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Gender and Sociocultural Disparities in Dyslipidemia: A Cross-Sectional Study in South Waziristan, Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

Background: Dyslipidemia, abnormal levels of cholesterol & lipids, is a major cause of heart disease and can vary widely due to gender, lifestyle, and access to healthcare, especially in remote areas. **Objective:** The primary objective of this study was to examine gender and sociocultural differences in Dyslipidemia among patients from South Waziristan, Khyber Pakhtunkhwa, Pakistan. **Methods:** A cross-sectional study was conducted among 104 patients from South Waziristan. Lipid profiles including LDL, TC, TG, and HDL were measured. Data were statistically analyzed and its significance was compared with $p<0.0001$ to explore differences by gender, age group, caste, diabetes status, and physical activity levels. **Results:** A substantial difference of Dyslipidemia between male and female participants was observed. Data revealed that women of age group 46–60 presented increased LDL at 216 mg/dL and TC at 262 mg/dL than male levels (LDL 97 mg/dL and TC 179 mg/dL respectively). The Wazir caste population showed increased levels of LDL and TG which were most pronounced in their female population. Females who did not exercise regularly presented the highest LDL levels while diabetic females showed below-average HDL (42 mg/dL vs. 55 mg/dL) together with LDL results (81 mg/dL vs. 135 mg/dL) than non-diabetic female subjects. **Conclusion:** Females, particularly postmenopausal women exhibit elevated levels of LDL and total cholesterol, with lifestyle factors and caste characteristics also influencing lipid profiles. These findings underscore the need for targeted, gender and culture-specific interventions in South Waziristan.

INTRODUCTION

Dyslipidemia refers to abnormal levels of lipids in the bloodstream which is a major contributor to diabetes, atherosclerotic cardiovascular disease (ASCVD), and stroke that affects an estimated 500 million people worldwide (1,2). Increased low-density lipoprotein (LDL) cholesterol is a major risk factor, promoting cholesterol deposition in arterial walls and hastening the progression of ASCVD (3,4). Females tend to have increased triglycerides (TG), total cholesterol (TC), and LDL relative to males, especially after menopause, to validate gender disparity in lipid profiles (5,6). These gender differences are worsened by lifestyle inactivity and psychosocial stressors to enhance dyslipidemia risks (7,8). Regional differences also play a significance role, with South Asia, particularly Pakistan, reporting an alarmingly high prevalence of dyslipidemia, such as high-density lipoprotein (HDL) cholesterol in 87.4% of the population (9). Lifestyle impact is highlighted by rural-urban differences (10,11). This study seeks to clarify gender and sociocultural differences in dyslipidemia among South Waziristan, KPK, filling a gap in evidence from conflict-affected rural communities (12).

METHODOLOGY

This cross-sectional study was conducted to examined gender and sociocultural differences in dyslipidemia in South Waziristan, KPK. Sample was collected from 104 patients at district headquarter (DHQ) Hospital Wana, stratified by gender and age group. The inclusion criteria was permanent residence, full lipid profiles including TC, LDL, HDL, TG, and an 8-10 hour fasting period before blood sampling. Exclusion criteria were incomplete data and intake of lipid-lowering medication in the last month. Blood samples were taken by trained health staff according to standard procedure. LDL and HDL were measured using enzymatic colorimetric assays on an automated biochemistry analyzer. Statistical analysis was

conducted using GraphPad Prism (5th version), t-tests, and descriptive statistics, with p-values calculated to assess statistical significance.

RESULTS

Out of 104 patients, the majority (41%) belonged to the 31-45 age group, which included 29 males (67%) and 14 females (33%). This was followed by 29 patients (28%) from the 46–60 age group, comprising 22 males (76%) and 7 females (24%). Patients above 60 years accounted for only 7% of the total sample, while 25 individuals (24%) were in the 14-30 age group, including 15 males (60%) and 10 females (40%). Demographic characteristics dyslipidemia patients are shown in Table 1.

Regarding literacy, half of the participants (50%) were literate, consisting of 37 males (71%) and 15 females (29%). The remaining 50% were illiterate, comprising 34 males (65%) and 18 females (35%).

Data reveals that out of 104 patients, maximum patients (41%) were from age group 31-45 years that comprises on 29 (67%) males and 14 (33%) females followed by 29 patients from 46-60 years old including 22 (76%) males and 7 (24%) females. Only 7% of the patients were from the age group above 60 years whereas, 25 (24%) belongs to age group 14-30 years including 15(60%) males along with 10(40%) female patients.

Table 1

Gender-Based Demographic Characteristics of Patients with Dyslipidemia

Demographic Variables		Male	Female	Total
Age categories (years)	31-45	29(67%)	14(33%)	43(41%)
	46-60	22(76%)	7(24%)	29(28%)
	14-30	15(60%)	10(40%)	25(24%)
	≥60	5(71%)	2 (29%)	7(7%)
		χ^2 = 1.61; P = 0.66		
Major castes	Wazir	41(63%)	24(37%)	65(63%)
	Sulaimankhel	14(61%)	9(39%)	23(22%)
	Mahsud	16(100%)	0	16(15%)
		χ^2 = 8.83; P = 0.01		
Education	Literate	37(71%)	15(29%)	52(50%)
	Illiterate	34(65%)	18(35%)	52(50%)
		χ^2 = 0.400; P = 0.5274		
Family type	Single	49(65%)	26(35%)	75(72%)
	Extended	22(76%)	7(24%)	29(28%)
		χ^2 = 1.07; P = 0.301		
Socio-economic status	Mid	43(69%)	19(31%)	62(60%)
	Poor	15(60%)	10(40%)	25(24%)
	High	13(76%)	4(24%)	17(16%)
		χ^2 = 1.35; P = 0.51		
Total		71(68%)	33(32%)	104(100%)

Mahsud caste had no female participants due to sociocultural restrictions on females' healthcare access. Percentages are rounded to the nearest whole number.

It was noted that half of our sample (50%) was literate comprising on male 37(71%) and 15(29%) female whereas, 34(65%) males and 18(35%) female patients were illiterate in our sample. In terms of family structure, 72 % of our population consists of single family type whereas; 28% belonged to extended family type.

Caste distribution showed that the majority were from the Wazir caste (63%), followed by Sulaimankhel (22%) and Mahsud (15%). Socioeconomic status indicated that 60% of the participants belonged to the middle class, 24% were from a low-income background, and only 16% came from a high socioeconomic status. Statistical analysis of demographic characteristics revealed no significant gender differences in socioeconomic status, educational attainment, or family structure.

Table 2 presents the average lipid profiles of dyslipidemia patients across different age groups. The results indicate that females consistently exhibited higher levels of LDL and total cholesterol (TC) compared to males. Notably, females aged 46-60 years had a mean LDL level of 216 mg/dL, significantly higher than the 97 mg/dL observed in males. Similarly, their TC levels were elevated (female: 262 mg/dL vs. male: 179 mg/dL), with both differences being statistically significant (P < 0.0001). Although mean HDL was slightly higher in females overall (53 mg/dL vs. 45 mg/dL), the age group 46-60 experienced a striking female HDL peak (70 mg/dL vs. 46 mg/dL in males), although this difference was not statistically significant (P=0.5513) (Table 2). TG were slightly higher in males (235 mg/dL vs. 232 mg/dL), with significant differences between age groups.

Table 2

Gender-Based Lipid Profile Averages across Age Groups in Dyslipidemia Patients

Age categories	Average of HDL Level in (mg/dL)			Average of LDL Level in (mg/dL)			Average of TG Level in (mg/dL)			Average of TC Level in (mg/dL)		
	Male	Female	P -Values	Male	Female	P -Values	Male	Female	P -Values	Male	Female	P -Values
14-30	46	44	P<0.0001	88	82	P<0.0001	215	239	P<0.0001	178	173	P<0.0001
31-45	45	46	P<0.0001	94	85	P<0.0001	271	193	P<0.0001	186	164	P<0.0001
46-60	46	70	0.5513	97	216	P<0.0001	216	286	P<0.0001	179	262	P<0.0001
≥60	42	41	P<0.0001	87	86	0.2566	169	213	P<0.0001	159	170	0.0006
Total	45	53		92	124		235	232		180	196	

Abbreviations: LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TG = triglycerides, TC = total cholesterol.
† Non-significant HDL difference (p = 0.5513) in the 46–60 age group, likely due to small sample size.

The Wazir caste, which consisted of 63% of participants, had higher LDL (133 mg/dL) in female as compared to 92 mg/dL in male whereas, TG level in female was 256 mg/dL slightly higher than 242 mg/dL in male. TC level was also high in female (203 mg/dL) as compared to male (180 mg/dL) of Wazir caste. The HDL level in female was also higher (55 mg/dL) than male (45 mg/dL). In Sulaimankhel caste, TG level is higher in male (197 mg/dL) as compared to female (168 mg/dL) whereas, TC level in male was also found higher (195 mg/dL) in male as compared to female (178 mg/dL). In this caste LDL (male; 106 mg/dL, female; 100 mg/dL) and HDL (male; 50 mg/dL, female; 45 mg/dL) was observed more in male as compared to female. All these parameters can be found from Table 3 for Mahsud

caste as well.

Table 3

Average Lipid Profile Parameters by Major Caste and Gender in Dyslipidemia Patients

Major Caste	Average of HDL Level in (mg/dL)		Average of LDL Level in (mg/dL)		Average of TG Level in (mg/dL)		Average of TC Level in (mg/dL)	
	Male	Female	Male	Female	Male	Female	Male	Female
Wazir	45	55	92	133	242	256	180	203
Sulaimankhel	50	45	106	100	197	168	195	178
Mahsud	41	0	82	0	249	0	167	0
Total	45	53	92	124	235	232	180	196

Abbreviations: SD = standard deviation; LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TC = total cholesterol.

Lifestyle factors further regulated lipid patterns. Diabetic females had lower HDL (42 mg/dL compared with 55 mg/dL among non-diabetic females) and LDL (81 mg/dL compared with 135 mg/dL). Sedentary females had dangerously high LDL (158 mg/dL compared with 93 mg/dL in sedentary males). Unhealthy dietary habit costs LDL higher in male (135 mg/dL) as compared to female (96 mg/dL). Smoking was associated with increased HDL in males (49 mg/dL vs. 44 mg/dL in non-smokers), and too much screen time (≥4 hours) had no female data at all. Of note, male participants in sports had outlier TG levels (547 mg/dL), a possible outlier to investigate further in Table 4.

Table 4

Influence of Lifestyle and Behavioral Factors on Lipid Profile by Gender in Patients with Dyslipidemia

Factors Associated with Dyslipidemia	Average of HDL Level in (mg/dL)		Average of LDL Level in (mg/dL)		Average of TG Level in (mg/dL)		Average of TC Level in (mg/dL)	
	Male	Female	Male	Female	Male	Female	Male	Female
Diabetes								
No	47	55	96	135	240	212	187	203
Yes	44	42	92	81	231	262	175	167
Physical Activities								
Moderate	45	45	99	90	222	318	180	180
Sedentary	46	62	93	158	233	226	180	221
Active	46	43	92	89	258	190	188	167
Dietary habit								
Unhealthy	46	55	96	135	240	212	185	203
Healthy	45	42	93	81	232	262	179	167
Smoking status								
Non-Smoker	44	44	92	133	228	275	175	224
Smoker	49	55	98	104	249	199	193	167
Stress level								
High	45	45	99	90	207	318	177	180
Low	43	39	84	69	260	187	175	149
Moderate	47	55	97	135	237	212	187	203
Sleep duration								
≤6 Hrs.	44	47	97	97	213	303	178	191
≥8 Hrs.	44	39	92	70	246	265	174	143
6-8 Hrs.	46	54	94	128	239	209	186	198
Screen Time								
≤2 Hrs.	44	42	92	81	233	262	176	167
≥4 Hrs.	45	0	94	0	227	0	180	0
2-4 Hrs.	47	55	96	135	242	212	189	203
Participation in sports								
No	46	52	94	122	226	234	182	196
Yes	41	41	90	85	547	212	180	160
Outdoor activities								
Occasionally	48	60	103	155	218	225	191	219
Rarely	44	44	90	86	234	273	175	172
Regularly	46	42	95	86	276	203	189	165
Total	46	51	94	116	236	230	182	190

‡ Mahsud caste female data unavailable due to sampling limitations.

Abbreviations: LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TG = triglycerides; TC = total cholesterol.

Table 5

Mean ± SD of Lipid Profile Parameters by Gender in Dyslipidemia Patients

Lipid profile	Male (Mean ± SD)	Female (Mean ± SD)
HDL (mg/dL)	45 ± 26	53 ± 44
LDL (mg/dL)	92 ± 72	124 ± 117
Triglycerides (mg/dL)	235 ± 121	232 ± 91
Total Cholesterol (mg/dL)	180 ± 76	196 ± 119
Total Cholesterol/HDL Ratio	4 ± 2	4 ± 2
LDL/HDL Ratio	2 ± 2	2 ± 3

No female participants reported ≥4 hours of daily screen time. † Extreme triglyceride value (547 mg/dL) in male sports participants may reflect an outlier or measurement error.

Table 5 reveals that mean lipid parameters also highlighted the trends, with females showing greater LDL (124 ± 117 mg/dL) as compared to male (92 ± 72 mg/dL) and TC (female: 196 ± 119 mg/dL vs. male: 180 ± 76 mg/dL), though cholesterol ratios were similar between genders.

DISCUSSION

Current studies across the country and the world have repeatedly shown important gender differences in dyslipidemia patterns with important prognostic implications for cardiovascular disease and public health practice. The current research from South Waziristan,

KPK, is also in accordance with these larger patterns, showing that the female population has higher LDL and TC levels than the male population, more so in the age group 46–60 years. For example, females in this age group reported mean LDL and TC levels of 216 mg/dL and 262 mg/dL, respectively, compared with 97 mg/dL and 179 mg/dL in males, and these differences were significant. These results reflect large-scale studies conducted in Pakistan, which also showed increased average LDL, TC, and HDL levels among females, while males have greater triglyceride levels (13,14). The South Asian drifts wherein ethnical regulations prioritizing male health fitness approach lines-up with male-dominated dominance (68%), most likely misdiagnosing females as shown through different research works (13,15).

This gender-based pattern is not unique to Pakistan. International studies, such as those conducted in Nepal, Ethiopia, and Saudi Arabia, similarly report that females especially postmenopausal are more likely to have elevated TC levels, potentially due to hormonal changes influencing lipid metabolism (14,16). The higher prevalence of dyslipidemia in females after the age of 50 is a recurring observation, suggesting that menopause may play a critical role in altering lipid profiles and increasing atherogenic risk (14,16,17). In the current study, the pronounced rise in LDL and TC among older females supports this hypothesis and underscores the need for targeted screening and intervention in this demographic.

Socio-cultural and lifestyle factors also contribute to the observed patterns. In South Waziristan, the Mahsud caste had exclusively male participants, limiting gender comparisons, while the Wazir and Sulaimankhel castes included both genders, revealing further nuances in lipid profiles across social groups. The Wazir caste showed higher LDL and TG, particularly among females, which may reflect dietary, genetic, or lifestyle influences. The impact of diabetes and sedentary behavior was also evident: diabetic females had lower HDL and LDL levels, while sedentary females exhibited alarmingly high LDL concentrations. These findings are consistent with broader research indicating that diabetes, obesity, and lack of physical activity are significant determinants of dyslipidemia across populations (9,16).

Comparing the prevalence rates, the burden of dyslipidemia in Pakistan is notably higher than in neighboring countries such as India and China. Studies report that 43.6% of Pakistani adults have high TC, 52.8% have high TG, and 35.6% have high cholesterol, with over half exhibiting low HDL (17). In contrast, Indian and Chinese populations show significantly lower rates, suggesting that genetic predisposition, dietary habits, and limited access to preventive healthcare may exacerbate the problem in Pakistan (9,16). The current study's findings from a rural, socio-culturally distinct region further highlight the importance of considering local context in designing public health strategies.

CONCLUSION

The research reveals that a significant difference in gender and sociocultural differences was observed in dyslipidemia in South Waziristan, KPK. LDL and total cholesterol (TC) levels are elevated in postmenopausal females, and lifestyle factors along with caste characteristics also influence lipid profiles. The findings of this research highlight the need for public health interventions that incorporate gender, sociocultural contexts, and lifestyle modifications to effectively manage and prevent dyslipidemia in this region.

Future Prospectus

Future studies should be larger and community-based to validate these findings and explore the genetic, dietary, and lifestyle factors contributing to disparities in dyslipidemia. Long-term longitudinal studies are required to determine the lasting effects of these disparities on cardiovascular disease risk. Interventional studies also need to be performed in order to compare culturally appropriate lifestyle and dietary interventions with standard therapies in reducing dyslipidemia prevalence and enhancing lipid profiles among this population.

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Ethical Approval

The patients were informed about the research and their consent was taken.

*Author's Contributions

SR, AHS, RN, SH, AR, AS, MAK & AR

SR, AHS & RN: Data collection and study design.

SH, AR & AS: Developed the research design, data analysis and write up

MAK & AR: Research write up, critical analysis, editing, proof reading and managing submission.

All authors approved the final manuscript.

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