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Original Article

Enhancing physical activity programs for diabetic patients at high and very high cardiovascular risk

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Abstract:
This study aimed to identify the populations most susceptible to cardiovascular risks, aligning with the 2021 ESC guidelines. Additionally, this study aimed to evaluate statin prescriptions to determine suitable candidates for tailored physical activity (PA) programs, geared towards risk reduction risk reduction. This retrospective observational descriptive study encompassing 305 participants aged 45 and above without cardiovascular events at the outset, involved detailed analyses across various variables. The initial phase involved descriptive analyses of LDL and non-HDL cholesterol levels. The subsequent phase focused on comparing these cholesterol levels based on gender and age utilizing a general univariate linear model. The study also explored disparities linked to statin prescriptions. A notable finding was that a significant majority of the subjects (67.9%) did not meet the target LDL and non-HDL levels (65.2%). Despite investigating the impact of physical activity on cholesterol values, no significant differences or associations were uncovered between those practicing PA and those who were not. Intriguingly, patients not prescribed statins exhibited higher LDL (106.24±25.16) and non-HDL (134.06±25.83) averages. Comparatively, those prescribed medium-potency statins (81.89±27.13) and high-potency statins (107.49± ± 35.03) for non-HDL demonstrated lower values. Contrary to expectations, the claimed physical activity of this patient cohort did not influence cholesterol improvement. Thus, there is an imperative need to design physical activity programs targeting at-risk populations, accompanied by a suitable prescription to ensure program adherence. This dual approach aims to enhance patient health and optimize cholesterol levels, complementing pharmacological prescriptions. In light of current literature and the study's outcomes, there exists a considerable gap in achieving anticipated targets, primarily owing to inadequate statin prescriptions. Consequently, there is a need for physical activity professionals to offer complementary non-pharmacological treatments. Emphasizing the proven benefits of physical activity, the study underscores its role in reducing the risk of adverse events across all ages and genders. Notably, a direct correlation is established between moderate to vigorous physical activity and decreased all-cause mortality, cardiovascular morbidity, and mortality, and the incidence of type 2 diabetes mellitus (DM2). Sedentary individuals, in particular, face a greater risk, reinforcing the critical importance of promoting an active lifestyle.
Key Words: Physical activity; HDL Cholesterol; no-HDL cholesterol; cardiovascular disease; cardiovascular risk; diabetes mellitus (DM), statins.

Introduction

An active lifestyle protects against chronic diseases especially cardiovascular disease (CVD) and obesity, leading to a decrease in CVD mortality (Chakravarthy et al., 2002; Group et al., 2021; Monda et al., 2009; Stamatakis et al., 2007). There are a large number of CVD-related biomarkers such as blood pressure, obesity, resting heart rate, and cholesterol that respond favorably to increases in physical activity (PA) and exercise (Ghobadi & Hoseini, 2015). Conversely, it has been established that the risk of metabolic syndrome increases in direct correlation with hours of sedentary entertainment and inversely with increased PA (Wijndaele et al., 2009).

Cardiovascular disease, of which atherosclerotic cardiovascular disease (ASCVD) is the main component, is the cause of death of more than 4 million people in Europe each year (De Backer et al., 2019; Group et al., 2021; Townsend et al., 2016). Dyslipidemia is characterized by abnormal lipid levels in the blood, being a major risk factor for ASCVD, in recent years, sports have been recognized as a potential therapeutic tool for dyslipidemia, by having beneficial effects on the lipid metabolism and CVD risk factors (Mosteoru et al.,

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2023). It is therefore important to analyze whether patients in a geographic health area meet the targets recommended in the most current evidence, and to insist on primary prevention, throughout life, promoting healthy habits and adherence to healthy PA programs in the entire population, including healthy people, and in all age ranges (Brotons Cuixart & Lobos Bejarano, 2017; Group et al., 2021), but paying special attention to the population groups at greatest risk since it has been observed that a greater benefit is obtained.

In this study we will focus on patients with high cardiovascular risk (CVR), who present complex lipid alterations, which are not restricted only to elevated low-density lipoprotein cholesterol (LDL-C) or total cholesterol (TC), but also present reduced values of high-density lipoprotein cholesterol (HDL-C) and/or elevated triglycerides (TG), which require intensified and individualized medical treatment.

Recall that the key event in atherogenesis is the retention of LDL and other cholesterol-rich lipoproteins in the arterial wall. Their causal role in the development of arterial disease (AD) has been demonstrated in genetic, observational, and interventional studies (Ference et al., 2017). The relative reduction in CVD risk is proportional to the absolute reduction in LDL-C regardless of the treatment prescribed, with no evidence that there is a lower limit of LDL-C values (Baigent et al., 2005; Group et al., 2021; Mihaylova et al., 2012) that is detrimental. The absolute benefit of lowering LDL-C can translate into a significant absolute reduction in a patient at high or very high risk (Mihaylova et al., 2012), i.e. the higher the CVD risk, the greater the benefit of lowering plasma LDL-C, however minimal (Dorresteijn et al., 2011; Group et al., 2021).

In the ESC Guidelines 2021 on the prevention of CVD in clinical practice, they review and redefine concepts, including "residual" cardiovascular risk, as the estimate of risk after lifestyle changes and risk factor treatment, and apply to patients with established AD. On the other hand, for young and healthy people, lifetime CVR estimation is available to support therapeutic decisions and replaces 10-year estimation algorithms, which systematically estimate a low 10-year risk even in the presence of high-risk factors (Group et al., 2021).

The physiological mechanisms of PA can improve lipid metabolism and, therefore, reduce the risk of dyslipidemia. This occurs because physical activity increases lipoprotein lipase (LPL) activity, increases HDL levels, decreases LDL values, improves insulin sensitivity, and reduces chronic inflammation (Mosteoru et al., 2023). It is well known that regular PA practice improves glycemic control in patients with Diabetes mellitus (DM) and is the most important non-pharmacological treatment (Knowler et al., 2002). For people with DM, as a novelty, the control of non-HDL cholesterol levels is recommended, since it has all the information on apolipoproteins containing apolipoprotein B, does not require the TAG (triglycerides) concentration to be lower than 400 mg/dl, and is more accurate in these patients (Chamnan et al., 2010; Grant et al., 2020; Zozaya et al., 2019).

Low- and medium-impact aerobics physical activity, such as continuous running, or any other activity that includes repeated rhythmic movements that increase heart rate and respiratory rate, also improve the lipid profile. On the other hand, the effects of high-intensity interval training, and cardiorespiratory endurance exercises also improve the lipid profile in adults (Mosteoru et al., 2023).

Treatment decisions are made based on benefits, possible side effects, and patient preferences, reinforcing a good doctor-patient relationship and therapeutic adherence (Dorresteijn et al., 2011). In the first step, we will estimate the CVR following the protocols of the guidelines and taking into account risk modifiers (ethnicity, mental health, etc.), we will have an interview, to expose their situation, the advantages of a healthy lifestyle, and participation in PA programs, treatment options, possible adverse effects, taking into account age, comorbidity and the circumstances of each person, and in a second step we will initiate lifestyle changes (increasing PA levels) and treatment.

This study aims to detect the target populations in which the importance of participating in health-oriented PA programs is most important. For this purpose, we performed a retrospective observational descriptive study of the lipid control of a group of patients with type 2 diabetes mellitus (DM2) without cardiovascular events with high and very high CVR analyzing LDL and non-HDL control, according to the guidelines and recommendations of the more recent European guidelines on Cardiovascular Risk Prevention (Group et al., 2021).

In addition, among the strategies for the control of LDL-C, we will evaluate two fundamental pillars, one is pharmacological treatment, so we will analyze the results according to the prescription of statins, and the second is the performance of PA by the patients.

Material & methods

Participants and procedure

A retrospective descriptive observational study was carried out in a group of 305 patients from the Endocrinology Department of the University Hospital Complex of A Coruña (CHUAC), approved by the research ethics committee of A Coruña-Ferrol, with registration code: 2021/089. The sample consisted of patients aged between 48 and 87 years. 148 were women and 156 men, with a lipid profile performed in the study setting, who had not presented cardiovascular events (acute myocardial infarction (AMI), established cerebrovascular disease (CVA), peripheral arterial disease (PAD), at the time of inclusion and were not institutionalized. The study dataset was updated by reviewing the electronic medical record.

Statistical analysis

To develop the objectives, descriptive analyses were performed according to the nature and scale of the variables. For variables on a nominal scale (adequate levels of LDL-C, adequate levels of non-HDL-C, statins type, and, PA practice), the mode will be calculated and frequency tables will be presented. For the variables on a ratio scale (LDL-C, non-HDL-C), the mode, median, and arithmetic mean were calculated as measures of central tendency; the quartiles were calculated as measures of position; and the minimum, maximum, and standard deviation were calculated as measures of dispersion. These descriptions were made globally and also according to the grouping variables (PA practice, gender, age (< 70 or ≥ 70 years), and CVR in patients with DM2 (CVRDM2)). For the ratio scale variables (LDL Cholesterol, non-HDL Cholesterol), the values were compared according to the grouping variables gender, age (< 70 or ≥ 70 years), CVR (moderate, high, or very high), and PA practice, using a general univariate linear model, using the ratio scale variables as dependent variables and the three grouping variables as fixed factors. These designs explore the effects that each factor (Gender, Age, CVR, and, PA in patients with DM2) has on the dependent variable (LDL Cholesterol or non-HDL Cholesterol), as well as the interaction effects. If any fixed factors were insignificant, the model was refitted by eliminating those factor(s). If any of the effects turned out to be significant, two-by-two comparisons were made between the different levels of the factors, using ANOVA as the comparison procedure when the grouping variable had more than two categories (using Scheffe's method for multiple comparisons) or the t-test for two independent samples in dichotomic grouping variables (in both cases, after guaranteeing normality with the Kolmogorov-Smirnov test and equality of variances through Levene's test). If the prerequisites were not achieved, the nonparametric approach was used (Kruskal-Wallis for k independent samples, or Mann-Whitney for two independent samples). The goodness of fit of the model was assessed by R-squared analysis.

To find associations between variables, we used crosstabs and association measures, so when we associated at least one nominal variable, we used the contingency coefficient and Cramer's V as association measures. And we used Tau-b and Tau-c as association measures for ordinal variables.

Two nominal variables were studied in objective 2 (Target LDL Cholesterol and Target non-HDL Cholesterol) will also be used. The program used to carry out the statistical study was SPSS version 27.0. The level of significance was established at $p<0.05$ in all cases.

Results

The group of patients presented the following characteristics. Regarding physical activity, 61.31% report daily physical activity, and the remainder are sedentary. However, the body mass index (BMI), in more than 60% of the patients, presents a value higher than 24, and 30%, above 31, which is very worrying, since practically all the patients, are above the recommended weight. Sixty percent claim to have a balanced diet, whereas 40% do not. Tobacco consumption is not frequent, only 8.52% say they are tobacco users, 34.1% are ex-smokers, and the remainder have never consumed it. Alcohol consumption is also infrequent, with 58% stating that they do not consume it regularly. Occasional consumption is observed in 32.13%, and chronic consumption in 8.85% of our population. Renal function was normal in 22.62%, with some degree of chronic kidney disease (CKD), the most frequent being mild deterioration. Most of the patients, 71.47%, suffer from DM, from 5 to 35 years ago. Only 11.5% are in the first 5 years of the disease, and only 4% have had the disease for 25 to 45 years.

The levels of LDL and non-HDL cholesterol can be seen in Table 1, classified by PA practice, gender, and, age.

Table 1.- Descriptive analysis of LDL and non-HDL cholesterol variables

LDL Cholesterol								
mg/dL	**N**	**Mode**	**Median**	**□±σ**	**Mín.**	**Max.**	**Q_1**	**Q_3**
Overall								
Overall	305	68[1]	87	90.28±29.79	25	203	68	110
By PA practice								
Yes	187	68	90	92.82±30.57	25	203	70	114
No	118	72	83,5	86.25±28.17	25	182	64	105
By gender								
Females	149	63[1]	92	95.99±31.03	39	203	72.5	114,9
Males	156	55[1]	83	84.83±27.56	25	165	64.25	104.15
By age groups								
Less than 70	107	63[1]	83	84.44±28.80	25	182	63	103
70 or greater	198	90[1]	90,5	93.44±29.91	34	203	71.75	113.25
By gender and age groups								
Less than 70 females	48	63[1]	86	91.06±28.97	46	182	68.75	111
Females 70 or greater	101	78	87	98.33±31.83	39	203	76	116.5
Less than 70 males	59	84[1]	75	79.04±27.74	25	154	56	99
Males 70 or greater	97	65[1]	87	88.34±27.00	34	165	68	109
Non-HDL Cholesterol								
Global								

Overall	305	105[1]	115	117.72±31.15	43	240	92	138.5
				By PA practice				
Yes	187	105	115	118.51±30.16	47	224	93	139
No	118	133	113,5	116.47±32.74	43	240	91	136.5
				By gender				
Females	149	134	123	123.87±32.87	47	240	101.5	146,5
Males	156	105	108	111.85±28.29	43	192	90	132.75
				By age groups				
Less than 70	107	132	111	113.98±31.12	43	240	89	132
70 or greater	198	105	117,5	119.74±31.05	47	224	97.5	142.25
				By gender and age groups				
Less than 70 females	48	132	113,5	121.42±32.94	76	240	99.25	145.25
Females 70 or greater	101	119[1]	125	125.03±32.92	47	224	102.5	149
Less than 70 males	59	89[1]	106	107.93±28.42	43	180	88	125
Males 70 or greater	97	105	109	114.24±28.09	47	192	93.5	138.5

[1] There are several modes, the lowest of the values is presented.

Table 2 describes the LDL-C and non-HDL-C target values, according to whether or not they achieve the healthy values, grouped by PA practice, gender, age, and, CVRDM2.

Table 2.- Descriptive analysis of LDL Cholesterol and non-HDL Target variables

		LDL Cholesterol target		
	N	**No N (%)**	**Yes N (%)**	**Mode**
		Overall		
Overall	305	207 (67.9)	98 (32.1)	No
		By PA practice		
Yes	187	134 (71.7)	53 (28.3)	No
No	118	73 (61.9)	45 (38.1)	No
		By gender		
Females	149	109 (73.2)	40 (26.8)	No
Males	156	98 (62.8)	58 (37.2)	No
		By age groups		
Less than 70	107	66 (61.7)	41 (38.3)	No
70 or greater	198	141 (71.2)	57 (28.8)	No
		By gender and age groups		
Less than 70 females	48	31 (64.6)	17 (45.4)	No
Females 70 or greater	101	78 (77.2)	23 (22.8)	No
Less than 70 males	59	35 (59.3)	24 (40.7)	No
Males 70 or greater	97	63 (64.9)	34 (35.1)	No
		By CVRDM2		
Moderate	75	27 (36%)	48 (64%)	Yes
High	180	135 (75)	45 (25)	No
Very High	50	45 (90)	5 (10)	No
		Non-HDL Cholesterol Target		
		Overall		
Overall	305	199 (65.2)	106 (34.8)	No
		By PA practice		
Yes	187	129 (69)	58 (31)	No
No	118	70 (59.3)	48 (40.7)	No
		By gender		
Females	149	104 (69.8)	45 (30.2)	No
Males	156	95 (60.9)	61 (39.1)	No
		By age groups		
Less than 70	107	65 (60.7)	42 (39.3)	No
70 or greater	198	134 (67.7)	64 (32.3)	No
		By gender and age groups		
Less than 70 females	48	32 (66.7)	16 (33.3)	No
Females 70 or greater	101	72 (71.3)	29 (28.7)	No
Less than 70 males	59	33 (55.9)	26 (44.1)	No
Males 70 or greater	97	62 (63.9)	35 (36.1)	No
		By CVRDM2		
Moderate	75	31 (41.3)	44 (58.7)	Yes
High	180	125 (69.4)	55 (30.6)	No
Very High	50	43 (86)	7 (14)	No

[1] There are several modes, the lowest of the values is presented.

Regarding the plasma level of LDL-C and non-HDL-C, most of the values exceed the target level of 55 and 70 mg/dL, recommended by the different clinical practice guidelines. As for LDL-C and non-HDL-C, the modal values are "No" in all cases, except in the moderate CVRDM2, which presents a "Yes" modal value.
The comparison between the LDL-C and non-HDL-C values is shown in Table 3. It can be seen that no significant differences are found in the LDL and non-HDL cholesterol values, and, as shown in Table 2, targets are not reached in any case.

Table 3.- Comparison of LDL and non-HDL cholesterol values as a function of PA practice.

Variable	Group	□±σ	K-S Sig.	Levene Sig.	T-test Sig.
LDL Cholesterol	Yes	92.82±30.57	0.596	0.451	0.060
	No	86.25±28.17	0.755		
Non-HDL Cholesterol	Yes	118.51±30.16	0.328	0.477	0.577
	No	116.47±32.74	0.957		

When the association between achieving (or not) the cholesterol targets and the PA practice is assessed (Table 4), it can be seen that no significant associations are found (phi values are 0.074 for LDL-C and 0.084 for non-HDL-C), but there is some trend indicating that patients who meet LDL and non-HDL cholesterol targets tend not to engage in frequent physical activity (typified residuals 1.2 for LDL and 1.1 for non-HDL).

Table 4.- Association between PA practice and LDL and non-HDL cholesterol targets.

LDL Cholesterol Target			
Target		**PA practice**	
		Yes	**No**
No	**Count**	134	73
	Expected Count	126.9	80.1
	Standardized Residual	0.6	-0.8
Yes	**Count**	53	45
	Expected Count	60.1	37.9
	Standardized Residual	-0.9	***1.2***
Phi (signification)	-0.102 (0.074)		
non-HDL Cholesterol Target			
Target		**PA practice**	
		Yes	**No**
No	**Count**	129	70
	Expected Count	122	77
	Standardized Residual	0.6	-0.8
Yes	**Count**	58	48
	Expected Count	65	41
	Standardized Residual	-0.9	***1.1***
Phi (signification)	-0.099 (0.084)		

Regarding the comparison of the LDL-C variable, this design explores the effects that each factor (gender, age, RCVDM2, and, PA Practice) has on the dependent variable (LDL-C), as well as the interaction effects. The fixed factors of gender and age are significant, while CVRDM2 and PA Practice are not significant, so we should readjust the model. It is also important to note that there are no significant interactions. In the model after eliminating the factor RCVDM2 and PA Practice, the fixed factors Gender (0.000) and Age (0.009) are statistically significant. The interactions of Gender and Age 70 do not show statistical significance, so we cannot establish their existence.

The corrected model, which includes the effects of the two significant factors, as well as their interaction, shows statistical significance (0.001) and indicates that the model explains part of the variability of the dependent variable (LDL-C), specifically 5.3%.
Once the fixed factors of gender and age were found to be significant in the general linear model, it can be seen in Table 3 that LDL-C is significantly higher in males than in females and patients aged 70 years or older than in younger patients (Table 5).

Table 5.- Comparison of significant fixed effects in the general linear model on the LDL Cholesterol variable.

Variable	Group	□±σ	Sig. K-S	Sig. Levene	Comparison Sig.
Gender	Females	95.99±31.03	0.497	0.290	**0.001**[1]
	Males	84.83±27.56	0.699		
Age	Less than 70	84.44±28.80	0.689	0.664	**0.012**[1]
	70 or greater	93.44±29.91	0.691		

K-S: Kolmogorov-Smirnov normality test
[1] T-test for independent sample's signification
[2] Mann-Whitney test significations

The comparison of the non-HDL-C variable, as in the previous model, explores the effects that each factor (gender, age, RCVDM2, and PA Practice) has on the dependent variable (non-HDL-C), as well as the interaction effects. Among the fixed factors, only gender is significant, while age, CVRDM2, and PA Practice do not present significance, so we should readjust the model. It is also important to note that there are no significant interactions between the factors. After eliminating the non-significant fixed factors, only the fixed factor gender (0.000) is statistically significant and explains part of the variability of the dependent variable (non-HDL-C), specifically 4.4%. The comparison by gender can be seen in Table 6, with non-HDL-C values being significantly higher in females than in males.

Table 6.- Comparison of significant fixed effects in the general linear model on the non-HDL Cholesterol variable.

Variable	**Group**	**$\bar{x}\pm\sigma$**	**K-S Sig.**	**Levene Sig.**	**Comparison Sig.**
Gender	Females	123.87±32.87	0.849	0.129	**0.001**[1]
	Males	111.85±28.29	0.486		

K-S: Kolmogorov-Smirnov normality test
[1] T-test for independent sample's signification
[2] Mann-Whitney test significations

Table 7 shows the LDL-C values of the patients according to the statin type variable. The minimum value of 25 mg/dL corresponds to patients taking high-potency statins, and the same occurs with the maximum value of 203 mg/dL. Patients not taking statins present the highest mean (106.24±25.16), followed by patients taking low-potency statins (92.57±26.00), those taking high-potency statins (83.62±34.13), with the lowest values corresponding to patients taking medium-potency statins (81.89±27.13).

Table 7.- Descriptive analysis of the LDL cholesterol variable, according to the type of statins.

mg/dL	**N**	**Mode**	**Median**	**$\bar{x}\pm\sigma$**	**Mín.**	**Max.**	**Q_1**	**Q_3**
Not intake	77	116	107	106.24±25.16	46	165	89.5	125
Low-potency	53	96	94	92.57±26.00	53	153	70	109.5
Medium-potency	107	68[1]	78	81.89±27.13	38	182	63	99
High-potency	58	71[1]	79.5	83.62±34.13	25	203	61.25	102.3

[1] There are several modes, the lowest of the values is presented.

Table 8 shows the non-HDL-C values of the patients according to the statin type variable. The minimum value of 43 mg/dL corresponds to patients taking high-potency statins, while the maximum value of 240 mg/dL corresponds to a patient taking medium-potency statins. The patients with the highest mean (134.06±25.83) are those not taking statins, followed by patients taking low-potency statins (120.19±25.40) and patients taking medium-potency statins (111.24±30.09), with patients taking high-potency statins having the lowest mean value (107.49±35.03).

Table 8.- Descriptive analysis of the non-HDL cholesterol variable, according to the type of statins.

mg/dL	**N**	**Mode**	**Median**	**$\bar{x}\pm\sigma$**	**Mín.**	**Max.**	**Q_1**	**Q_3**
Not intake	77	134	134	134.06±25.83	82	192	113.5	152.5
Low-potency	53	106	118	120.19±25.40	70	171	104.5	139.5
Medium-potency	107	91	106	111.24±30.09	59	240	90	127
High-potency	58	104[1]	104	107.49±35.03	43	224	79.75	132.75

[1] There are several modes, the lowest of the values is presented.

Discussion

The study sample is a population mostly above the recommended weight, with healthy habits, although they could be improved, since more than half of them state that they practice daily physical activity, eat a healthy diet, are not sedentary, and do not consume tobacco and alcohol, but even so, most of them do not achieve the target levels of plasma LDL-C recommended by clinical practice guidelines, in this case the European one, which is our reference, and which tend to be increasingly strict in the recommended values (Aneri et al., 2021). Females over 70 years of age are the least likely to achieve the targets for both LDL-C and non-HDL-C, and very high CVRDM2 are among those who least achieve the targets, even though they would benefit most from an absolute reduction (Mihaylova et al., 2012), however small, in their cholesterol levels.

Regarding comparisons, the fact that age and gender explain a percentage of LDL-C levels, and gender, of non-HDL-C levels, has to put us on alert for patients over 70 years of age, and males, as they will require closer follow-up.

For every 1 mol/dL decrease in LDL-C, CVR decreases by 21% (Cholesterol Treatment Trialists et al., 2016). Considering that the practice of PA is associated with beneficial health changes in HDL-C, LDL-C, and TC (Monda et al., 2009), current studies, in line with ours, reveal that the majority of patients in our setting, at moderate to very high cardiovascular risk, do not achieve these goals (Cinza Sanjurjo et al., 2020; Kotseva et al., 2019). The IBERICAN study (Cinza Sanjurjo et al., 2020), carried out on patients who attended primary care in

Spain, showed that LDL-C control barely reached 26%, and in the EUROASPIRE (Patients with ischemic heart disease) it reached only 29% (Kotseva et al., 2019), therefore neither in patients without an event nor in those who have had one, is optimal control achieved, as recommended.

Regarding non-HDL-C levels, the results are superimposable. The relationship between non-HDL-C and CVR is at least as strong as the relationship with LDL-C, because its concentration, gives the same information as the concentration of apolipoprotein B (Emerging Risk Factors et al., 2009; Group et al., 2021; Pencina et al., 2019). They are used in the SCORE2 (Systemic Coronary Rick Estimation 2) and SCORE2-OP (SCORE2-Old People) risk tables, which include non-HDL-C.

Given the results, we should analyze the causes of this insufficient control of cholesterol levels in these patients with high and very high CVR, and given that, as we have already said, the lifestyle, although it can be improved, is not declared as bad by the patients, we should consider whether the treatment prescribed in consultations, both primary and specialized care, is correct, or whether we allow ourselves to be carried away by therapeutic inertia instead of making an effort to ensure that our patients achieve the highly recommended objectives. Moreover, it would be essential to implement PA programs in patients as a coadjuvant treatment, given that the improvements in health are proven, even though the patient's perception may be different about PA levels. At present, we have powerful strategies and drugs that reduce CVR by lowering LDL-C, with statins being the therapeutic basis. The indications in the scientific evidence are clearly established, and their safety and effectiveness in the longer term are somewhat contrasted (Mihaylova, 2012, López-Miranda 2021), but the question is whether we apply them to routine clinical practice. In our sample of patients, we did not manage to prescribe them to 100% of the patients in whom it would be indicated, as we can see in the results. We should also analyze therapeutic adherence and possible adverse effects since the lowest LDL-C levels correspond to patients prescribed medium-potency statins and the lowest non-HDL-C levels to patients prescribed high-potency statins.

Diet in combination with properly prescribed PA is a powerful tool for improving body composition and lipid profiles, and, consequently, cholesterol levels (Ainsworth & Tudor-Locke, 2005; Gouveia et al., 2017; Prusik et al., 2018). Patients with DM2, who are the majority of our sample, have a doubled risk of CVD which reduces life expectancy by 4-8 years and also increases the risk of cardio-renal diseases, especially HF (heart failure) and CKD (chronic kidney disease) (Kristensen et al., 2019). The relative risk of CVD is higher at younger ages and moderately in women. For this reason, they should be stratified into high and very high-risk categories, to apply a sequential treatment and intervention, ensuring adequate adherence to lifestyle changes and treatment, ensuring a good doctor-patient relationship, which will have an impact on reaching the therapeutic LDL cholesterol target, resulting in a reduced risk of cardiovascular complications and death, especially a first episode, and an improvement in their quality of life (Group et al., 2021).

The causes, as evidenced in the current literature, range from insufficient prescribing, therapeutic inertia, possible lack of therapeutic adherence and not following a sequential approach to this group of patients, not conforming to the recommendations. Therefore, in our role as physicians, both in primary care and in specialized care, we should consider whether we are doing the right thing to transmit to our patients the importance of improving lifestyle habits (especially adherence to PA programs monitored by professionals in the physical activity sciences), and of choosing the best treatment and complying with its correct administration. It is well known that DM2 is related to PA practice levels, serving, in older people, to reduce the risk of sarcopenia, as well as to cause a decrease in blood sugar levels (Lim & Kang, 2023). Therefore, we believe that the combination of correct drug administration and PA practice would be the best solution.

Conclusion

Physical activity practiced by patients has no impact on cholesterol values, so it is necessary to propose physical activity programs oriented to at-risk populations, in order to be able to carry out an adequate prescription to achieve adherence to the programs and improve the health of patients and optimize their cholesterol values, in synchrony with the appropriate pharmacological prescription. Sports, exercise, and, in general, PA can be used as a form of medicine for dyslipidemia.

In line with the current literature, medicine is far from achieving the recommended objectives (the prescription of statins is not adequate) and physical activity professionals can provide coadjuvant non-pharmacological treatments. Emphasizing the proven benefits of physical activity, the study underscores its role in reducing the risk of adverse events across all ages and genders. Notably, a direct correlation is established between moderate to vigorous physical activity and decreased all-cause mortality, cardiovascular morbidity, and mortality, and the incidence of type 2 diabetes mellitus (DM2). Sedentary individuals, in particular, face a greater risk, reinforcing the critical importance of promoting an active lifestyle. Finally, the consideration of individual factors such as age, and sex, may be necessary to effectively manage dyslipidemia.

Ethical considerations

This research complies with the ethical standards of the corresponding committees and with the 1975 Declaration of Helsinki in its most current version and has been approved by the research ethics committee of A Coruña-Ferrol, with registration code: 2021/089.

The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript nor the creation of table captions and/or figure legends.

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