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Artículo de investigación científica y/o desarrollo tecnológico

Assessment of lipid profile in university workers: a cross-sectional study with recommendations for preventing cardiovascular disease outcomes

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Abstract

Cardiovascular diseases (CVD) represent a significant disease burden and costs to health systems. Dyslipidemia plays a crucial role in their development; however, there are few specific recommendations for mild lipid profile alterations in individuals not receiving pharmacological treatment.

Objective: This study aims to identify risk factors and develop a personalized recommendation algorithm to reduce these risks in university workers.

Methods: A cross-sectional, descriptive study was conducted using data from 309 university workers who participated in a cardiovascular prevention program. Information was collected from August 20 to September 25, 2024, and included anthropometric measurements, vital signs, laboratory tests, and lifestyle habits. The results were interpreted based on guidelines from the European Society of Cardiology (ESC) and the American Diabetes Association (ADA). A literature review was also conducted to integrate strategies into a personalized recommendation algorithm.

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Results: Of the total participants, 28.16% were men and 71.84% were women. A total of 39.8% were classified as overweight, and 10.67% as having grade I obesity. Furthermore, 19.74% had elevated LDL cholesterol levels, and 28.47% had high triglycerides. Literature suggests that improving sleep patterns and consuming diets rich in unsaturated fatty acids and soluble fiber may reduce these risks.

Conclusions: Personalized interventions are essential for reducing cardiovascular risk in working populations. A system of individualized recommendations could facilitate lifestyle changes, prevent the progression of dyslipidemia, and lower the incidence of CVD among university workers.

Resumen

Las enfermedades cardiovasculares (ECV) representan una importante carga de enfermedad y costos para los sistemas de salud. La dislipidemia es crucial en su desarrollo; sin embargo, existen pocas recomendaciones específicas para alteraciones leves del perfil lipídico en individuos sin tratamiento farmacológico.

Objetivo: identificar factores de riesgo de enfermedad cardiovascular y desarrollar un algoritmo de recomendación personalizado para reducir estos riesgos en los empleados universitarios.

Métodos: se realizó un estudio descriptivo transversal con datos de 309 trabajadores de una universidad que participaron en un programa de prevención cardiovascular. La información se recolectó del 20 de agosto al 25 de septiembre de 2024 e incluyó mediciones antropométricas, signos vitales, pruebas de laboratorio y hábitos de estilo de vida. Los resultados se interpretaron según las pautas de la Sociedad Europea de Cardiología (ESC) y la Asociación Americana de Diabetes (ADA). También se realizó una revisión de la literatura para integrar estrategias en un algoritmo de recomendación personalizado.

Resultados: del total de participantes, el 28,2 % eran hombres y el 71,8 % mujeres. El 39,8 % se clasificó con sobrepeso y el 10,7 % como obesidad grado I. Además, el 19,7 % tenía niveles elevados de colesterol LDL y el 28,5% tenía triglicéridos altos. La literatura sugiere que mejorar los patrones de sueño y consumir dietas ricas en ácidos grasos insaturados y fibra soluble puede reducir el riesgo cardiovascular.

Conclusiones: las intervenciones personalizadas son esenciales para reducir el riesgo cardiovascular en las poblaciones trabajadoras. Un sistema de orientaciones individualizadas podría facilitar cambios en el estilo de vida, prevenir la progresión de la dislipidemia y reducir la incidencia de estas enfermedades entre los empleados universitarios.

Introduction

Cardiovascular diseases (CVDs) are a group of disorders that affect the heart and blood vessels (1). According to the World Health Organization (WHO), an estimated 17.9 million people die each year due to CVD, with 85% of cases attributed to acute myocardial infarction (AMI) and stroke (2). As the workforce has transitioned from physically demanding jobs to more sedentary employment, coupled with the rise of a productivity-driven culture, there has been a steady increase in the prevalence of CVD, which may be linked to a reduction in free time, leading to less investment in sports, family time, and being able to cook healthy food (1). Given that these diseases represent a significant burden of morbidity and mortality worldwide, as well as substantial costs to healthcare systems (3), developing strategies to reduce CVD risk has become an urgent challenge for public health and occupational health.

It has been noted that most cardiovascular diseases (CVDs) are preventable. The INTERHEART study by Yusuf PF et al., which included approximately 30,000 patients from 52 countries, researched the relationship between various risk factors and the development of acute myocardial infarction (AMI) (4). The study concluded that over 90 % of the attributable risk for AMI is linked to nine easily measurable and potentially modifiable risk factors: smoking, hypertension, diabetes mellitus, abdominal obesity, psychosocial factors, physical inactivity, dyslipidemia, and the consumption of fruits, vegetables, and alcohol (4). Observing lipid profile abnormalities, the study found that these account for 54% of the risk of developing AMI (4).

Dyslipidemia is defined as an abnormal distribution of lipids in the blood (5) and is one of the most significant risk factors for developing cardiovascular disease (CVD) (6). The most common form is hypercholesterolemia (7), where low-density lipoprotein (LDL) the lipoprotein responsible for transporting cholesterol to the arterial walls—is elevated (6). Several studies have determined that high LDL levels and their oxidized form may be responsible for the initial development of atherosclerotic disease (6), which serves as the common underlying mechanism in the pathophysiology of CVD (1).

It has been established that the risk of cardiovascular disease (CVD) is not only dependent on a rise in LDL cholesterol levels, low high-density lipoprotein (HDL) levels, or high triglycerides but also on the duration of exposure to these conditions (3). The Doetinchem cohort study concluded that participants who developed CVD had slightly unfavorable metabolic risk factors and biochemical markers 15 to 20 years before diagnosis, despite not meeting the criteria for high cardiovascular risk at the time (8). Furthermore, in comparison to those who did not develop CVD, statistically significant differences were observed in HDL, triglyceride, and glucose levels (8). A study conducted in China comparing cardiovascular risk between industrial workers and farmers found higher total cholesterol (TC), LDL, and triglyceride levels among factory workers performing primarily hand labour (9).

Therefore, developing strategies for the prevention, early diagnosis, and timely treatment of lipid profile abnormalities in workers could help reduce their exposure to this modifiable risk factor. Although therapeutic strategies aimed at lowering LDL cholesterol levels have already been established, current Clinical Practice Guidelines (CPGs) lack a consensus on specific recommendations for patients with lipid profile alterations who do not meet the criteria for high cardiovascular risk or other conditions requiring the initiation of lipid-lowering agents.

In addition, the occupational dimension of cardiovascular risk should be highlighted. Recent studies suggest that heat stress and adverse working conditions may amplify vulnerability to lipid profile alterations and cardiovascular outcomes, even in workers without a prior high-risk diagnosis. This focus is particularly relevant in active populations such as university workers, where productivity demands and environmental burdens add to traditional metabolic and behavioral factors.

In scientific literature, personalized recommendations for cardiovascular risk are developed using health recommendation systems (HRSs), which integrate clinical and personal patient data, such as laboratory results and treatment plans (10.11). These systems are valuable in addressing information overload and the medical language barrier, as HRSs use simple, everyday language, making it easier for patients to understand and follow medical recommendations (11). It is crucial to determine the most effective strategies for providing personalized recommendations tailored to factors such as sex, age, body mass index (BMI), and LDL, HDL, and triglyceride

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levels to address lipid profile abnormalities adequately. By implementing such an approach, it would be possible to prevent both the onset and progression of dyslipidemia, as well as adverse cardiovascular outcomes, in individuals who do not require pharmacological treatment but have laboratory values outside the recommended targets. This study aims to identify risk factors and develop a personalized recommendation algorithm to reduce these risks in university workers.

Materials and methods

A cross-sectional study was conducted using descriptive statistical analysis and linear regression based on a secondary analysis of an existing anonymized database containing information on workers from a university in enrolled in a cardiovascular disease prevention program. Data was collected between August 20 and September 25, 2024, and included anthropometric measurements (weight, height, and abdominal circumference), vital signs (systolic and diastolic blood pressure), laboratory tests (total cholesterol, LDL, HDL, triglycerides, and fasting glucose), and a preliminary questionnaire regarding dietary habits, physical activity levels, and medical history.

For data interpretation, reference values were taken from the 2019 European Society of Cardiology (ESC) / European Atherosclerosis Society (EAS) guidelines for lipid profile evaluation (12), the 2024 American Diabetes Association (ADA) guidelines for blood glucose levels (13), and the 2024 ESC guidelines for blood pressure classification (14). Data was analyzed using statistical software (Excel), employing descriptive statistics to summarize the demographic and clinical characteristics of the sample. Additionally, correlation tests were conducted to measure relationships between laboratory results. The findings are presented using measures of central tendency, dispersion, and R-squared values. Since this study involved a secondary analysis of an existing, anonymized database, informed consent and ethical committee approval were not necessary according with the normative.

Regarding the recommendations, a literature search was conducted using EBSCOhost, MEDLINE, Health Source-Consumer Edition, and PubMed databases. The search included the key terms: *"Lipids," "Cardiovascular Risk," "Risk Reduction," "Worker," "Workers," and "Recommendation"*, as well as the following search strategy: (*"Lipids"[Mesh] AND "Cardiovascular Diseases"[Mesh] AND "Risk Reduction Behavior"[Mesh] AND "Health Planning Guidelines"[Mesh] NOT "High Risk"*). This approach had the objective of identifying relevant information on various strategies with the potential to reduce blood lipid levels. Based on the prior findings, an algorithm with personalized recommendations was developed, tailored, and implemented for the study population.

Results

Population characterization

The database included 313 university workers. Nevertheless, a secondary analysis was conducted on 309 participants due to missing information and data entry errors. Of this reread total, 28,2% were men, and 71.8% were women. The age distribution showed that 35,6% of the population was between 39 and 48 years old, with a mean age of 42,7 ± 10 years.

Regarding lifestyle habits, 17.5% reported having smoked at least 100 cigarettes in their lifetime, 48.9% engaged in at least 30 minutes of daily physical activity, and 67.3% consumed fruits or vegetables daily. Personal and family medical history was also assessed: 8.7% reported regular use of antihypertensive medication, 12.9% had experienced elevated blood glucose levels at some point, 1,3 % had a diagnosis of type 2 diabetes mellitus (T2DM), and 44,6% had a family member with this diagnosis.

The database included anthropometric measurements and vital signs, revealing that 11% of men had a waist circumference (WC) greater than 94 cm, while 11,9 % of women had a WC greater than 90 cm. Regarding body mass index (BMI), 48,2 % of participants were classified as having normal weight, 39,8 % were overweight, and 10,7 % had grade I obesity. Observing blood pressure (BP) measurements, 62,8 % of participants had normal systolic blood pressure (SBP), while 3,.1 % had elevated SBP, and 6,1 % were classified as hypertensive at the time of measurement. Remarkably, 100 % of participants had normal diastolic blood pressure (DBP) at the assessment time.

Considering blood glucose, total cholesterol (TC), LDL, HDL, and triglyceride (TG) levels, 92,2 % of participants had blood glucose levels within the normal range, 6,7 % were in the prediabetes range, and 0,03 % fell within the diabetes range. LDL cholesterol levels were normal in 80.25% of participants and elevated in 19,7 %. Regarding HDL cholesterol, 76,7 % had adequate levels, while 23,3 % had decreased. Triglycerides (TGC) were below 150 mg/dL in 71,5 % of participants, whereas 28,5 % had elevated TGC levels. The median, mode, standard deviation, minimum, and maximum values for each variable are presented in table 1.

Table 1. Descriptive statistical characterization of the variables analyzed in the patient sample

	Median	Mode	Standard Deviation	Minimum Value	Maximum Value
Age	43	52	10.1	19	66
SBP	115	110	13.8	88	176
DBP	71	65	9.48	52	105
BMI	25	25.6	3.7	16.4	38.6
WC	84	79	10.78	64	130
Glicemia	88	88	10.7	32	202
LDL	120.4	127	30.8	38.2	215.2
HDL	46	51	11.3	23	117
TC	194	166	37	101	297
TGC	105	49	65	32	457

SBP: Systolic Blood Pressure **DBP:** Diastolic Blood Pressure **BMI:** Body Mass Index **WC:** Waist Circumference **TC:** Total Cholesterol

Source: *self-elaborated*

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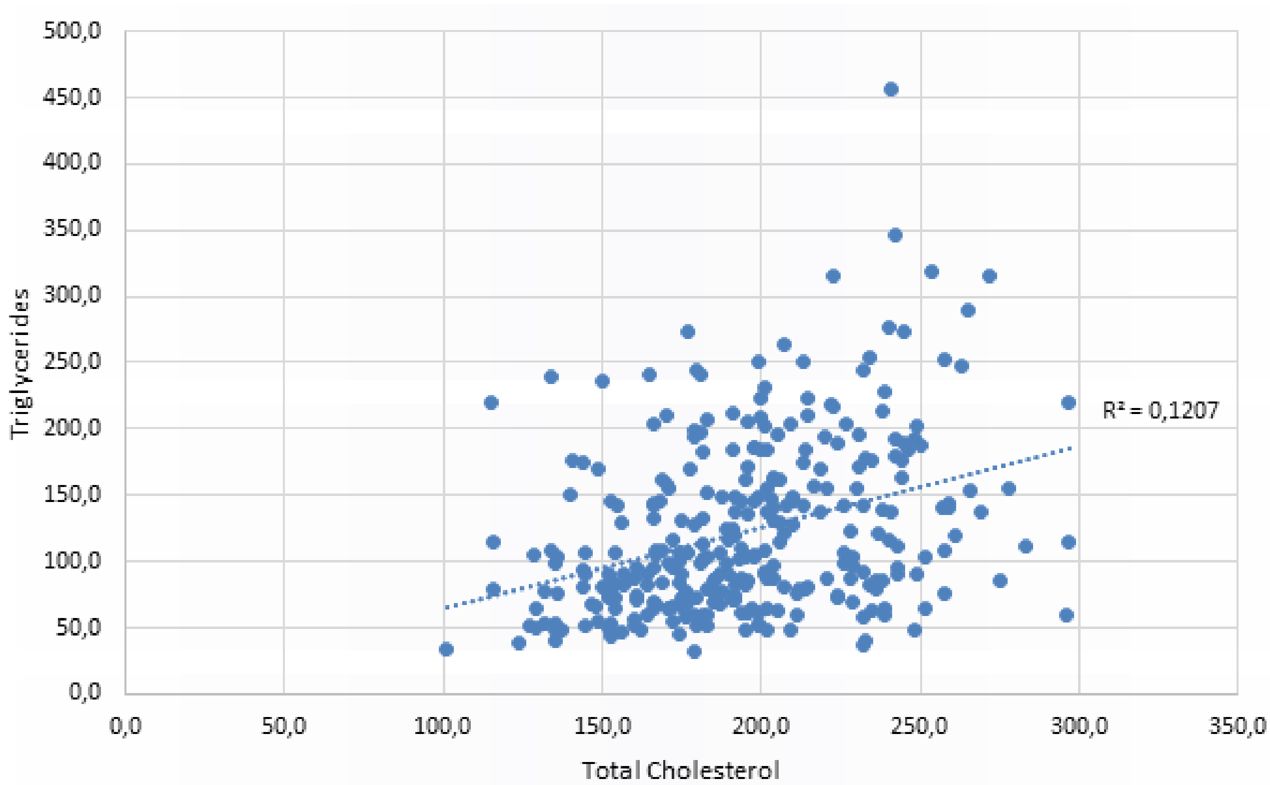
Statistical analysis

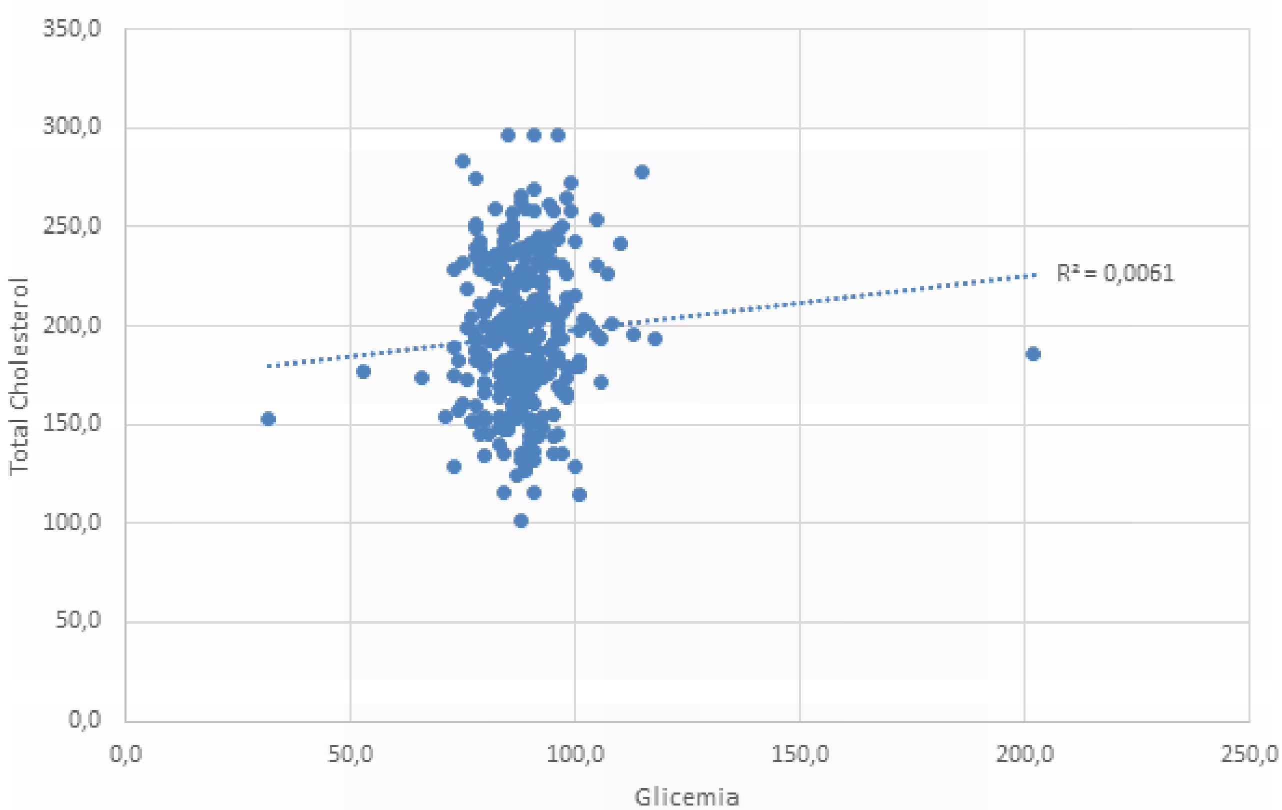
Figure 1. Linear regression between total cholesterol and triglyceride values



Source: *self-elaborated*

Figure 1 establishes the correlation between total cholesterol (TC) and triglycerides (TG). Observing the slope of the generated trend line, it is evident that it is positive, indicating a direct correlation—that is, as the independent variable (TC) increases, the dependent variable (TGC) also increases. Next, the R-squared (R^2) value is interpreted. With an R^2 of 0,1, the model explains 12,1 % of the variance in the dependent variable. This suggests that total cholesterol levels account for just over 10 % of the variation in triglyceride levels. Finally, qualitatively assessing the dispersion of data points along the trend line, most values appear relatively close to the regression line, although a few outliers are observed at a greater distance from the trend.

Figure 2. Linear regression between blood glucose and total cholesterol levels



Source: *self-elaborated*

This graph aims to establish the correlation between blood glucose levels and total cholesterol (TC). Observing the slope of the generated trend line, it is evident that it is positive, indicating a direct correlation—meaning that as the independent variable (blood glucose) increases, the dependent variable (TC) also increases. Next, the R-squared (R^2) value is interpreted. With an R^2 of 0,0061, the model explains only 0,6 % of the variance in the dependent variable. This suggests that variations in blood glucose levels account for less than 1% of the changes in total cholesterol levels, indicating a very weak correlation. Finally, considering the dispersion of data points along the regression line, most values appear relatively close to the trend line, although some outliers are observed at a greater distance. This distribution is likely due to the physiological range of blood glucose concentrations, while the outliers on the x-axis may correspond to cases of hyperglycaemia or hypoglycaemia.

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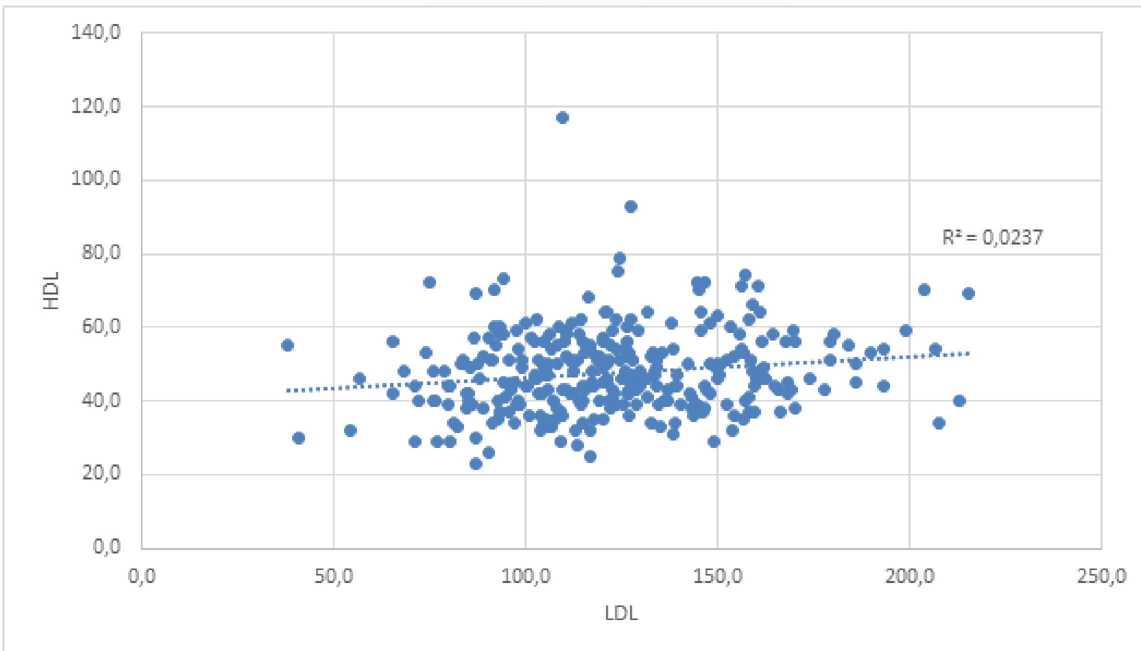
Figure 3. Linear regression between LDL and HDL levels



Source: *self-elaborated*

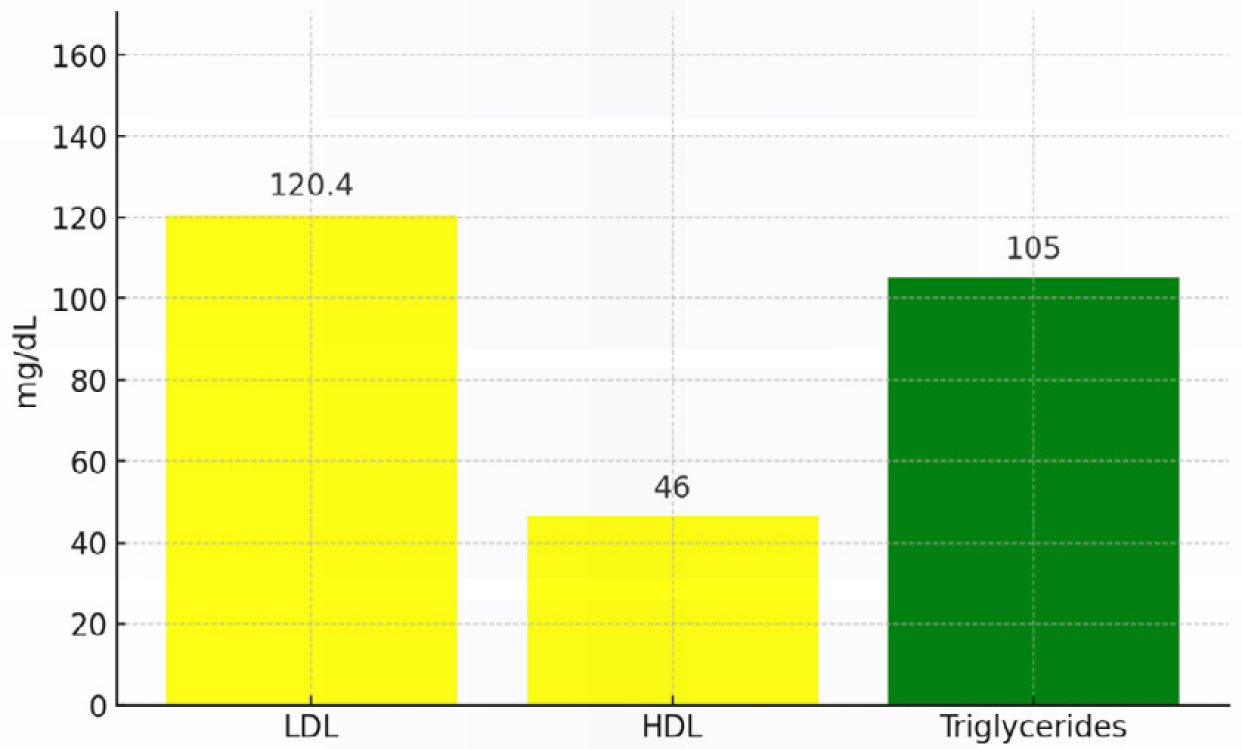
This graph aims to establish the correlation between low-density lipoprotein (LDL) and high-density lipoprotein (HDL) levels. Observing the slope of the generated trend line, it is evident that it is positive, indicating a direct correlation—meaning that as the independent variable (LDL) increases, the dependent variable (HDL) also increases. Next, the R-squared (R^2) value is interpreted. With an R^2 of 0,0237, the model explains only 2,37 % of the variance in the dependent variable. This suggests that LDL levels account for less than 3 % of the variation in HDL levels, indicating a very weak correlation.

Finally, assessing the dispersion of data points along the regression line, most values appear relatively close to the trend line, although some outliers are observed at a greater distance.

In the previously analyzed regression models, a positive slope was observed in all cases, with a variable dispersion that can be explained by the physiological ranges of each parameter. Finally, based on the R-squared (R^2) values, only the first model demonstrated a significant variance, while in the last two models, no meaningful association between the variables can be stated.

To facilitate the interpretation of the findings, it is helpful to represent the primary outcomes through simplified visual schemes. The use of comparative traffic-light-style figures for LDL, HDL, and triglycerides improves understanding of out-of-range values and their translation into actionable recommendations, as shown in Figure 4. Including such summary graphics could enhance both the clinical applicability and the educational value of the results.

Figure 4. Traffic-light-style visualization of the lipid profile medians (LDL, HDL, Triglycerides)



Source: *self-elaborated*

Strategies found in scientific literature

Wang et al. connected the late sleep onset (LSO) with an unfavourable cardiometabolic profile, categorized by lower HDL levels and higher triglyceride (TGC) and LDL levels, even after adjusting for demographic factors and health behaviours. Moreover, in individuals sleeping eight or more hours per night, LSO was linked to increased LDL levels, which could raise the risk of cardiovascular disease (CVD). These findings highlight the importance of maintaining regular sleep schedules to promote cardiometabolic health and reduce cardiovascular risk (15).

Schoeneck et al. systematically assessed the effects of various foods on LDL cholesterol levels and compared their findings with current guidelines. Based on 37 guidelines, 108 systematic reviews, and 20 randomized clinical trials, they found that foods rich in unsaturated fatty acids and low in saturated and trans fats, along with those high in soluble fiber and plant sterols/stanols, moderately reduced LDL cholesterol levels. Foods such as avocado and turmeric significantly lowered LDL, while legumes, nuts, and green tea had more minor LDL-lowering effects. Conversely, unfiltered coffee was linked with increased LDL levels (16).

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Siri et al. found that a diet rich in monounsaturated fats (like those found in canola oil, olive oil, and avocado) and polyunsaturated fats (such as sunflower oil, fish, and flaxseed) can increase HDL cholesterol levels by 7,6-13,3 mg/dL, making it a valuable strategy for patients with low HDL levels. Additionally, reducing the intake of trans fats and free sugars is recommended, as these can lower HDL cholesterol levels (17,18). Considering the impact of diet on triglyceride (TGC) levels, evidence suggests that a low-carbohydrate diet can have triglyceride-lowering effects for 6 to 11 months. However, these effects tend to lessen after two years of adherence (19). Also, the consumption of phytosterols has been associated with a reduction in TGC levels of up to 28 % (20). There is also evidence linking trace element deficiencies, such as selenium deficiency, to lipid profile abnormalities since selenium is obtained through plant-based food sources (21). However, Mazaheri-Tehrani et al. concluded in their study that there is no strong correlation between blood selenium levels and cholesterol or triglyceride levels (21). Furthermore, given the narrow margin between a safe and toxic dose of selenium, there is insufficient evidence to justify selenium supplementation in individuals with abnormal lipid profiles (21).

Alhazmi shepherded a systematic review of 19 studies on the effectiveness of exercise in reducing cardiometabolic risk factors (22). Various studies have concluded that low- and moderate-intensity aerobic exercise impacts cholesterol levels, with no significant differences between them, primarily leading to a reduction in LDL levels (22). It was determined that exercise programs for sedentary individuals can modify cardiovascular disease (CVD) risk factors by reducing BMI, triglycerides, and total cholesterol (TC) (22). Although most studies agree that exercise contributes to lowering cardiovascular risk factors, they did not find a specific duration or intensity as the most effective approach (22).

Mann et al. concluded that high-intensity interval training (HIIT) combined with a high training volume led to greater reductions in LDL and total cholesterol (TC) compared to moderate-intensity exercise (23). Additionally, resistance training, which involves external resistance or bodyweight exercises, has also shown positive effects on the lipid profile. Prabhakaran et al. researched the effect of 14 weeks of resistance training (40-50 minutes, three times per week) in premenopausal women and found a significant reduction in LDL levels (24). Likewise, Lira et al. directed a randomized study assessing cholesterol levels after a resistance training program with varying intensities, reporting a significant reduction in triglyceride levels and an increase in HDL levels when performing low- to moderate-intensity resistance exercises (25).

There is also evidence suggesting that prolonged sitting—defined as taking fewer than 1,700 steps per day—is associated with increased triglyceride (TGC) levels and a reduced effect of exercise on triglyceride levels (22). Therefore, combining aerobic exercise with moderate-intensity resistance training while minimizing prolonged inactivity may serve as a widespread strategy to optimize cardiovascular health by improving the lipid profile.

Finally, having a body mass index (BMI) in the obesity range predisposes individuals to high levels of triglyceride (TGC) and reduced HDL levels (21). Additionally, these two lipid profile abnormalities have been identified as predictors for the development of type 2 diabetes mellitus (T2DM), another significant risk factor for cardiovascular disease (CVD) (21). Although this is not the primary focus of this article, it can be concluded that beyond directly reducing cardiovascular risk, weight management may also benefit individuals at risk of developing diabetes.

Discussion

This study aims to describe the central lipid profile abnormalities among workers of a university and to develop a set of personalized recommendations for addressing these alterations based on evidence from the scientific literature. Statistical analysis of the variables revealed notable prevalences of smoking, sedentary behaviour, and insufficient fruit and vegetable intake. Regarding personal medical history, only around 9 % of participants had a diagnosis of hypertension or diabetes. However, up to 28 % of individuals exhibited at least one lipid profile abnormality, with hypertriglyceridemia being the most common and hypercholesterolemia the least frequent.

It is important to emphasize that, as reported in the Hulsegge et al. study, prolonged exposure to unfavourable lipid profile values may increase the risk of cardiovascular disease (CVD) in the future, even if it does not currently show high cardiovascular risk (8). Therefore, the analysed data reinforce the importance of addressing dyslipidaemia in workers who do not yet require pharmacological management but who could reduce their long-term risk of adverse outcomes, such as myocardial infarction (MI) and stroke, through lifestyle modifications.

Tailored dietary and lifestyle recommendations have been proposed as an effective intervention for modifying the lipid profile and reducing cardiovascular risk. In line with studies such as those by Schoeneck et al. (16), Wang et al. (15), and Mann et al. (23), a diet rich in unsaturated fatty acids and fiber, combined with aerobic exercise, resistance training, and adequate sleep patterns, can have beneficial effects on LDL, HDL, and triglyceride levels. This accentuates the importance of implementing preventive strategies based on lifestyle modifications. Additionally, the use of health recommendation systems (HRSs) eases the adoption of these changes by providing individualized recommendations focused on specific lipid profile alterations (10,11).

However, it is imperative to emphasize that lifestyle modifications and even pharmacological therapy may not always be enough to control dyslipidaemia. It is key to consider patients in whom therapeutic failure may be secondary to an underlying genetic alteration, as they may require more specialized medical attention promptly.

A key aspect of this study is its practical applicability. Beyond describing the prevalence of dyslipidemia, the findings support the development of personalized recommendations tailored to the reality of workers. The practical objectives of the intervention are threefold: (i) early recognition of lipid profile alterations in occupational contexts, (ii) promotion of basic preventive skills among workers, and (iii) personalization of recommendations according to individual characteristics. Integrating these goals into institutional prevention programs facilitates the transfer of scientific knowledge into daily practice.

Figures 5, 6, and 7 illustrate the various strategies identified and classified according to the study population's different levels of LDL, HDL, and triglycerides (TGC).

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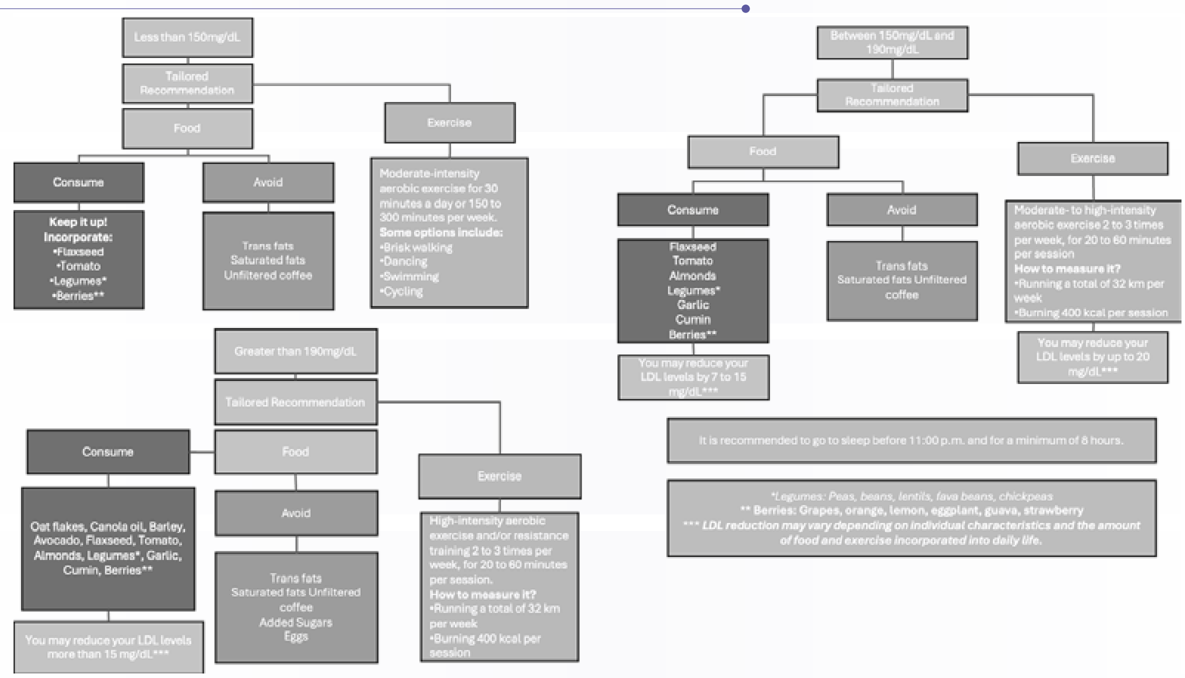
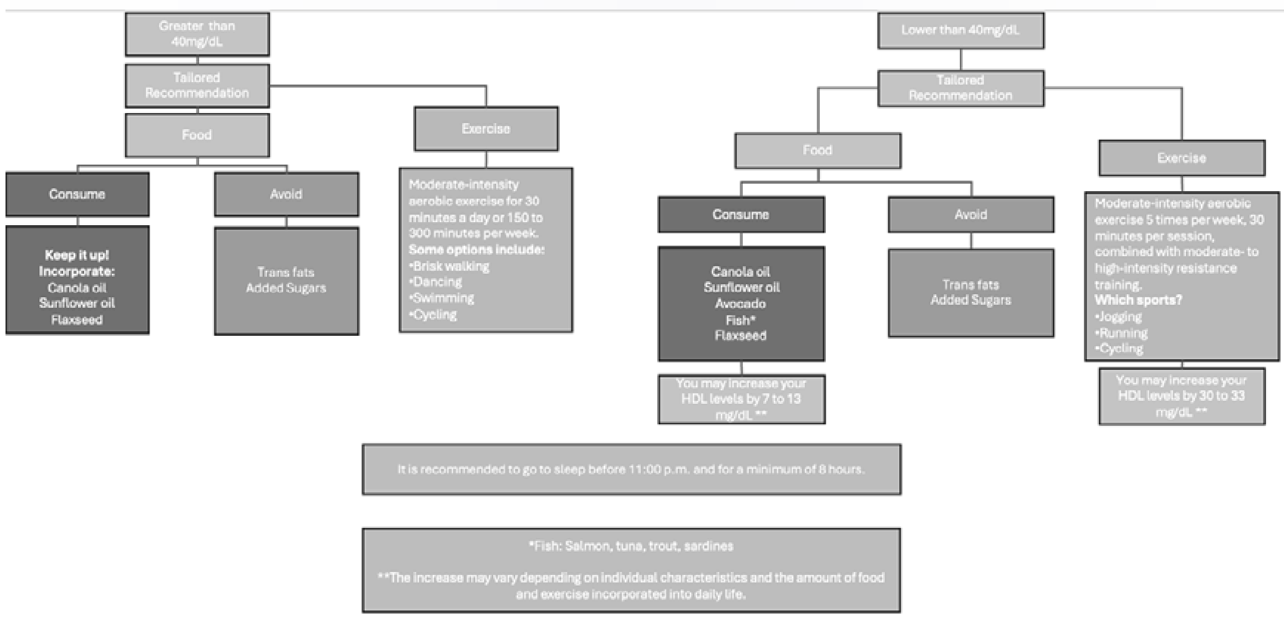
Figure 5. Tailored recommendations for different LDL levels



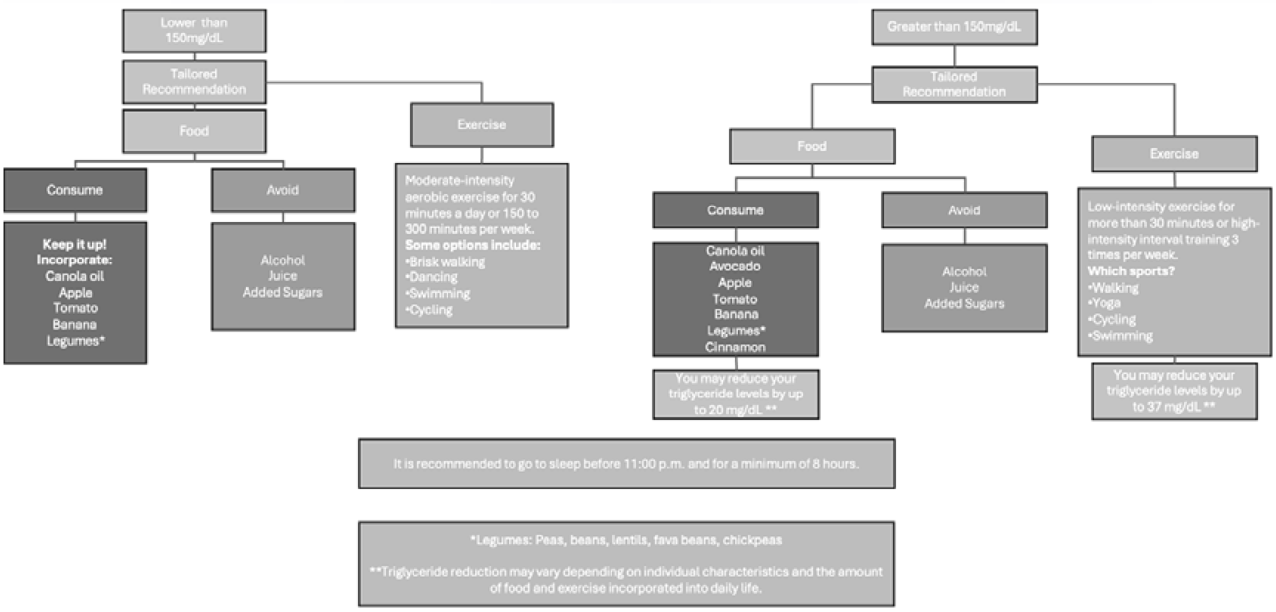
Source: *self-elaborated*

Figure 6. Tailored recommendations for different levels of HDL



Source: *self-elaborated*

Figure 7. Tailored recommendations for different triglyceride levels



Source: *self-elaborated*

Conclusions

Active and early contact with lipid profile abnormalities in working populations, such as university workers, is essential. By implementing personalized recommendations that promote healthy lifestyle habits, cardiovascular risk in this group could be significantly reduced. Non-pharmacological interventions, including a balanced diet and regular physical activity, are key strategies for managing abnormal blood lipid levels and reducing long-term cardiovascular disease (CVD) risk. The implementation and follow-up of CVD prevention programs with a personalized approach are vital in improving cardiovascular health among individuals with mild to moderate dyslipidemia who do not currently require pharmacological therapy. Future studies could focus on evaluating the impact of health recommendation systems (HRSs) in this population and analyzing the effectiveness of personalized recommendations in improving adherence to lifestyle changes.

In summary, beyond the descriptive analysis and statistical correlations, this work proposes a practical action plan applicable in occupational settings: one maintain health promotion as a transversal axis, two strengthen comprehensive prevention with interventions in diet, exercise, and sleep, three individualize recommendations according to lipid profile, and four encourage seeking specialized support when needed. This stepwise approach helps ensure that university cardiovascular prevention programs move from theory to practice, generating a direct impact on the health and well-being of workers.

Limitations

This study has several limitations that should be considered when interpreting the results.

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First, the sample size may not represent the general university workers population, limiting the generalizability of the findings to other workplace settings. Additionally, self-selection bias may have influenced the results, as participants who chose to enroll in the study might have had greater health awareness, which may not necessarily reflect the behavior of the general population.

Data collection relied on self-reported information, subject to recall and social desirability biases. Furthermore, the lack of standardized cutoff points when assessing medical history could lead to misclassification and potentially erroneous conclusions. Finally, the effectiveness of the recommended interventions may vary significantly between individuals, as responses to lifestyle modifications differ across demographic groups, limiting the applicability of the recommendations to a broader population.

Conflicts of interest

The authors of this study declare that no conflicts of interest exist regarding the conduct of this research. They have not received funding from commercial entities and have no professional or personal relationships that could influence the study's results or recommendations. Additionally, the authors declare no financial interests or investments in companies or products related to dyslipidemia or cardiovascular diseases. All aspects of the study have been conducted with the highest standards of integrity and objectivity, ensuring the validity and credibility of the findings presented.

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