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Impact of the COVID-19 pandemic on BMI in youth living with HIV

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Abstract

Background: Many youth saw a rise in body mass index and obesity during the COVID-19 pandemic associated with virtual schooling and a lack of physical exercise options due to lockdown orders. However, the impact of the worldwide COVID-19 pandemic on body mass index in HIV-infected youth on anti-viral therapy has not been studied.

Objective: This study examined COVID-19's impact on body mass index in 157 behaviorally acquired and 39 perinatally acquired youth living with HIV.

Methods: Retrospective chart analysis was conducted for body mass index records across pre-COVID, COVID, and post-COVID periods.

Results: Age and acquired type showed significant associations with increased body mass index. Limitations included missing data and physiological body mass index changes.

Conclusion: The perinatally acquired group's body mass index increased by 1.6 during and 2.3 post-pandemic compared to pre-pandemic levels. Longitudinal follow-up of body mass index changes is needed in this vulnerable population.

Keywords
Pandemic, HIV, BMI, youth, antiretrovirals

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Background

The COVID-19 pandemic was a difficult and sedentary period for many people. Strict lockdown orders led to adults working from home, children doing virtual schooling, and an all-around lack of physical exercise. Many youth saw a rise in body mass index (BMI) and obesity during the pandemic, with emphasis on weight gain in vulnerable populations: previously obese youth, uninsured youth, and Hispanics.[1] To our knowledge, the impact of the worldwide COVID-19 pandemic on BMI in HIV-infected youth on anti-viral therapy has not been studied.

In addition, BMI changes related to pandemic factors, integrase strand transfer inhibitors (INSTI)—now a common treatment backbone in combination HIV therapy—have had some concerning reports linked to increased weight gain as a side effect.[2–4] Dolutegravir, specifically, showed the highest weight gain in a systematic review of INSTI studies.[5,6] There has also been concern about weight gain in those persons living with HIV switching off of tenofovir disoproxil fumarate and/or onto tenofovir alafenamide.[2,7] Another study showed increased weight gain in the perinatally acquired (PA) group on INSTI versus the behaviorally acquired (BA) group.[3]

We sought to determine the association of the COVID-19 pandemic with changes in BMI of youth with BA compared to PA HIV infection while also considering the potential effect of the patient's antiviral class of medication.

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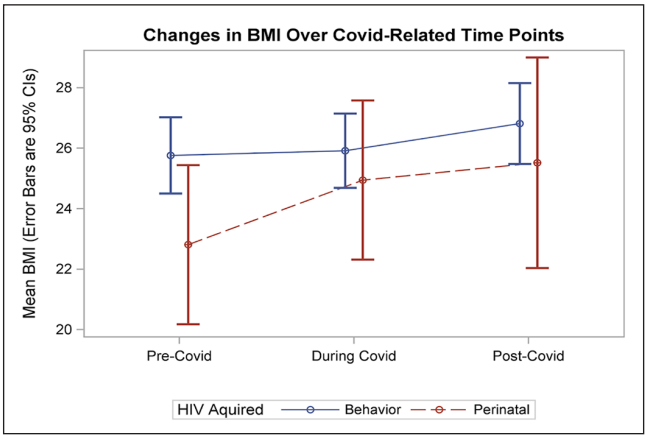

Figure 1. Changes in BMI over COVID-related time points. The figure demonstrates the mean and 95% confidence intervals for BMI at each study-defined timepoint (pre-, during, and post-COVID).

Methods

A retrospective chart review was completed on all patients at the "Horizons Project" HIV clinic via the EPIC electronic medical record (EMR) system from January 2019 to December 2021. Inclusion criteria were persons living with HIV receiving care in the clinic; age range of 1–32 years and one or more appointments attended over the 3 years. The exclusion criterion was any patient (record) not meeting the inclusion criteria. Patients were assigned a number and then de-identified for the data collection process. Patients were then grouped into BA or PA. Factors measured were age, sex (biologic), antiretroviral regimen, and BMI (kg/m^2). BMI was measured at three time points; pre-COVID (2019), COVID (2020), and post-COVID (2021) to note trend over time. To be clear, data from 2019 were considered pre-COVID, as March 2020 was considered "during COVID" as this was when most pandemic lockdown protocols were first put in place. The year 2021 was deemed as "post-COVID" due to the widespread lifting of pandemic restrictions in Michigan by that time.[8]

Statistical analysis

The analysis performed was a chi-square (or Fisher's exact) test for categorical data depending on the size of the sample.[9,10] For continuous data with normal distribution, we used Student's *t*-tests. To account for potential interdependencies within our data, we utilize a random effect (intercept) and repeated measures linear model (PROC MIXED in SAS ver 9.4, (SAS Institute Inc., Cary, NC, USA)). Mandatory included variables were age, group (BA or PA), and time (pre-, during, and post-COVID). Drug class and sex were considered but were removed since $p > 0.1$ for both and those factors did not improve model performance. Of major interest is the group × time interaction (changes over time by group). Given the number of included patents, this was the only interaction we were able to examine. This technique allowed us to assess the main effects but also capture the nuanced variations that might arise from repeated measurements within the same subjects.

Ethical approval and informed consent

This study was approved by the Wayne State University Human Investigation Committee (Institutional Review Board), number IRB-22-03-4446, with a waiver of informed consent.

Results

Included in this study were 196 patients treated at the "Horizons Project" HIV clinic. Of these, 144 (73%) were males and 52 (27%) were females. There were 157 (80%) BA subjects and 39 PA (20%). Mean (standard deviation) ages were 23.0 (2.7) in the BA group and 16.8 years (6.9) ($p < 0.0001$) in the PA group. An INSTI was the treatment backbone for 163 (86%). Mean BMI was noted among grouped subjects during the three time intervals in univariate analysis: pre-COVID (25.1 ± 7.2), during COVID (25.7 ± 6.9), and post-COVID (26.7 ± 7.4).

The unadjusted BMI changes at each of the three time points grouped by BA and PA groups are shown in Figure 1. The mixed linear model included 190 patients and suggested age ($p < 0.0001$) and the acquired type × time period interaction ($p = 0.005$) were associated with increased BMI. Table 1 shows the estimates with associated 95% confidence intervals for factors included in the final model.

Discussion

After accounting for patient age and class of antiviral agent taken by the patient, BMI in the PA group increased by 1.6 during the pandemic and by 2.3 post-pandemic relative to pre-pandemic. The trend of increased BMI was not seen in BA subjects. The BA group may have had additional food insecurity issues as adults. They also could have been working (not in prolonged or long-term virtual school sessions) during the pandemic, allowing for more physical activity than the younger cohort. This distinction in daily routines and responsibilities during the pandemic could certainly contribute to the differing BMI outcomes observed. To further understand the foundations of BMI changes in this vulnerable population—whether from virus suppression, adverse effects of treatment regimens, or other causes—longitudinal follow-up is required.

A strength of this study is that the entire patient population from Horizons HIV clinic was assessed. Also, the repeated measures statistical model strengthened our results as it gave a better depiction of the BMI trend over the 3-year time period.

Table 1. Mixed linear model results.

Effect	Estimate	Lower 95% CI	Upper 95% CI	*p*-value
Intercept	13.71	7.70	19.73	<0.0001
Age (per year)	0.46	0.24	0.69	<0.0001
How acquired				
Perinatal	0.34	−2.92	3.60	0.84
Behavior	Ref.			
Drug class				
Integrase backbone	1.16	−2.08	4.40	0.48
Non-integrase backbone	Ref.			
Time period				
COVID	0.35	−0.16	0.86	0.18
Post-COVID	1.45	0.85	2.05	<0.0001
Pre-COVID	Ref.			
Acquired × period interaction[a]				
Perinatal during COVID	1.60	0.64	2.57	0.001
Perinatal post-COVID	2.29	0.36	4.23	0.02
Perinatal pre-COVID	Ref			

CI, confidence interval.
[a]Overall *F*-test $p = 0.005$.

A limitation of this study is the missing data from a proportion of patients who did not attend their appointments each year during the study periods along with the fact that no sample size calculation was completed. This could be due to the vulnerable urban patient population having barriers to attending medical appointments, like lack of transportation and/or time off work. In addition, it was also not possible to exclude some normal physiological BMI changes from the data interpretation. Finally, the influence of confounding factors, such as socioeconomic status, access to healthcare, and psychological stress on BMI, remains unknown.

Possible future routes for study include collecting data from the "Horizons Project" HIV clinic patients on the socioeconomic influences on BMI that may impact them and accounting for that in the analysis. These could include food insecurity, stable employment, transportation to grocery stores, access to gyms/fitness centers, and geographical location in relation to healthy food options and others. Possible longitudinal interventions that could be measured to assess for influence on BMI trends could include nutrition and dietary counseling; involvement in physical activity programs or organized sports through school or the local community; mental health support and support groups; and community healthy, fresh produce food distribution programs.

Conclusion

Youth living with PA HIV BMI increased by 1.6 during the pandemic and by 2.3 post-pandemic relative to pre-pandemic. These same changes in BMI were not noted in the BA patient population. Longitudinal studies and follow-up will be required to assess future BMI trends in these vulnerable populations.

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None.

Author contributions

EM, ES, SM, and CH were responsible for the conceptualization, study design, data collection, investigation, and original draft. RDW reviewed data initially and completed a formal analysis with EM, SM, and ES. SM, ES, CH, RW, and EM then wrote, critically revised, and edited the original into a final draft. The final draft of the work was read and approved by all authors before submission.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethics approval

Ethical approval for this study was obtained from the Wayne State University Human Investigation Committee (IRB; approval number: IRB-22-03-4446).

Informed consent

Informed consent was not sought for the present study because the study was retrospective and obtaining consent would have made the study impossible to complete in a reasonable timeframe: A waiver of informed consent was requested and granted for this study as the study was retrospective in nature and obtaining informed consent would have made it impossible to carry out the study.

Trial registration

Not applicable.

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