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COMPARISON OF HDL LEVEL BETWEEN SOUTHERN BLACK AFRICAN ADULT MEN AND WOMEN

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ABSTRACT

Background: High-density lipoprotein (HDL) cholesterol has been shown to be associated with a reduced risk of coronary heart disease. It has also been demonstrated that HDL level varies with ethnicity and gender. Gender difference studies have been done in several countries and in some cases, black participants were included but there are no records on studies from Africa. Therefore, this study is meant to stimulate for research on HDL in Africa. We investigated the gender difference in HDL cholesterol level in Black Africans in Southern Africa. **Results:** A total of 10,555 lipid profiles were retrieved of which 63.9% (6745/10555) were females with a median age 58 years (95%CI 56.7 – 57.4years) and 36.1% (3810/10555) were males with a median age 53 years (95%CI 52.5 – 53.5years). Females had a median HDL of 1.3mmol/L (95%CI 1.28 – 1.31mmol/L) and males had median HDL of 1.2mmol/L (95%CI 1.23 – 1.26). **Conclusion:** The mean gender difference in HDL level of 0.048 mmol/L (1.85 mg/dL) in this population is lower than those observed in studies conducted in European, American and Asian countries.

KEYWORDS: Cholesterol; High Density Lipoprotein; Gender Difference; Chris Hani Baragwanath Academic Hospital (CHBAH).

1. INTRODUCTION

The National Cholesterol Education Program (NCEP) defined HDL cholesterol level of 60 mg/dL or greater as a negative (protective) risk factor (normal range 1.04 – 1.55mmol/L) (40 to 60 mg/dl) (NCEP., 2001). In Europe, HDL level of 1.04mmol/L (40 mg/dL) or less in men and 45 mg/dL or less in women is suggested to increase risk of cardiovascular diseases (Graham et al., 2007).

The absence of studies originating from Africa, meant utilisation of reference ranges derived from USA and European studies. HDL level varies with ethnicity and gender. It has also been observed in many studies that women have higher HDL cholesterol levels than do men, and this has been hypothesized to be one of the reasons women have a lower incidence of coronary disease (Davis et al., 1996; Eaker et al.,1998). Adjustment for covariates like alcohol consumption, cigarette smoking, obesity, and exogenous hormone, which have been shown to influence the magnitude of the difference in HDL, there, was no change in the gender difference (Davis et al., 1996). This gender difference in HDL would be expected to be present in the black Southern African population but the magnitude in the difference might be different from other ethnic groups. The percentage difference may also be different to those found in blacks in other regions (Ford et al., 1988).

Lipoprotein studies were centred on LDL because of its association with atherosclerosis. However, the occurrence of myocardial infarction in people with normal or subnormal LDL is shifting attention to HDL because of several positive metabolic roles it plays (Barter et al., 2004; Mineo and Shaul., 2012).

2. METHOD

2.1 Study Population

This was a retrospective evaluation of HDL results for 10,555 patients in Chemical Pathology at Chris Hani Baragwanath Academic Hospital (CHBAH) in South Africa, from 1 January 2006 to December 2010. CHBAH is located in SOWETO, a suburb with a population made up of 98.5% blacks and 1.5% Asians, coloured, and whites. CHBAH occupying 70 ha (170 acres), with 3,400 beds and 6,760 staff members is considered the third largest hospital in the world. In addition to serving over 30 suburbs in SOWETO, its location and accessibility attracts patients from other countries in the Southern African Region.

2.2 Study Site

The study was conducted in Chemical Pathology using the National Health Laboratory Services, DISA database. The laboratory handles the highest work volumes compared to any single laboratory (private and public services) in South Africa. It is accredited by the South African National Accreditation System (SANAS) and serves the largest tertiary academic hospital in the southern hemisphere and surrounding clinics. The laboratory participates in the Royal College of Pathologists of Australasia (RCPA) and National Health Laboratory Services (NHLS) EQA programs. The CHBAH Medical Advisory Board and University of the Witwatersrand Research Ethics Committee approved the study.

2.3 Analytical procedure

HDL forms part of the lipid profile, which includes TC, TG and LDL. Blood samples collected into Becton, Dickinson (BD) serum separator tubes for the determination of lipid profiles. Samples were centrifuged at least 30 minutes after collection and analysed immediately. Measurements of lipid profiles were on a Roche Modular diagnostic platform according to the specification of the manufacturers: Roche Diagnostics (Risch-Rotkreuz, Switzerland).

High Density Lipoprotein (HDL) is measured using the homogeneous enzymatic colorimetric test as fully described in Appendix II and assay key performance data is included in Table 2.2 below. In the presence of magnesium ions, dextran sulphate selectively forms water‑soluble complexes with low density lipoprotein (LDL), very low-density lipoproteins (VLDL) and chylomicrons, which are resistant to polyethylene glycol (PEG)‑modified enzymes. The cholesterol concentration in HDL is determined enzymatically by cholesterol esterase and cholesterol oxidase coupled with PEG to the amino groups (approx. 40 %). Cholesterol esters are broken down into free cholesterol and fatty acids by cholesterol esterase and the free cholesterol is oxidised by cholesterol oxidase to Δ4‑cholestenone and hydrogen peroxide. Peroxidase enzyme catalyses a reaction between hydrogen peroxide and 4‑amino‑antipyrine and Sodium N-(2-hydroxy-3-sulfopropyl)-3,5-dimethoxyaniline (HSDA) to form a purple‑blue dye. (Sugiuchi et al., 1995; Matsuzaki et al 1996). The colour intensity of this dye is directly proportional to the cholesterol concentration and is measured photometrically.

2.4. Data analysis

Microsoft Excel was used to capture the data. The basic characteristics of the study population were expressed as median with 95%CI. After stratification by gender, we analysed the gender mean difference in HDL. Statistical analyses were performed using Graphpad Prism (Version 5, GraphPad Software Inc. San Diego, CA) and STATA (Version 11, StatSoft, USA) statistical programs. Student's test (t-test) was used to compares the two gender groups. Statistical significance for the analysis was defined as $p < 0.05$.

3. RESULTS

Results: A total of 10,555 lipid profiles were retrieved of which 63.9% (6745/10555) were females with a median age 58 years (95%CI 56.7 – 57.4years) and 36.1% (3810/10555) were males with a median age 53 years (95%CI 52.5 – 53.5years). Females had a median HDL of 1.3mmol/L (95%CI 1.28 – 1.31mmol/L) and males had median HDL of 1.2mmol/L (95%CI 1.23 – 1.26) shown in Figure. 1 below.

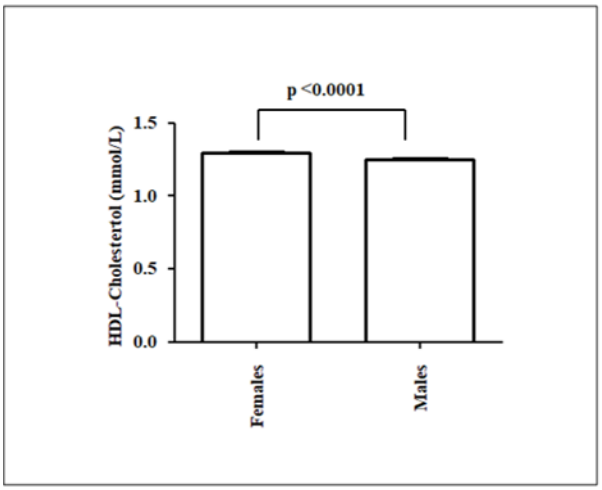

Figure 1: Distribution of high density lipoprotein (HDL) level in females and males.

4. DISCUSSION

In this study, we assessed the gender difference in HDL level without adjusting the relevant covariate factors like age, smoking, BMI, alcohol consumption, TG and LDL-C in both sexes. The study demonstrated a significant gender difference ($p<0.0001$) for the unadjusted HDL of 0.048mmol/L (1.85 mg/dL) which is lower than both the unadjusted gender difference of 0.130mmol/L (5mg/dL) as well as the covariate adjusted difference of 0.065mmol/L (2.5mg/dL) in the Korean population (Kim et al., 2011). A study involving six countries, Canada,

China, Israel, Poland, Russia and United States of America also found a significant sex difference for HDL as well regional/geographic variability shown in Table 1. However, adjustment for covariates did not eliminate the gender variability.

Table 1: Geographical HDL Gender Differences.

Location	Men =n	Women = n	Gender difference (mmol/L)	Reference
Canada	131	81	0.401	LRCP.,1974
China	1688	1800	0.060	P.R.C.-U.S.A., 1992
Israel	262	211	0.310	LRCP., 1974
Korea	1,833	2,632	0.065	Kim et al., 2011
Poland	851	928	0.111	Rywik et al., 1985
Russia	4036	696	0.090	Levy et al ., 1988
USA	2450	3123	0.389	LRCP., 1974; ARIC.,1989
Southern Africa	6745	3810	0.048	Magwete et al.,2018

Lipid Research Clinics Program (LRCP)
People's Republic of China-United States of America (P.R.C.-U.S.A)
Atherosclerosis Risk in Communities (ARIC)

The sex difference in HDL levels, usually assumed to be due to biologic factors, has been seen to differ across cultures and may therefore be related to environmental factors (Davis et al., 1996). The higher HDL level in women is considered to be the reason in the lower mortality from cardiovascular disease in women (Barrett., 1997). Increasing HDL level by 6% has been associated with a reduction in incidence of cardiovascular disease by approximately 23%, a feature similar to the reduction cardiovascular disease when LDL is reduced by 28% (Sacks et al., 1996). The absence of incidence or mortality of cardiovascular diseases from longitudinal studies in the African population to determine the cut-o- value of HDL leaves the use European and American derived ranges as the starting point. Therefore, based on those ranges the difference in HDL by gender in Southern African is the lowest across the world. We hope that our results will motivate researcher to investigate and set ranges for HDL in Africa.

5. CONCLUSION

This is the first report on HDL gender differences from a study carried out in Africa. The HDL gender difference in the adult Southern African population is the lowest compared to those reported in other continents, America, Europe and Asia.

6. Strength and Limitation

It is the first study on HDL gender difference in the African population.

This was a single centre study, even though it is used by nearly all the black Africans from the Southern African, a multi-centre study would be encouraged.

DECLARATIONS

Competing interests: None.

Funding: None.

Ethical approval: CHBAH Medical Advisory Committee, Department of Health and University of the Witwatersrand Ethics Committee.

Author Contributions

- Agnes Magwete: Writing and revision of the manuscript.
- Donald M Tanyanyiwa: Generated hypothesis, wrote manuscript.
- Mamello Priscilla Sifiko: Collected and compiled research data.
- Hilda Tarisai Matarira: Editing and data analysis.
- Floyd Tokwe: Collected and compiled research data.

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