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Lipid profile estimation among adults at Hospital Tiquipaya, Bolivia, 2023

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Keywords:
hypercholesterolemia; hyperlipoproteinemia type IV; nutritional status; age groups; dyslipidemias (source: MeSH-NLM).

ABSTRACT

Objective. To estimate lipid profiles according to sex, age group, and nutritional status among adult patients attending Hospital Tiquipaya (Bolivia) during the first quarter of 2023. **Methods.** A quantitative, observational, retrospective, cross-sectional study was conducted. The population comprised 562 patients, with a sample of 531 selected through probabilistic random sampling. Data were collected from clinical record forms with biochemical analyses of total cholesterol, triglycerides, HDL, and LDL, and analyzed using descriptive statistics. **Results.** Low HDL levels were found in 68 % of patients, which was more frequent in obese patients (67 %). Elevated LDL predominated in older adults (40 %) and in obese individuals (43 %). High cholesterol and triglyceride levels were mainly associated with overweight and obesity. The mean atherogenic index was higher in men (5.51) and in middle-aged adults (5.51), indicating greater cardiovascular risk in males and in the 40-59 age group. **Conclusions.** Lipid alterations were identified, revealing a high prevalence of dyslipidemias among adult patients at Hospital Tiquipaya during the first quarter of 2023, with significant variations by sex, age, and nutritional status.

Estimación del perfil lipídico en adultos del Hospital Tiquipaya, Bolivia, 2023

Palabras clave:
hipercolesterolemia; hiperlipoproteinemia tipo iv; estado nutricional; grupos de edad; dislipidemias (fuente: DeCs-BIREME).

RESUMEN

Objetivo. Estimar el perfil lipídico según sexo, grupo etario y estado nutricional en pacientes adultos que acudieron al Hospital Tiquipaya (Bolivia), durante el primer trimestre de la gestión 2023. **Métodos.** Se realizó un estudio cuantitativo de diseño observacional, retrospectivo, transversal y descriptivo. La población estuvo conformada por 562 pacientes, mientras que la muestra fue de 531 pacientes seleccionados mediante muestreo probabilístico aleatorio. Se recopilaron datos en fichas de contenido de historias clínicas con análisis bioquímicos de colesterol total, triglicéridos, HDL y LDL, analizados mediante la estadística descriptiva. **Resultados.** El 68 % de los pacientes presentaron bajos niveles de HDL, siendo más frecuente en pacientes con obesidad (67 %). El LDL elevado predominó en adultos mayores (40 %) y en personas con obesidad (43 %). El colesterol y los triglicéridos altos se asociaron principalmente con sobrepeso y obesidad. El índice aterogénico promedio fue mayor en hombres (5,51) y en adultos de mediana edad (5,51), lo que indica un mayor riesgo cardiovascular en varones y en la población de 40 a 59 años. **Conclusiones.** Se evidencian alteraciones lipídicas, lo que demuestra una alta proporción de dislipidemias por trimestre en pacientes adultos atendidos en el Hospital Tiquipaya durante el primer trimestre de 2023, con variaciones significativas según sexo, edad y estado nutricional.

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INTRODUCTION

This study addresses a highly relevant public health issue: the estimation of lipid profile values in adults for the early detection of cardiovascular diseases (CVD). According to the World Health Organization (WHO) [1] data and statistics from 2021, 17.9 million people die each year worldwide from heart failure, peripheral vascular disease, coronary heart disease, and cerebrovascular disease. Chronic noncommunicable diseases account for 81% of all deaths in the Americas, and 39% of these occur in individuals aged 30 to 70 years [2]. Cardiovascular diseases are the second leading cause of mortality in Bolivia. According to WHO [3] estimates, in 2021 heart diseases represented 24% of all registered deaths in Bolivia, while other noncommunicable diseases accounted for 18%.

Sedentary lifestyle, lack of physical activity, overweight, hypertriglyceridemia, and hypercholesterolemia are known risk factors for cardiovascular diseases [4]. Based on this, several effective strategies exist for preventing and managing cardiovascular conditions, such as maintaining a balanced diet and engaging in moderate physical activity—both of which help reduce the risk of developing CVD [5].

The lipid profile consists of several biochemical indicators: total cholesterol, low-density lipoproteins (LDL), high-density lipoproteins (HDL), and triglycerides, which together provide an integrated view of fat metabolism [6]. These parameters not only help identify cases of dyslipidemia but also allow calculation of the atherogenic index, a valuable tool for estimating cardiovascular risk. When properly interpreted, this information can guide health professionals in making more precise clinical decisions, contributing to the development of effective intervention plans that prioritize both prevention and treatment [7].

Therefore, monitoring elevated LDL cholesterol, triglycerides, and low HDL cholesterol is essential, as these biochemical indicators are fundamental for preventing deaths from cardiovascular diseases. To achieve this, lipid profile testing should be performed at least once a year [8].

Within this context, evaluating the lipid profile is a key clinical practice that enables the identification of imbalances in cholesterol and triglyceride levels, thus facilitating timely interventions that can significantly reduce the likelihood of cardiovascular events [9]. Beyond individual diagnosis, it is important to examine how lipid profiles vary according to sex, age, and nutritional status, as these variables may influence atherogenic risk.

In line with this issue, Franyutti et al. [10] reported that men in Mexico (41 %) had a higher atherosclerotic risk than women (27 %), with HDL levels below 40 mg/dL. Furthermore, men showed a greater atherosclerotic risk, and age was associated with an increased presence of risk factors in the population. In Peru, Palacios [11] found that lipid profile alterations were most prevalent in individuals aged 50 to 60 years: elevated total cholesterol, decreased HDL cholesterol, high LDL cholesterol, and elevated triglycerides were more frequent in this age group. Additionally, women more frequently showed low HDL cholesterol levels.

Regarding lipid profile and nutritional status, Alfieri in Ecuador [12] showed that 15 % of individuals with excess weight presented hypercholesterolemia and 22 % hypertriglyceridemia, concluding that, compared with 23% of patients with a healthy weight, 57 % of overweight patients exhibited some alteration in their lipid profile.

This study is justified because it provides essential data on reference values for triglycerides, LDL, HDL, and total cholesterol—key risk factors used to assess an individual's cardiovascular risk. Furthermore, it is relevant due to the lack of specific studies on lipid profile estimation, particularly in the Department of Cochabamba, Bolivia. The results of this study represent a scientific contribution to the Hospital Tiquipaya and provide a foundation for developing prevention strategies. In addition, the study was feasible and aligned with current research priorities, as lipid profile estimation at the Hospital allowed timely identification of health issues and supported improvements in comprehensive patient care.

Therefore, the main objective of the study was to estimate the lipid profile (total cholesterol, triglycerides, HDL, and LDL) in adult patients who attended Hospital Tiquipaya during the first trimester of 2023.

METHODS

Study type and area

Within the positivist paradigm, this study used a quantitative approach with an observational,

retrospective, cross-sectional, descriptive design. It was conducted at Hospital Tiquipaya in the Department of Cochabamba (Bolivia) between January and March 2023.

Population and sample

The study population consisted of 562 medical records from patients of both sexes, classified according to the criteria of the Instituto Nacional de Estadística of Bolivia as young adults, middle-aged adults, and older adults, ranging from 18 to 91 years of age, who were treated at Hospital Tiquipaya during the first trimester of 2023. Inclusion criteria comprised medical records of patients treated during the specified period. Records with incomplete demographic or clinical data were excluded. A population proportion formula was used to determine a sample size of 531 patients. Sample selection was carried out through simple random probability sampling using random numbers generated in the Epidat program.

Variables and data collection instruments

To estimate the lipid profile—composed of total cholesterol, triglycerides, HDL, and LDL, classified into established categories—biochemical tests were performed in fasting conditions in the clinical laboratory unit of Hospital Tiquipaya. Body mass index (BMI), following WHO guidelines [13], was classified as underweight, normal weight, overweight, and obesity [14]. The atherogenic index [15] was calculated according to Castelli's method [16], defined as the ratio of total cholesterol to HDL concentration [17], and was stratified by sex and age group. Data were collected from the laboratory logbook (TC, TG, HDL, and LDL) and from atherogenic index calculations, as well as from medical records (height and weight) used to calculate BMI.

Sociodemographic variables such as sex and age group were also included, categorized as 18-39 years (young adult), 40-59 years (middle-aged adult), and 60-91 years (older adult), based on information from medical records and the logbook.

Data collection techniques and procedures

Data were obtained from patients treated in outpatient consultations between January and March 2023.

Document review was used as the data collection technique, with a content form serving as the instrument, allowing the use of secondary sources for analyzing the lipid profile. A database was then created in Excel containing information such as record number, sex, age, anthropometric data (weight, height, BMI), and biochemical parameters related to the lipid profile (cholesterol, triglycerides, HDL, and LDL).

Data analysis

Given the descriptive level of the research, qualitative variables (sex and age group) were analyzed using absolute frequencies and percentages in Excel. Proportions were also calculated to describe the distribution of the lipid profile according to sex, age group, and nutritional status. For the quantitative variable (atherogenic index), the formula total cholesterol / HDL was applied. Measures of central tendency (mean), dispersion (standard deviation), position (minimum and maximum values), and 95% confidence intervals (lower and upper limits) were calculated. Higher values of this index were associated with greater cardiovascular risk, while lower values indicated reduced risk. Normal reference values were considered to be < 4.5 in men and < 4.0 in women.

Ethical considerations

The study adhered to the ethical principles of the Declaration of Helsinki for research involving human subjects. Authorization for all procedures was granted by the Head of the Laboratory Service and the Hospital administration. Confidentiality of personal and clinical data was ensured. In addition, formal authorization procedures were fulfilled through the hospital director, in accordance with internal control requirements and standard operating procedures (SOPs).

RESULTS

Table 1 shows that the distribution of the lipid profile by sex revealed that 135 female patients (36 %) and 59 male patients (37 %) had hypercholesterolemia. Regarding triglycerides, 60 male patients (38 %) presented hypertriglyceridemia, compared with 112 female patients (30 %). Additionally, 109 male patients (68 %) had low HDL levels, compared with 216 female patients (58 %). With respect to LDL cholesterol, 146 female patients (39 %) and 62 male patients (39 %) had elevated LDL levels, showing the same proportion in both sexes.

Table 1. Absolute and relative frequency of the lipid profile by sex in adult patients attending Hospital Tiquipaya, 2023

Sex	Cholesterol		Triglycerides		HDL		LDL	
	High >200 mg/dL	Low ≤200 mg/dL	High ≥200 mg/dL	Low <200 mg/dL	Low <40 mg/dL	High ≥40 mg/dL	High >130 mg/dL	Low ≤130 mg/dL
	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)
Female	135 (36)	236 (64)	112 (30)	259 (70)	216 (58)	155 (42)	146 (39)	225 (61)
Male	59 (37)	101 (63)	60 (38)	100 (62)	109 (68)	51 (32)	62 (39)	98 (61)
Total	194 (37)	337 (63)	172 (32)	359 (68)	325 (61)	206 (39)	208 (39)	323 (61)

Table 2 shows that 70 patients (38 %) aged 40-59 years (middle-aged adults) presented high cholesterol and elevated triglycerides. Likewise, the 40–59 and 60-91 age groups showed the highest proportion of low HDL levels (116 [63%]). Finally, the 60-91 years group exhibited the highest frequency of elevated LDL, with 98 patients (40 %).

Table 3 indicates that, among overweight individuals, 65 patients (40 %) had high cholesterol, while in the obesity group, 112 patients (40 %) showed elevated cholesterol levels. In addition, 103 obese patients (37 %) had high triglycerides. The obesity group also showed the highest proportion of low HDL levels (187 patients, 67 %) and elevated LDL (121 patients, 43 %).

Table 4 shows that the mean atherogenic index (total cholesterol/HDL) was slightly higher in men (5.51) compared with women (5.21), suggesting a tendency toward greater atherogenic risk in the male population.

Table 5 shows that the highest mean atherogenic index was observed in the 40-59 years group (5.51), followed by the 60–91 years group (5.33) and the 18-39 years group (4.86). This indicates that atherogenic risk tends to increase with age, reaching its peak in middle adulthood.

Table 2. Absolute and relative frequency of the lipid profile by age group in patients attending Hospital Tiquipaya, 2023

Age group	Cholesterol		Triglycerides		HDL		LDL	
	High >200 mg/dL	Low ≤200 mg/dL	High ≥200 mg/dL	Low <200 mg/dL	Low <40 mg/dL	High ≥40 mg/dL	High >130 mg/dL	Low ≤130 mg/dL
	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)
18–39 years (young adult)	33 (32)	69 (68)	26 (25)	76 (75)	51 (50)	51 (50)	38 (37)	64 (63)
40–59 years (middle-aged adult)	70 (38)	113 (62)	69 (38)	114 (62)	116 (63)	67 (37)	72 (39)	111 (61)
60–91 years (older adult)	91 (37)	155 (63)	77 (31)	169 (69)	154 (63)	92 (37)	98 (40)	148 (60)
Total	194 (37)	337 (63)	172 (32)	359 (68)	321 (60)	210 (40)	208 (39)	323 (61)

Table 3. Absolute and relative frequency of the lipid profile by nutritional status in patients attending Hospital Tiquipaya, 2023

Nutritional status	Cholesterol		Triglycerides		HDL		LDL	
	High >200 mg/dL	Low ≤200 mg/dL	High ≥200 mg/dL	Low <200 mg/dL	Low <40 mg/dL	High ≥40 mg/dL	High >130 mg/dL	Low ≤130 mg/dL
	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)	fi (%)
Underweight	1 (33)	2 (67)	1 (33)	2 (67)	2 (67)	1 (33)	1 (33)	2 (67)
Normal weight	16 (19)	69 (81)	18 (21)	67 (79)	40 (47)	45 (53)	22 (26)	63 (74)
Overweight	65 (40)	98 (60)	50 (31)	113 (69)	96 (59)	67 (41)	64 (39)	99 (61)
Obesity	112 (40)	168 (60)	103 (37)	177 (63)	187 (67)	93 (33)	121 (43)	159 (57)
TOTAL	194 (37)	337 (63)	172 (32)	359 (68)	325 (61)	206 (39)	208 (39)	323 (61)

DISCUSSION

Based on the estimation of total cholesterol, triglycerides, HDL, and LDL concentrations, the discussion focuses on comparing the results with previous studies and identifying priority areas for the prevention of cardiovascular diseases in the study population.

In comparison with the findings of the present study on the lipid profile by sex, research conducted by Ríos [18] in 2024 in Ecuador reported a higher proportion of hypercholesterolemia (54 %), with a greater impact among women (59 %). Hypertriglyceridemia reached 56 %, with a mean of 175 mg/dL, affecting 54% of men and 58 % of women. Regarding HDL levels, low concentrations were found in 47 % of men and 46 % of women, and 94% of both sexes presented LDL concentrations above the optimal value.

In addition, and emphasizing the low HDL levels, the results of the present study are consistent with data from the National Health and Nutrition Examination Survey (NHANES) [19] for 2021-2023 in the United States, where a high proportion of low HDL was reported: 21.5 % in men versus 6.6 % in women.

Regarding the results of the lipid profile by age group obtained in this study, they align with the findings of Carroll et al. [19], who reported that the

Table 4. Mean atherogenic index by sex in patients attending Hospital Tiquipaya, 2023

Descriptive statistics		Atherogenic index by sex	
		Female	Male
n		371	160
Mean		5.21	5.51
Median		4.88	5.24
Mode		5.00	5.45
Standard deviation		1.69	1.61
Minimum value		3.52	3.90
Maximum value		6.90	7.11
95% confidence interval	Lower limit	5.04	5.26
	Upper limit	5.39	5.75

Table 5. Mean atherogenic index by age group in patients attending Hospital Tiquipaya during the first trimester of 2023

Descriptive statistics		Atherogenic index by age group		
		18-39 years	40-59 years	60-91 years
n		102	183	246
Mean		4.86	5.51	5.33
Median		4.62	5.22	5.10
Mode		5.72	5.00	4.50
Standard deviation		1.45	1.70	1.70
Coefficient of variation		29.82	30.84	31.95
Minimum value		3.41	3.81	3.63
Maximum value		6.30	7.21	7.03
95% confidence interval	Lower limit	4.58	5.38	5.17
	Upper limit	5.14	5.65	5.49

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proportion of elevated total cholesterol was higher in the 40-59-year age group (16.7%) compared with individuals younger than 40 years and older than 60 years. However, another study conducted by Bravo [20] in 2022 in Ecuador found that triglyceride levels among individuals aged 45 to 70 years did not show marked variations between age groups. In Peru, research by Palacios Sedano [11] identified that elevated LDL cholesterol was most frequent among individuals aged 50 to 60 years, although the incidence decreased in older adults.

Taken together, the findings from Hospital Tiquipaya reflect patterns consistent with those described in the scientific literature, as a high proportion of hypertriglyceridemia was observed among men, as well as reduced HDL levels in both sexes, and elevated total cholesterol and LDL among middle-aged and older adults. These results reinforce the need to establish prevention strategies, early diagnosis, and treatment of dyslipidemias, with emphasis on high-risk groups to reduce the incidence of cardiovascular disease.

In accordance with the findings on the lipid profile by nutritional status, a study conducted by Bays et al. [21] in 2024 reports that the characteristic lipid pattern includes elevated triglyceride levels, reduced HDL, and increased LDL cholesterol. This is consistent with the present study, where increased LDL and triglyceride levels were observed among individuals with obesity. Similarly, research by Alfieri Pappalardo [12] in 2021 in Paraguay found alterations in the lipid profile according to nutritional status among adult men who were overweight. Hypercholesterolemia was reported in 15% of patients, hypertriglyceridemia in 22 %, and combined hypercholesterolemia with hypertriglyceridemia in 20 %.

Regarding reduced HDL levels, the findings of the present study coincide with previous reports. Research by Marín Paredes et al. [22] in 2023 in Lima (Peru) on dyslipidemia in patients with obesity found that 53.9% of patients with low HDL were overweight; 52.3 % of patients with elevated cholesterol were overweight, and 45.7 % of those with elevated LDL were also overweight.

Likewise, a study by Bays et al. [21] in 2024 in adults with obesity reported that the characteristic lipid pattern included elevated triglycerides, reduced HDL, and increased LDL cholesterol. This correlates with findings at Hospital Tiquipaya, where 67 % of underweight and obese patients presented low HDL levels, and 43 % of obese individuals showed elevated LDL.

These observations reinforce the evidence that excess body weight is a determining factor in the development of dyslipidemias and that individuals with obesity have a higher risk of presenting lipid metabolism alterations. Therefore, the findings from Hospital Tiquipaya reflect patterns similar to those reported in the literature, where overweight and obesity are associated with elevated total cholesterol, triglycerides, and LDL, as well as reduced HDL.

The findings related to the atherogenic index (total cholesterol/HDL) are also consistent with previous studies that have identified a higher predisposition among men to present higher atherogenic index values. A study by Huber et al. [23] in 2020 in Argentina on the Castelli Index found that values greater than 4.5 (dimensionless index) were present in 13% of patients, with a mean value of 3.38, and higher levels were found among men and adults older than 50 years.

Similarly, age and the atherogenic index have been widely documented. A study by Herrera [24] in 2022 at the Hospital Clínico-Quirúrgico Hermanos Ameijeiras in Havana (Cuba) highlighted the utility of the atherogenic index in diagnosing subclinical atherosclerosis and noted that age over 50 years, obesity, and hypertension were predominant risk factors in the development of atherosclerosis.

This is consistent with the results of this study, where the 40–59-year group (middle-aged adults) presented the highest atherogenic index, followed by the 60–91-year group (older adults), suggesting that atherogenic risk increases with age. Indeed, the findings from Hospital Tiquipaya align with previous studies indicating that men and middle-aged adults present higher atherogenic indices and, therefore, a greater risk of atherosclerosis and cardiovascular disease.

In general terms, scientific evidence supports that the measurement of a range of lipids transported by different types of plasma lipoproteins in the blood is known as the lipid profile [25]. Dyslipidemia, a disorder characterized by alterations in blood lipid levels, is becoming an increasingly important factor in the cardiovascular health of the adult population [26]. Factors such as obesity, physical inactivity, diabetes mellitus, smoking, hypertension, and dyslipidemia are usually considered modifiable risk factors [27]. In

contrast, non-modifiable factors include age, sex, and genetic background, which are inherent to each individual and cannot be altered or eliminated [28]. Furthermore, the risk of cardiovascular disease has been shown to increase with age, as evidenced by the fact that nearly four out of every five deaths occur in individuals older than 65 years [29]. This is supported by classical research, such as the Framingham Study [30] initiated by the U.S. Public Health Service in 1949, which remains a fundamental reference due to its impact on the identification of cardiovascular risk factors.

The main strength of this study was its large sample size, which allowed the detection of recurrent trends in the lipid profile of the population. Moreover, the study was conducted in a geographic area with limited published evidence, thus providing original and relevant information for the region.

Among the study's limitations, it should be noted that, being cross-sectional and retrospective and based on medical records, the results depend on the quality and completeness of the documentation. This prevents establishing causal relationships; for this reason, inferential statistics were not applied.

Based on the results obtained, it is recommended to strengthen strategies for the prevention and monitoring of the lipid profile in older adults and women. Likewise, local health education programs aimed at preventing and controlling dyslipidemias should be implemented. To reduce cardiovascular risk, it is necessary to develop informational workshops for the population about the effects of menopause on lipid metabolism in women, promote healthy lifestyles through nutrition fairs, and establish free annual lipid profile screenings.

Conclusions

The study conducted among adult patients at Hospital Tiquipaya (Bolivia) during the first quarter of 2023 revealed a high proportion of dyslipidemias, with significant differences according to sex, age, and nutritional status. The most affected age group consisted of older adults aged 60 to 91 years. Men exhibited a lipid profile with a greater proportion of hypertriglyceridemia and low HDL levels. Additionally, obesity was identified as a determining factor in lipid alterations, underscoring the need for prevention strategies tailored to age, sex, and nutritional status. Men had higher atherogenic index values, which increased with age and were highest in the 40-59-year group. To reduce the risk of cardiovascular disease, the findings highlight the importance of implementing preventive measures that emphasize health education, routine cholesterol monitoring, and the promotion of healthy lifestyles.

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