International Journal of Research in Medical Sciences
Orimadegun BE et al. Int J Res Med Sci. 2025 Feb;13(2):587-594
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20250222

Original Research Article

Comparison of fasting and non-fasting lipid profile in Nigerian adults

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Received: 17 June 2024
Revised: 24 July 2024
Accepted: 27 December 2024

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ABSTRACT

Background: Lipid profiles are a vital cardiovascular risk factor. Traditionally fasting lipid profiles are used to minimise postprandial variability, the necessity of fasting for accurate lipid assessment has been questioned, and its utility among Nigerian adults remains uncertain. We compared fasting and non-fasting plasma lipid levels in Nigerian adults to assess the practicality of a non-fasting lipid profile.
Methods: We conducted this self-control comparative study at University College Hospital in Ibadan, Nigeria. We recruited 90 consenting adults aged 18 and older from various outpatient units. We collected plasma samples after an overnight fast and two hours post-prandial. We analysed the lipid levels using standard laboratory methods. We used paired t-tests and bland Altman graphs to compare mean values and determine agreement.
Results: The fasting total cholesterol (TC) (5.25±2.05 mmol/l) and LDL cholesterol (3.84±2.08 mmol/l) levels were significantly higher than their non-fasting counterparts (3.95±1.79 mmol/l and 2.34±1.74 mmol/l, respectively; $p<0.001$). Conversely, triglyceride (TG) levels were significantly higher in the non-fasting state (1.68±0.88 mmol/l) compared to the fasting state (1.35±0.73 mmol/l; $p<0.001$). HDL cholesterol levels showed minimal differences between fasting and non-fasting conditions ($p=0.136$). Bland-Altman analysis indicated that the variations between fasting and non-fasting lipid profiles fell within clinically acceptable limits.
Conclusions: Within the acceptable limits of agreement, non-fasting lipid profiles offer a practical alternative to fasting profiles for cardiovascular risk assessment in Nigerian adults.

Keywords: Cardiovascular risk, Fasting lipid profile, Plasma cholesterol, Triglycerides levels, Nigerian adults

INTRODUCTION

Lipid profiles are crucial indicators for assessing and managing cardiovascular risk as they provide comprehensive insights into various lipid parameters that influence the development of cardiovascular diseases (CVD).[1] Numerous studies have emphasised the importance of lipid profiles in evaluating the risk of atherosclerosis and other cardiovascular conditions.[1] The lipid profile typically includes measurements of plasma TC, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and TGs. These components are critical in assessing cardiovascular health and guiding therapeutic interventions.[2] Traditionally, lipid measurements have been taken from fasting blood samples to minimize variability and accurately represent baseline lipid levels. This practice aims to reduce the postprandial increase in TGs, which could otherwise interfere with the assessment of the status of other lipid parameters.[3] This is because postprandial lipidaemia, a brief increase in TGs after a meal, may confuse cardiovascular risk assessment, necessitating the use of fasting lipid profiles.[4]

The traditional lipid testing that requires patients to fast for 8-12 hours may be inconvenient and impede compliance. However, despite the traditional reliance on fasting lipid profiles, recent research has raised questions about the feasibility and necessity of this approach, particularly in

diverse populations like Nigerian adults.[3] It has been stated that fasting may not be necessary, as studies indicate that non-fasting lipid profiles may provide equally reliable information for cardiovascular risk assessment.[5] The implications of these propositions are significant for clinical practice, especially in settings with diverse populations where the practicality of fasting lipid profiles may be challenging.[4] Studies suggest that non-fasting lipid profiles may provide equally reliable information for cardiovascular risk assessment while being more convenient for patients.[4]

Nigeria's cardiovascular disease burden is rising, reflecting worldwide trends but with regional differences. Changes in diet, urbanisation, and sedentary lifestyles have an impact on epidemiology.[6] The current state of lipid profiles among Nigerians shows a high prevalence of dyslipidaemia, with varying levels of different lipid parameters. Studies indicate that dyslipidaemia is common among Nigerian adults.[7] Fasting lipid profiles have traditionally been the common practice in Nigeria and globally for assessing lipid levels due to the stability of TGs in the fasting state and established reference ranges.[8]

Many studies have shown negligible variations in fasting and non-fasting lipid profiles that do not affect cardiovascular risk assessment.[4,9] A thorough evaluation by Nordestgaard et al found that non-fasting lipid profiles are clinically comparable to fasting profiles for most lipid markers.[4] Their findings recommend that non-fasting samples be used regularly to improve patient compliance and clinical procedures. Dipankar and Pawar[9] compared fasting and postprandial lipid levels in young, healthy people. Fasting and non-fasting TC, HDL-C, LDL-C, and TGs did not vary clinically. This suggests that non-fasting lipid profiles can be used to estimate cardiovascular risk.

In the context of metabolic disorders like obesity, where dyslipidaemia is prevalent, both fasting and non-fasting lipid profiles play a crucial role in assessing cardiovascular risk factors.[10] Furthermore, the shift towards accepting non-fasting lipid levels for guiding dyslipidaemia treatment in cardiovascular and cerebrovascular disease prevention further supports the increasing utilization of non-fasting lipid profiles in clinical practice.[11] While fasting lipid profiles have been traditionally common, the emerging evidence suggests a growing acceptance and utilisation of non-fasting lipid profiles globally.[12] Despite these advances, the use of non-fasting lipid profiles has been scarcely studied among Nigerian populations, where logistical and patient compliance difficulties are especially important.

In most countries, standard practice requires patients to fast for at least 8 hours before sample collection.[4] Interestingly, evidence is lacking that fasting is superior to non-fasting when evaluating the lipid profile for cardiovascular risk assessment.[4] Starting in 2009, Denmark adopted non-fasting lipid testing as the standard practice in clinical investigations.[3] This decision was made based on recommendations from the Danish Society for clinical biochemistry.[4] The society advised that all laboratories in Denmark should use random non-fasting lipid profiles as the standard, while also giving clinicians the choice to re-measure TG concentrations in the fasting state if non-fasting values exceed 4 mmol/l (350 mg/dl).[4] Furthermore, the UK NICE guidelines have endorsed non-fasting lipid testing in the primary prevention setting since 2014.[13]

However, the application of non-fasting lipid profiles in the Nigerian adult population is unclear. There is the paucity of data comparing the fasting and non-fasting lipid profiles in this population, which may have distinct genetic, nutritional, and lifestyle variables affecting lipid metabolism. The use of non-fasting lipid profiles to predict cardiovascular events has been demonstrated in other populations, but studies have not included Nigerians, who may have variable baseline lipid levels and risk factors.

The absence of data about the accuracy of non-fasting lipid profiles in predicting cardiovascular risk, combined with the challenges posed by fasting lipid profiles, hinders the establishment of evidence-based guidelines for lipid testing procedures in Nigeria. Therefore, this research investigates the plasma lipid profile levels of Nigerian adults, both while fasting and when not fasting, to assess the feasibility of using non-fasting measurements in clinical practice without sacrificing diagnostic accuracy. To formulate suggestions for enhancing patient compliance and assessing cardiovascular risk, it is crucial to determine the validity of non-fasting lipid values in this context. This study will provide clarity on the global cholesterol testing controversy and underscore the need for therapeutic advice tailored to individual populations. The objective of the study is to compare the levels of fasting and non-fasting lipid profiles in Nigerian adults.

METHODS

Study design and location

This comparative study was conducted to assess and compare the levels of fasting and non-fasting plasma lipid profiles in Nigerian adults. The study utilised a self-control approach, wherein participants served as their control group. The research was carried out at the general-out-patient (GOP) clinic, and central phlebotomy, in the University College Hospital (UCH) located in Ibadan North, Oyo State, Nigeria from December 2017 to December 2018. These sites were chosen due to their accessibility to a diverse population of adult patients.

Study population

The study population comprised asymptomatic individuals who sought routine medical examination at the UCH, Ibadan. Participants were recruited from the GOP clinic, and central phlebotomy in UCH Ibadan. Only consenting adults above the age of 18 were included in the study.

Sample size determination

The sample size for this study was calculated using the formula for comparison of paired means. It was estimated that a minimum of 90 participants was required to achieve a power of 80% and a level of significance of 5% (two sided), for detecting an effect size of 0.3 between pairs.

Sampling technique

Participants were selected using a convenience sampling method from the aforementioned units in UCH Ibadan until the required sample size was achieved. This method ensured that a representative sample of the patient population was included in the study. The inclusion criteria for the study were consenting adult patients above 18 years of age and absence of symptoms. Exclusion criteria included individuals on lipid-lowering drugs such as statins, participants younger than 18 years, and non-consenting individuals.

Sample and data collection

After obtaining voluntary informed consent from participants, a questionnaire was administered to gather socio-demographic data, including age, sex, and anthropometric measurements. Venous blood samples (5 ml) were collected from the antecubital fossa area of each participant after fasting and postprandial into EDTA bottles. Fasting samples were taken after a 10-12 hour overnight fast, while non-fasting samples were collected two hours after the participants had consumed a meal on the same day. The blood samples in the EDTA bottles were centrifuged at 4000 gm for 10 minutes to obtain plasma. The plasma samples were then aliquoted into plain bottles and immediately stored at -20°C until analysis.

Laboratory procedures

All laboratory procedures adhered to good laboratory practice standards. The levels of plasma TC, HDL, and TGs were determined using enzymatic colorimetric method using reagent kit by DIALAB. The levels of LDL-cholesterol were calculated using Friedewald formula.

Data analysis

Data from the questionnaires and laboratory results were analysed using Stata/BE 18.0 for Windows (StataCorp LLC, TX, USA). Continuous variables were summarised as means±SD, while categorical variables were presented as percentages. Pearson correlation was employed to assess associations between variables, and paired t-tests were used to compare fasting and non-fasting HDL-cholesterol levels. The levels of agreement between the two methods for the various components of the lipid profile were assessed using the Bland-Altman plots, which plot the difference between fasting and non-fasting plasma lipid levels against the average of these two measurements for each individual.[14] A p value of less than 0.05 was considered statistically significant.

Ethical approval

Ethical approval for the study was obtained from the university of Ibadan/university college hospital (UI/UCH) research ethics committee before the commencement of the research.

RESULTS

Characteristics of the participants

Table 1 presents the demographic and anthropometric characteristics of the study participants, which include a total of 90 individuals, with 43 males and 47 females. The overall mean age of the participants was 42.2 years (±9.8) with males having a mean age of 41.3 years (±9.8) compared to females at 43.0 years (±9.8); p=0.391. Males had a significantly higher mean weight 79.5 kg (±12.2) compared to females, 75.3 kg (±15.4); p<0.001. indicating that males in the study generally weighed more than females.

The mean body mass index (BMI) of the participants was 27.6 kg/m^2 (±5.5). Males had a mean BMI of 27.3 kg/m^2 (±4.8), while females had a slightly higher mean BMI of 27.9 kg/m^2 (±6.1). This difference in BMI was not statistically significant (p=0.590). The waist-to-height ratio was nearly identical for both males and females, with an overall mean of 0.91 (±0.12). Other characteristics were as shown in the table.

Mean plasma lipid among the study participants

Table 2 presents the mean values of fasting and non-fasting plasma lipid profile among the study participants. The mean TC level was significantly higher in the fasting state (5.25±2.05 mmol/l) compared to the non-fasting state (3.95±1.79 mmol/l), with a mean difference of 1.30 mmol/l (95% CI: 1.05 to 1.56; p<0.001). For HDL cholesterol, the mean value in the fasting state was 0.80±0.34 mmol/l, slightly lower than the non-fasting mean value of 0.84±0.33 mmol/l.

However, the difference of -0.04 mmol/l (95% CI: -0.09 to 0.01) was not statistically significant (p=0.136). The mean LDL cholesterol level was significantly higher in the fasting state (3.84±2.08 mmol/l) compared to the non-fasting state (2.34±1.74 mmol/l), with a mean difference of 1.50 mmol/l (95% CI: 1.24 to 1.75; p<0.001).

Conversely, TG levels were higher in the non-fasting state, with a mean value of 1.68±0.88 mmol/l compared to 1.35±0.73 mmol/l in the fasting state. The mean difference was -0.33 mmol/l (95% CI: -0.50 to -0.17; p<0.001), indicating that TGs increase significantly postprandially.

Table 1: Characteristics of study participants.

Variables	All participants (n=90)	Male (n=43)	Female (n=47)	P value
Mean age (in years)	42.2±9.8	41.3±9.8	43.0±9.8	0.391
Mean weight (kg)	77.3±14.0	79.5±12.2	75.3±15.4	<0.001
Mean height (m)	1.7±0.1	1.7±0.1	1.7±0.1	0.165
Mean BMI (kg/m^2)	27.6±5.5	27.3±4.8	27.9±6.1	0.590
Waist-to-height ratio	0.9±0.1	0.9±0.1	0.9±0.1	0.973
Educational attainments, N (%)				
Primary	9 (100.0)	2 (22.2)	7 (77.8)	0.175
Secondary	22 (100.0)	13 (59.1)	9 (40.9)	
Tertiary	59 (100.0)	28 (47.5)	31 (52.5)	

Table 2: Mean plasma lipids of study participants.

Variables	Fasting		Non-fasting		Difference		P value
	Mean±SD	95% CI	Mean±SD	95% CI	Mean	95% CI	
TC (mmol/l)	5.25±2.05	4.82, 5.68	3.95±1.79	3.57, 4.32	1.30	1.05, 1.56	<0.001
HDL cholesterol (mmol/l)	0.80±0.34	0.73, 0.87	0.84±0.33	0.77, 0.91	-0.04	-0.09, 0.01	0.136
LDL cholesterol (mmol/l)	3.84±2.08	3.40, 4.27	2.34±1.74	1.98, 2.71	1.50	1.24, 1.75	<0.001
TGs (mmol/l)	1.35±0.73	1.19, 1.50	1.68±0.88	1.50, 1.87	-0.33	-0.50, -0.17	<0.001

Agreement between fasting and non-fasting lipids

The Bland-Altman plot shown in Figure 1 demonstrates the agreement between fasting and non-fasting TC values among the participants included in the research. The average disparity between fasting and non-fasting TC values is 1.736 mmol/l, suggesting that, on average, fasting TC readings are greater than non-fasting measures. The 95% limits of agreement span from -1.978 to 5.450 mmol/l, indicating that the disparities between the two measurement techniques often fall within this range for the majority of people. The plot demonstrates that 3 data points out of 90 (3.33%) lie outside the boundaries of agreement, suggesting that the bulk of the fasting and non-fasting TC values fall within an acceptable range of variability. The data points exhibit a distribution pattern around the mean difference line, with a propensity for larger disparities at higher average TC values. The mean values of TC measurements obtained from both fasting and non-fasting individuals range from 2.185 to 13.110 mmol/l, including most data points. This finding supports the consensus that there is a strong correlation between fasting and non-fasting TC measures throughout a broad range of values. In summary, the Bland-Altman analysis reveals a constant discrepancy between fasting and non-fasting TC values, however the majority of these variances are within the range considered clinically acceptable.

The Bland-Altman plot shown in Figure 2 illustrates the agreement between fasting and non-fasting TG measurements among the study participants. The mean difference between fasting and non-fasting TG levels is-0.335 mmol/l, indicating that, on average, non-fasting TG measurements are higher than fasting measurements. The 95% limits of agreement range from -1.855 to 1.186 mmol/l, suggesting that the differences between the two measurement methods generally fall within this range for most individuals. The plot shows that 5 out of 90 data points (5.56%) fall outside the limits of agreement, indicating that the vast majority of the fasting and non-fasting TG measurements are within the acceptable range of variability. The data points are distributed around the mean difference line, with no apparent pattern of increasing or decreasing discrepancies across the range of average TG values. The averages of fasting and non-fasting TG measurements lie between 0.587 and 3.523 mmol/l, covering the range of most data points and reinforcing the general agreement between fasting and non-fasting TG measurements across a broad spectrum of values. Overall, the Bland-Altman analysis demonstrates that while there is a consistent difference between fasting and non-fasting TG measurements, with non-fasting values being higher, most differences fall within clinically acceptable limits.

The Bland-Altman plot in Figure 3 demonstrates the agreement between fasting and non-fasting HDL-C levels across study participants. The average difference between fasting and non-fasting HDL-C levels is -0.042 mmol/l, indicating that non-fasting HDL-C readings are somewhat higher than fasting measures. The 95% ranges of agreement range from -0.560 to 0.476 mmol/l, indicating that the variations between the two measurement techniques are typically within this range for most persons. The figure reveals that 4 of 90 data points (4.44%) are beyond the boundaries of agreement, showing that the great majority of fasting and non-fasting HDL-C readings are within an acceptable range of variability. The data

points are evenly dispersed around the mean difference line, with no discernible trend of growing or decreasing disparities over the range of average HDL -C levels. Fasting and non-fasting HDL-C measurements have averages ranging from 0.297-2.172 mmol/l, which covers the majority of data points and reinforces the overall agreement between fasting and non-fasting HDL-C measures throughout wide range of values. Overall, Bland-Altman analysis shows that there is little variation between fasting and non-fasting HDL-C levels, with majority of changes lying under clinically acceptable ranges.

Figure 4 displays the Bland-Altman plot, which demonstrates the degree of agreement between the LDL-C measurements of the study participants during fasting and non-fasting periods. The mean difference between fasting and non-fasting LDL-C levels is 1.792 mmol/l, suggesting that fasting LDL-C measurements are generally higher than non-fasting. The 95% limits of agreement for the two measurement methods are -1.403 to 4.987 mmol/l, indicating that the majority of individuals experience differences within this range. The diagram indicates that the vast majority of the fasting and non-fasting LDL-C measurements are within the acceptable range of variability, as approximately 4 out of 90 data points (4.44%) fall outside the limits of agreement. The data points are distributed around the mean difference line, with a propensity for increased discrepancies at higher average LDL-C values. The range of most data points is covered by the averages of fasting and non-fasting LDL-C measurements, which range from 0.130 to 11.590 mmol/l. This reinforces the general agreement between fasting and non-fasting LDL-C measurements across a broad spectrum of values. In general, the Bland-Altman analysis indicates that there is a consistent disparity between fasting and non-fasting LDL-C measurements, with fasting values being higher. Nevertheless, the majority of the discrepancies are within clinically acceptable limits, which lends credence to the potential of non-fasting LDL-C measurements in clinical practice.

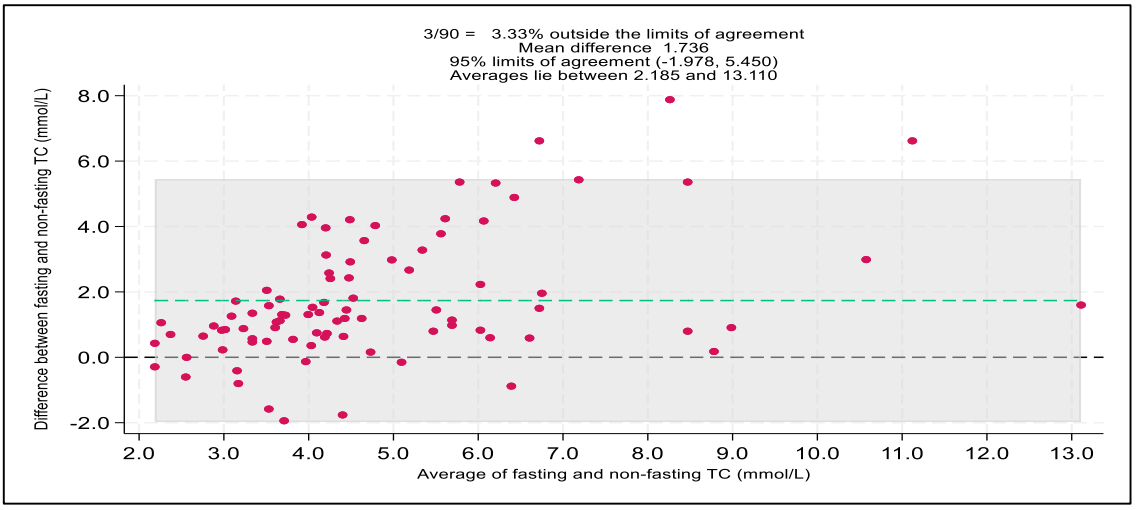

Figure 1: Bland-Altman graph of fasting and non-fasting plasma TC.

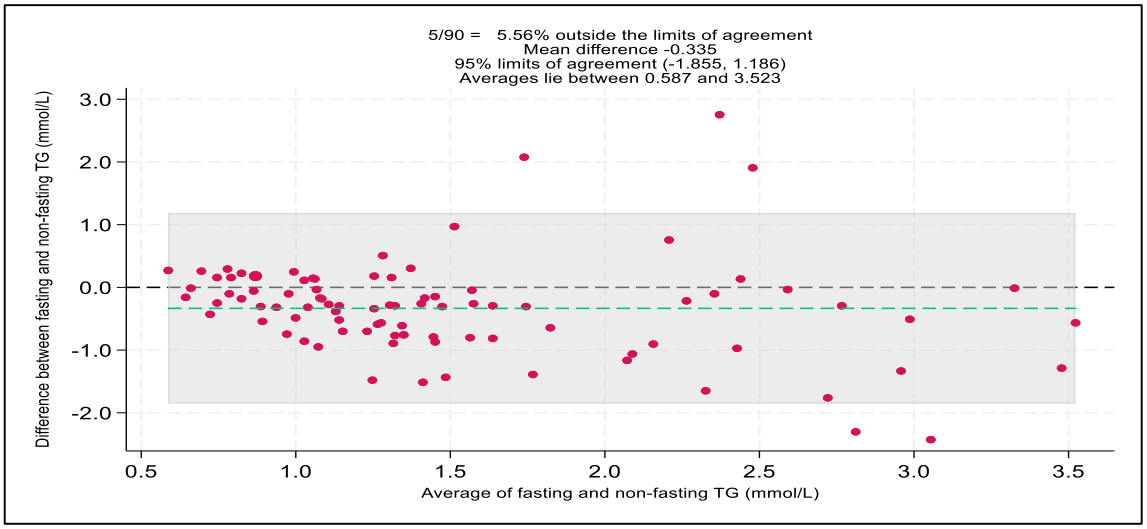

Figure 2: Bland-Altman graph of fasting and non-fasting plasma TGs.

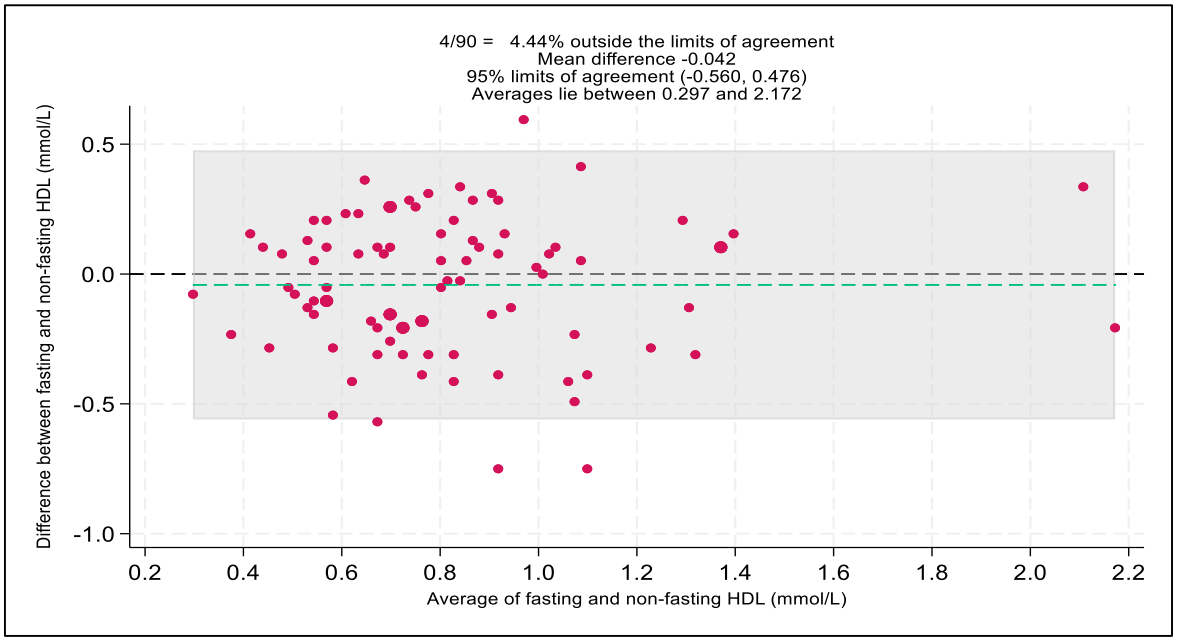

Figure 3: Bland-Altman graph of fasting and non-fasting plasma high density lipoprotein cholesterol.

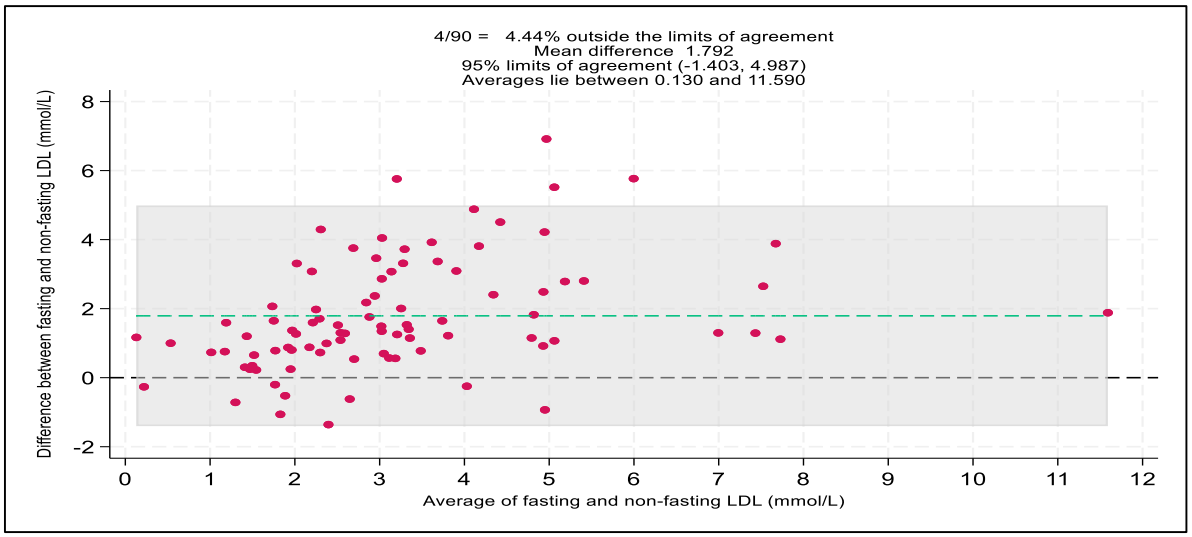

Figure 4: Bland-Altman graph of fasting and non-fasting plasma low density lipoprotein cholesterol.

DISCUSSION

The results of this study provide valuable insights into the comparative effectiveness of fasting and non-fasting lipid profiles for assessing cardiovascular risk in Nigerian adults. The results show that fasting significantly raises plasma TC and LDL-C levels compared to non-fasting, while non-fasting elevates TG levels. HDL-C levels showed minimal differences between fasting and non-fasting conditions. Importantly, the Bland-Altman plots revealed that most measurements for TC, TGs, HDL-C, and LDL-C between fasting and non-fasting states fell within clinically acceptable limits.[14,15] This suggests that non-fasting lipid profiles could be a practical and reliable alternative for cardiovascular risk assessment in Nigerian adults, offering a more convenient option without compromising diagnostic accuracy.

The higher levels of TC and LDL-C observed in fasting samples are consistent with the traditional belief that fasting conditions provide a stable baseline for lipid measurements. Fasting minimises the influence of recent dietary intake on lipid levels, particularly TGs, which are known to rise postprandially.[4] The higher TG levels in the non-fasting state are due to this rise that happens after a meal. This can temporarily raise lipid levels and could throw off assessments of cardiovascular risk if it is not properly taken into account.[16]

Our study's observation of minimal differences in HDL-C levels between fasting and non-fasting states challenges

the necessity of fasting for this lipid parameter. This finding aligns with previous research suggesting that non-fasting lipid profiles can be equally reliable for HDL cholesterol assessment, a critical factor in evaluating cardiovascular risk.[3] The minimal variance in HDL cholesterol levels suggests that we could use non-fasting measurements without significantly losing diagnostic accuracy.

Our results are significant because they challenge the longstanding reliance on fasting lipid profiles. Non-fasting profiles may offer comparable reliability for certain lipid parameters, particularly HDL cholesterol. This is especially relevant in regions where patient compliance with fasting requirements is challenging, such as Nigeria. Non-fasting lipid profiles could provide a more practical and patient-friendly alternative, enhancing patient compliance and streamlining clinical workflows without compromising the accuracy of cardiovascular risk assessments. Adopting non-fasting lipid profiles could also alleviate logistical burdens associated with fasting, such as the need for early morning appointments and overnight fasting, which are often inconvenient and difficult for patients to adhere to.[4]

The global trend towards accepting non-fasting lipid profiles, supported by organisations such as the European atherosclerosis society and the American college of cardiology, provides a strong rationale for further research in this area. Nordestgaard et al and Langsted and Nordestgaard studies have demonstrated the effectiveness of non-fasting lipid levels in assessing cardiovascular risk, highlighting the potential for similar applications in diverse populations, including Nigerians.[3,4] Our findings contribute to this growing body of evidence, emphasising the need for region-specific studies to tailor guidelines that consider local dietary habits, genetic predispositions, and prevalent health conditions.

Adopting non-fasting lipid profiles has broader implications for public health strategies. In resource-limited settings, where access to healthcare facilities and patient compliance with fasting protocols can be significant barriers, non-fasting lipid profiles offer a viable solution. Simplifying the testing process can improve access to cardiovascular risk assessment and early intervention, ultimately contributing to better health outcomes and reduced healthcare costs. Furthermore, we cannot overlook the psychological and practical benefits for patients. Removing the need for fasting can reduce anxiety and discomfort associated with blood tests, making the process more appealing and less burdensome. This could lead to increased participation in regular health check-ups and proactive management of cardiovascular risk factors.

However, the findings of this study highlight certain limitations and areas warranting further investigation. Although non-fasting lipid profiles show promise, we need to conclusively establish their predictive value for long-term cardiovascular outcomes in Nigerian adults. Future studies should focus on longitudinal analyses to evaluate whether non-fasting lipid profiles can reliably predict cardiovascular events over time. Additionally, this study was conducted in a hospital setting, which may not fully represent the broader Nigerian population. We need more extensive community-based studies to validate these findings across different demographics and settings. Another critical aspect that this study could not address is the potential variability in non-fasting lipid profiles due to different types of meals consumed before testing. Although we standardized the non-fasting sample collection timing to two hours post-meal, we did not control the composition of these meals. Future research should explore how different dietary compositions impact non-fasting lipid levels to provide more detailed guidelines on the optimal timing and conditions for non-fasting lipid testing.

In conclusion, this study provides compelling evidence that non-fasting lipid profiles could be a practical and reliable alternative to fasting profiles for assessing cardiovascular risk in Nigerian adults. While fasting provides a stable starting point, the small changes seen in HDL cholesterol and the manageable changes seen in other lipid parameters while not fasting suggest that non-fasting profiles are possible. These findings align with global trends and highlight the need for further region-specific research to establish robust guidelines that can enhance clinical practice and public health strategies in Nigeria. Future studies should focus on longitudinal outcomes, community-based validations, and the impact of different dietary compositions on non-fasting lipid levels to fully realise the potential benefits of this approach.

ACKNOWLEDGEMENTS

Authors are grateful to all the participants who took part in the study and the staff of the Medical Outpatient of the University College Hospital, Ibadan.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee UI/UCH Ethics Committee (UI/EC/17/0362)

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Cite this article as: Orimadegun BE, Afolabi FO, Tijani BA. Comparison of fasting and non-fasting lipid profile in Nigerian adults. Int J Res Med Sci 2025;13:587-94.