

5. Conclusions

This large-scale occupational study highlights the significant association between sociodemographic characteristics, lifestyle behaviors, and health-related quality of life (HRQoL) with type 2 diabetes mellitus (T2DM) risk as assessed by three validated non-invasive screening tools: FINDRISC, QDScore, and CANRISK. Older age, male sex, lower social class, smoking, physical inactivity, and poor adherence to the Mediterranean diet emerged as key determinants of elevated diabetes risk across all indices. Additionally, lower self-perceived health status, as measured by the SF-12, was independently associated with higher scores on all three T2DM risk scales, reinforcing the importance of incorporating subjective health perceptions into metabolic risk assessments.

These findings underscore the need for integrative strategies in workplace health promotion that target modifiable lifestyle factors while accounting for sociodemographic disparities. The inclusion of HRQoL in diabetes risk assessment provides additional insight into workers' health status. However, given the cross-sectional design and reliance on risk scores rather than clinical diagnoses, our conclusions should be interpreted cautiously. These findings are hypothesis-generating and highlight the need for longitudinal research before considering regulatory implications.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/diabetology6100109/s1, Table S1: Extended sociodemographic characteristics by diabetes risk category; Table S2: HRQoL subdomains by diabetes risk category; Table S3: Extended logistic regression models with additional covariates.

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Institutional Review Board Statement: The research adhered to national and international ethical standards, including the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the Balearic Islands (CEI-IB), under protocol number IB 4383/20, dated 26 November 2020. Participants' autonomy, rights, and confidentiality were strictly respected throughout the study. Prior to enrollment, all participants received comprehensive written and oral information detailing the study's objectives, procedures, and scope. Participation was entirely voluntary, and written informed consent was obtained from all individuals before data collection. To ensure data confidentiality, all personal identifiers were removed and replaced with encrypted codes accessible solely to the principal investigator. No identifiable personal information is included in any report or publication. The study complies fully with Spain's Organic Law 3/2018 on the Protection of Personal Data and the EU General Data Protection Regulation (GDPR, Regulation EU 2016/679). Participants were informed of their rights to access, rectify, delete, or restrict the use of their personal data at any time.

Informed Consent Statement: All participants provided written informed consent after receiving a clear explanation of the study aims, methodology, data protection protocols, and their rights.

Data Availability Statement: All data generated or analyzed during the study are securely stored at ADEMA University School, in accordance with applicable data protection regulations. Oversight is provided by the institution's Data Protection Officer, Ángel Arturo López González. Due to confidentiality agreements, the data are not publicly accessible but may be made available upon reasonable request and subject to appropriate ethical approval.

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