# Metabolic Health and bone density in youth living with perinatal HIV

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0822

The BONDY Study

## BACKGROUND

Adverse metabolic profiles in adults living with HIV are associated with traditional risk factors, HIV viraemia and antiretroviral therapy (ART). There is a paucity of data for youth living with perinatal HIV (YPaHIV) who experience HIV associated immune dysfunction and exposure to ART that may impact on metabolic outcomes associated with cardiovascular risk in later life. Body mass index (BMI) impacts both metabolic health and bone mineral density (BMD). We explored the relationship between markers of metabolic health, body fat distribution, hepatic steatosis and BMD in YPaHIV.

## METHODS

The BONDY study; a longitudinal observational cohort examined bone and metabolic health in YPaHIV aged 15-24 years by total body dual-energy X-ray absorptiometry (DXA), liver transient elastography (fibroscan) and fasting metabolic biochemistry. Two visits were undertaken at a median interval of 26 months with additional metabolic parameters measured at the second visit. Associations of markers with DXA and fibroscan outcomes and according ART regimen and tenofovir alafenamide (TAF) use were made using two-sample t-tests and correlations investigated by Pearson's coefficient.

Metabolic risk factors for lumbar spine (LS) BMD were assessed by linear regression.

- Age group at recruitment: 15-19 years vs 20-24 years
- Sex: male vs female
- Ethnicity: Black African vs other
- Body mass index: normal v over weight v obese
- Treatment group: TAF versus non TAF/ non tenofovir disoproxil
- Current ART regimen: Protease inhibitor (PI)-based vs non-nucleoside reverse transcriptase inhibitor (NNRTI)-based vs integrase inhibitor-based (INSTI) vs Other
- Current CD4 count: Categorised as above or below the median

Rates of the metabolic syndrome were defined using the Metabolic syndrome consensus definition adjusted for age and ethnicity.*

## PARTICIPANTS

85 youth living with PaHIV; 49 (58%) male, 80 (94%) black ethnicity, median age 22 years (IQR 19-24), and CD4 count 645 (IQR 272) cells/ul, were followed for 26 months (IQR 25-28). Mean (SD) systolic blood pressure (BP) was 120 (12), fasting lipids; triglycerides 0.7 (0.9), HDL 1.4 (0.4) and fasting glucose 4.5 (0.5). 6 (7.1%) fulfilled 3 or more criteria for the metabolic syndrome* with 13 (15.5%) and 30 (35.3%) two and one criteria respectively.

85 Youth living with Perinatal HIV median age 22 years,
94% black African, 42% female, 7% with metabolic syndrome*
were followed for 26 months

Adverse metabolic profiles including BMI, fasting lipids and gynoid fat distribution impacted negatively on bone health

There was no difference in weight gain or BMI change by TAF v non-TAF or by INSTI v NNRTI/PI usage

## RESULTS

- Positive correlations ($p<0.05$) were seen with BMD with BMI 0.23 (0.03), were as negative correlations with BMD were seen with fasting lipids [total cholesterol -0.33 (0.002), triglycerides -0.23 (0.03), LDL -0.31 (0.004)], total body -0.26 (0.02) and gynoid -0.26 (0.02) fat. (Table 1)
- Positive correlations with controlled attenuation parameter (CAP) score were seen with BMI 0.27 (0.01), waist circumference 0.29 (0.007) and fasting glucose 0.33 (0.002) but not with lipid or body fat parameters.
- Mean BMI was 25.7 (5.4) with no difference in change from baseline by TAF (n 44) versus non-TAF (n 41) including ART; +0.6 (2.7), +1.4 (2.6) respectively [p=0.22] (figure 1)
- Mean weight was 65.5 (15.5) kg with no difference in change from baseline by TAF (44) versus non-TAF (41) including ART +2.2 (7.8), +3.7 (6.3) respectively [p=0.34]
- Metabolic factors according to TAF vs non-TAF differed only for total cholesterol; mean (SD) 4.4 (0.9) v 4.0 (1.0); p0.03 with no differences seen for triglycerides, BMI, weight, waist circumference and body fat distribution.

**Table 1 Mean values and positive metabolic correlations with DXA and fibroscan results**

| | Mean (SD) | Correlation with LS BMD | Correlation with LS BMC | Correlation with hip BMD | Correlation with CAP score | Correlation with E score |
|---|---|---|---|---|---|---|
| LS BMD | 1.21 (0.18) | - | - | - | - | - |
| LS BMC | 48.2 (11.0) | - | - | - | - | - |
| Hip BMD | 1.08 (0.17) | - | - | - | - | - |
| CAP | 199 (53) | -0.04 (0.73) | 0.02 (0.89) | 0.10 (0.38) | - | - |
| E score | 5.31 (3.62) | 0.08 (0.48) | 0.07 (0.57) | -0.08 (0.49) | - | - |
| BMI | 25.7 (5.4) | 0.20 (0.07) | 0.04 (0.72) | **0.23 (0.03)** | **0.27 (0.01)** | 0.19 (0.08) |
| Systolic BP | 120 (12) | 0.21 (0.06) | **0.38 (0.0009)** | **0.22 (0.04)** | 0.04 (0.70) | 0.14 (0.22) |
| Waist circum | 81 (14) | 0.13 (0.23) | 0.11 (0.34) | 0.15 (0.16) | **0.29 (0.007)** | **0.23 (0.04)** |
| Total cholest | 4.2 (0.9) | **-0.31 (0.004)** | -0.19 (0.10) | **-0.33 (0.002)** | 0.10 (0.37) | -0.01 (0.94) |
| Triglycerides | 0.7 (0.9) | **-0.27 (0.01)** | -0.18 (0.12) | **-0.23 (0.03)** | 0.05 (0.62) | -0.02 (0.81) |
| LDL | 2.6 (0.7) | **-0.31 (0.004)** | -0.19 (0.11) | **-0.31 (0.004)** | -0.03 (0.77) | -0.04 (0.73) |
| Glucose | 4.5 (0.5) | -0.13 (0.26) | 0.00 (0.98) | -0.10 (0.36) | **0.33 (0.002)** | 0.12 (0.29) |
| ALT | 26 (22) | -0.07 (0.52) | -0.06 (0.64) | -0.07 (0.54) | 0.16 (0.16) | **0.56 (<0.0001)** |
| AST | 29 (14) | 0.02 (0.88) | 0.08 (0.49) | 0.01 (0.91) | 0.19 (0.08) | **0.42 (0.0001)** |
| Total body fat | 33.8 (10.8) | -0.10 (0.35) | **-0.27 (0.01)** | **-0.26 (0.02)** | 0.16 (0.16) | 0.09 (0.41) |
| Gynoid fat | 37.2 (12.7) | -0.05 (0.63) | **-0.30 (0.01)** | **-0.26 (0.02)** | 0.15 (0.17) | 0.08 (0.49) |

No correlation was seen with: CD4 count, change in BMI, change in weight, android fat, android:gynoid fat ratio, diastolic BP, heart rate, HBA1C, HDL, total cholesterol: HDL, albumin and platelet count. LS BMD; Lumbar spine bone mineral density, BMC; bone mineral content, CAP; controlled attenuation parameter

**Figure 1**

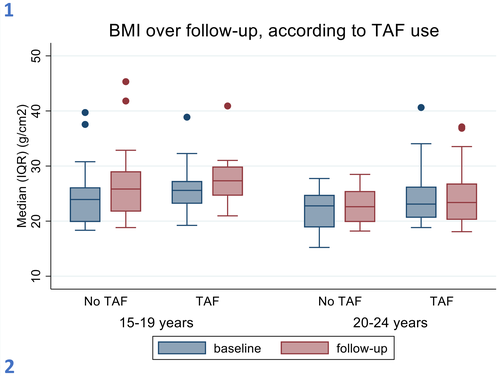
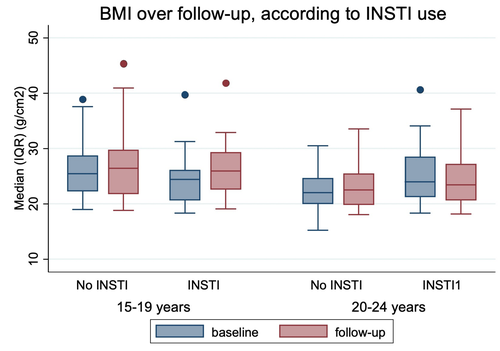



**Figure 2**




## CONCLUSIONS

Metabolic factors including gynoid fat distribution and abnormal lipid profiles impacted adversely on both metabolic and bone health in this youth cohort living with PaHIV. Effective interventions targeting traditional risk factors are required.

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**Acknowledgements:** we would like to acknowledge all the participants who kindly took part in the BONDY study and the clinical and research teams from the Family and 900 Clinics, the Childrens Research Unit and Clinical Trials @The Jefferiss Wing for their invaluable support.

**Funding:** Investigator led grant from Gilead Sciences

***Metabolic Syndrome Consensus definition:**

3 of the following lead to a diagnosis of the metabolic syndrome (IDF, AHA, NHLBI incorporated)

- Waist circumference > 102cm men, >88 cm women (from 16 years, adjusted for ethnicity)
- Triglycerides >/=1.7
- HDL <1.04 men, <1.29 women
- BP >/= 130/85 (from 15 years of age)
- Fasting glucose >/= 5.6

Ref; Metabolic syndrome - Symptoms, diagnosis and treatment | BMJ Best Practice 2022