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Journal

BMJ Open, 14(3)

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Publication Date

2024-03-08

DOI

10.1136/bmjopen-2022-065498

BMJ Open

Silhouette showcards confirm altered obesity-associated body image perception in international cohort study of African-origin populations

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To cite: Choo-Kang C, Reese TO, Micklesfield LK, *et al*. Silhouette showcards confirm altered obesity-associated body image perception in international cohort study of African-origin populations. *BMJ Open* 2024;**14**:e065498. doi:10.1136/bmjopen-2022-065498

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-065498).

JP-R since deceased.

Received 12 September 2022
Accepted 30 November 2023

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ABSTRACT

Objectives Given the increasing prevalence of obesity and need for effective interventions, there is a growing interest in understanding how an individual's body image can inform obesity prevention and management. This study's objective was to examine the use of silhouette showcards to measure body size perception compared with measured body mass index, and assess body size dissatisfaction, in three different African-origin populations spanning the epidemiological transition. An ancillary objective was to investigate associations between body size perception and dissatisfaction with diabetes and hypertension.

Setting Research visits were completed in local research clinics in respective countries.

Participants Seven hundred and fifty-one African-origin participants from the USA and the Republic of Seychelles (both high-income countries), and Ghana (low/middle-income country).

Primary and secondary outcome measures Silhouette showcards were used to measure perceived body size and body size dissatisfaction. Objectively measured body size was measured using a scale and stadiometer. Diabetes was defined as fasting blood glucose ≥126 mg/dL and hypertension was defined as ≥130 mm Hg/80 mm Hg.

Results Most women and men from the USA and Seychelles had 'Perceived minus Actual weight status Discrepancy' scores less than 0, meaning they underestimated their actual body size. Similarly, most overweight or obese men and women also underestimated their body size, while normal weight men and women were accurately able to estimate their body size. Finally, participants with diabetes were able to accurately estimate their body size and similarly desired a smaller body size.

Conclusions This study highlights that overweight and obese women and men from countries spanning the epidemiological transition were unable to accurately perceive their actual body size. Understanding people's perception of their body size is critical to implementing successful obesity prevention programmes across the epidemiological transition.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Strengths include a large, diverse cohort of African-origin individuals.
⇒ Use of participants who have been enrolled in research for several years and are well acclimated to research protocols.
⇒ Use of the epidemiological transition as a framework and use of tested methodologies to analyse body perception.
⇒ Limitations include biases due to use of self-reported data.
⇒ Limited sample size per country as cohorts were not necessarily representative of the entire country and lack of data describing risk factors related to diabetes and hypertension.

BACKGROUND

The prevalence of overweight and obesity is increasing in populations spanning the epidemiological transition and is particularly high in individuals of African origin, particularly women.[1–4] Overweight and obesity are strongly associated with the onset of non-communicable diseases such as type 2 diabetes and cardiovascular disease.[4–7]

Obesity is a complex, multifaceted condition. The development of obesity is rooted not only in the traditional biophysiological aetiologies related to energy balance, but also through sociocultural factors.[2 8–13] Given that a disproportionate number of individuals of African origin live in low/middle-income countries (LMICs) around the world, it is argued that racial inequities are rooted in a lack of access to a healthy, affordable diet, time for exercise, equality in education attainment and lack of adequate health-promoting resources.[14] While these social determinants of health explain some of the disparities surrounding obesity, an additional factor

focused on the psychological concept of body image[13] has garnered new attention.

Body image consists of both body perception and attitudinal dimensions of an individual. The perceptual assessments of body image examine the accuracy of an individual's ability to classify their weight relative to medical standards, typically body mass index (BMI). At the same time, the attitudinal component explores the individual's feelings and thoughts they have about their body, such as body satisfaction and perceived attractiveness.[13 15] Recent focus has turned to how misperception of body size and body dissatisfaction may be related to the development and management of obesity.[16–21]

Studies including African American women find that as an individual's BMI class increases, that is, to overweight or obesity, their ability to correctly classify their weight decreases. In a study of 69 African American women with a mean BMI ≥35 kg/m^2, 65% did not classify themselves as having obesity, while 29% did not even classify themselves as overweight.[17] Further, other studies of African American women have shown that perceived body size is not associated with health problems.[22] Although not as well studied, the role of sex has been explored and shows that cross-culturally men tend to have less accurate body size perception than women.[16 19 21] Men also desire a higher degree of muscularity and lean body mass, and some studies indicate that the male body image is a fine line between not desiring to be too thin versus not wanting to be large.[23–26]

To date, there are only a handful of studies exploring body image in adults living in LMICs.[27–29] Indeed, a dichotomy between traditional African ideals of body image and Western ideals has emerged, that is, thinner, leaner bodies.[27 28 30] Historically, many African cultures have favoured overweight or obesity, as it has been shown that a larger body size in women can indicate respect, beauty, health and fertility, while in men, it suggests wealth, dignity, confidence, and not having HIV or tuberculosis.[29 30] However, as Westernisation reaches across the epidemiological transition through globalisation, more individuals are being exposed to Western ideals of body image. One study in Ghana noted that most adolescents of both sexes favoured a medically defined normal or underweight BMI.[28] However, they noted that the traditional preference of the overweight ideal was still present in some adolescents.[28] Studies of African-origin women in South Africa have also encountered this shifting dichotomy across cultures and generations, with some favouring traditional African views, while others prefer Westernised ideals.[29–33] Few studies have compared body image across the epidemiological transition to examine how body size perception and dissatisfaction vary along the developmental continuum and differing mean population BMIs. Additionally, to our knowledge, very few studies have investigated how body size perception and dissatisfaction may affect development of diabetes and hypertension. One study investigated this relationship but found no statistically significant associations.[34] The same study did identify a positive association between perceived cardiovascular disease threat and body size dissatisfaction. Most studies discuss obesity being linked to diabetes and cardiovascular diseases in relation to body size misperceptions but do not explicitly look for associations with diabetes and hypertension. As body perception is linked to modifiable risk factors for cardiometabolic health (eg, drinking, poor eating habits), this can be important to the health promotion and guidelines given to patients regarding the management of diabetes and hypertension.

Previous studies examining body image have used validated questionnaires and silhouette showcards.[34 35] Our study uses the previously validated Pulvers' silhouette showcard survey tool for African-origin populations. Participants select their perceived weight status and desired appearance from the silhouette drawings. This study's main objective was to measure body size discrepancy and assess body size dissatisfaction in three African-origin populations spanning the epidemiological transition, with differing Human Development Index (HDI) scores. An ancillary objective was to investigate associations between wanting to be small and underestimating body size with diabetes and hypertension. We predict that underestimating body size will be associated with obesity. Furthermore, we predict this will be associated with poorer cardiometabolic health as these individuals may be more likely to participate in behaviours adverse to cardiometabolic health (eg, excessive drinking, overeating).

METHODS

Study populations

This study is a subset analysis from the Modeling the Epidemiologic Transition (METS)-Microbiome Study (R01-DK111848) initiated in 2017, for which the protocol has been published.[36] The METS-Microbiome Study is a longitudinal study which includes annual measurements of participants initially recruited for the METS (R01-DK080763) in five African-origin populations spanning the epidemiological transition varying by the United Nations HDI 2010.[36 37] The current data were collected between 2018 and 2019 from participants in metropolitan Chicago, Illinois, USA (HDI: 0.92, n=265), the mixed urban/rural Seychelles islands (HDI: 0.80, n=283) and rural Ghana (HDI: 0.59, n=203).[36 38] These three sites represent different stages of social and economic development and are classified by the World Bank.[39] The USA and Seychelles are high-income countries, while Ghana is classified as a low/middle-income country.

The study consisted of men and women aged 30–68 years old who were of African origin, except for Seychelles, where both black African participants and participants of mixed racial ancestry were included. Approximately 66% of the whole sample identified as female.

Patient and public involvement

Patients and members of the public were not involved in the design, conduct or dissemination of the study.

Anthropometric measurements

Participants completed a health examination, including measured height (m) and weight (kg). Across all sites, standardised equipment and protocols were used, as previously described.[36] BMI (weight (kg)/height (m^2)) was calculated and classified as underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2) or obese (BMI ≥30 kg/m^2).[39] Diabetes was defined according to the American Diabetes Association as fasting glucose ≥126 mg/dL or diagnosed with diabetes.[40] Fasting blood glucose was measured from capillary blood glucose tests (Accu-chek Aviva Plus, Roche). High blood pressure was defined as systolic blood pressure ≥130 mm Hg or diastolic blood pressure ≥80 mm Hg using the American Heart Association's definition. Participants had their blood pressure taken twice at least 1 hour apart, and each time, their blood pressure was measured three times (Omron, Kyoto).

Survey and silhouette body size showcards

The survey component of the METS-Microbiome Study consisted of a face-to-face interview performed by centrally trained personnel, capturing participants' sociodemographic status, health-related behaviours and medical history. Specifically, for this study, participants were presented with a sex and ethnicity-specific silhouette showcard (figure 1) created by Pulvers.[35] This nine-image tool displayed sex-specific body sizes in increasing order, ranging from very thin (estimated BMI of ≤18 kg/m^2) to morbidly obese (estimated BMI of >40 kg/m^2).[36]

To measure the perceptual and attitudinal components of body image, participants were asked, 'In the drawing, which figure best reflects how you think you look with regard to your body shape?' and a follow-up question of 'In the drawing, which figure best represents how you would like to look like with regard to your body shape, ideally?'. Participant responses were recorded on a scale from 1 (representing the thinnest silhouette) to 9 (representing the most obese silhouette). The first question was used to assess perceptual body image, and the latter assessed the attitudinal body image.

Body size discrepancy was assessed using the 'Perceived minus Actual weight status Discrepancy' (PAD) score, calculated by subtracting actual measured BMI status from perceived self-selected silhouette body size status.[33 41] Actual BMI status was coded as follows: 1=underweight (BMI <18.5 kg/m^2), 2=normal weight (BMI 18.5–24.9 kg/m^2), 3=overweight (BMI 25.0–29.9 kg/m^2) or 4=obese (BMI ≥30 kg/m^2). Perceived body size status was coded as follows: 1=silhouettes 1 and 2 (underweight); 2=silhouettes 3–5 (normal weight); 3=silhouettes 6 and 7 (overweight); and 4=silhouettes 8 and 9 (obese). Negative PAD scores represent an underestimation of current body size status, positive scores represent overestimation and a score of 0 represents participants who had an accurate perception of their body size status.

To determine body size dissatisfaction, a Feel–Ideal Discrepancy (FID) score was calculated by subtracting the ranking number, valued 1 through 9, of each silhouette that the participant thought would be their ideal body size (ideal score) from the silhouette rank number that the participant felt represented their current weight status (feel score). Positive FID scores represent a desire to be thinner, negative scores represent a desire to be larger and a score of 0 represents body size satisfaction.

Statistical analysis

Participant characteristics were summarised using means and 95% CIs. Proportions were calculated and presented as a per cent for categorical variables with accompanying CIs. Differences between sites were explored using logistic

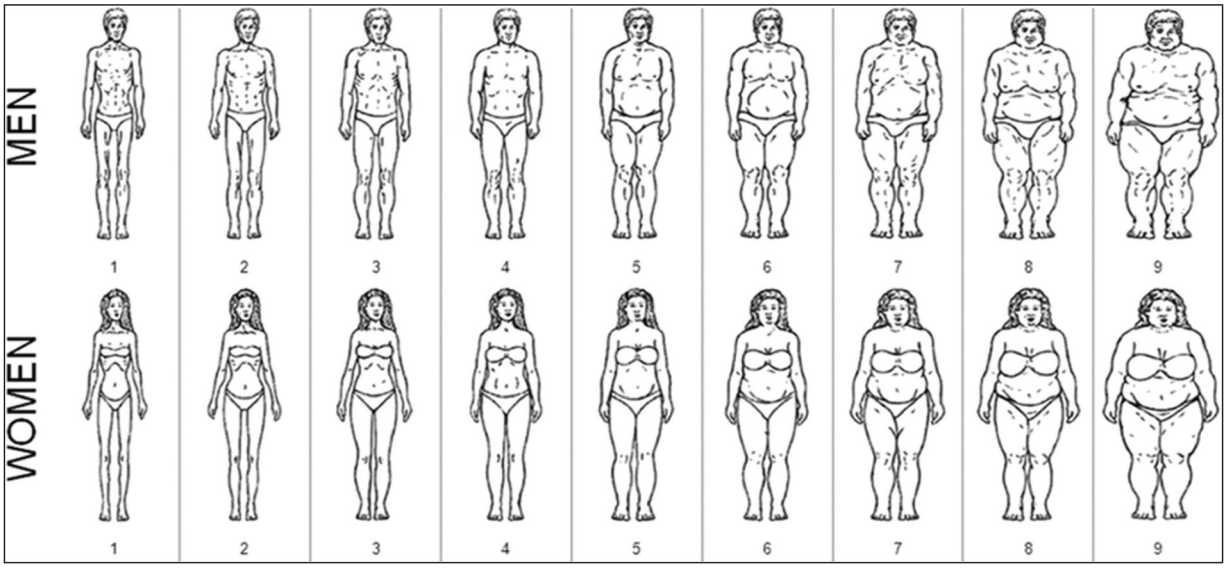

Figure 1 Pulvers' silhouettes designed for populations of African origin (source: Pulvers 2004, Obesity Res).

regressions. Logistic regressions adjusted for sex, age and obesity were used to evaluate associations between PAD and FID scores with diabetes and hypertension in order to estimate effects that perceived body size and body size dissatisfaction may have on these health outcomes. Sex, age and obesity were adjusted for as these are known determinants of both the exposure and outcome. All statistical analyses were performed using STATA SE V.12 (StataCorp, College Station, Texas, USA).

RESULTS

Demographics

Online supplemental table 1 shows the main characteristics of the 751 participants from the three countries. Mean age differed slightly across countries and was highest in men in the USA (47.1±6.2 years) and lowest in women in Ghana (41.4±5.8 years).

Anthropometrics

All measures of size, including height, weight and adiposity, tended to be highest in the USA, followed by participants in Seychelles and lowest in Ghana. BMI was higher in women than men in all countries (online supplemental table 1).

PAD scores: body size discrepancy

Commensurate with their larger body size, US women selected a larger 'feel' silhouette (6.2±1.7) than women from Seychelles and Ghana (5.4±1.7, p<0.01 and 5.5±2.0, p<0.01, respectively). There were no significant differences between the body image perception silhouettes selected by the men from the three different countries.

None of the women from the USA, only 0.5% from Seychelles and 7% of those from Ghana overestimated their body size. Of the US women with obesity, almost 69.5% did not accurately perceive themselves as having obesity. Similarly, 79.8% of Seychellois women and 65.3% of Ghanaian women who had obesity underestimated their weight status.

In the USA and Seychelles, only 26.1% and 29.0% of men accurately perceived their body size, while 53.7% of men in Ghana were able to perceive their body size accurately. Most overweight men in all three countries perceived themselves as normal weight or underweight (USA: 93.7%, Seychelles: 87.8%, Ghana: 65.2%).

Logistic regression models adjusted for age and sex demonstrated that overweight and obese individuals were more likely to underestimate their body size (obese OR Ghana: 4.77 (CI: 3.2, 6.3), Seychelles: 2.12 (CI: 1.2, 3.1), USA: 3.83 (CI: 2.5, 5.1)).

FID scores: body size dissatisfaction

When examining the FID scores, US women had the highest mean score compared with the significantly lower FID scores in Seychelles and Ghana (p<0.001 and p<0.001, respectively), meaning US women desired to be thinner. Men in Seychelles had a significantly higher mean FID score (0.84) compared with their US and Ghanaian peers (0.27, p=0.007 and 0.12, p<0.001, respectively). Across all sites, women tended to have higher FID scores than men. US women had the highest prevalence of body size dissatisfaction (positive or negative FID scores), with 94.4% of US women not content with their current weight status. Of the US women, 89.8% desired to be smaller (positive FID score), which was significantly higher than 50% in the Ghanaian women (p<0.001). Among the men, US men overall had the greatest body size dissatisfaction when compared with Ghanaian and Seychellois men, with 72.7% of men not content with their current weight status (p<0.001), with 40.9% wanting to be thinner and 31.8% wanting to be larger. The majority of men from Seychelles wanted to be thinner (57.0%), while the majority of men from Ghana (56.7%) were content with their body size.

Not surprisingly, FID scores were significantly higher for participants with overweight and obesity across all three sites, except for overweight Seychellois participants, when compared with their normal weight counterparts when adjusted for age and sex.

Health outcomes

Using logistic regression models adjusted for sex, age and obese status, those who wanted a smaller body size had increased odds of diabetes in the Ghanaian and Seychellois cohorts (table 1). In Ghana, those who wanted a smaller body size had higher odds of hypertension (table 1). There were no statistically significant association between underestimating body size and higher odds

Table 1 ORs (with CIs) for health outcomes

OR (CI)	Ghana	Seychelles	USA
Want smaller body size			
Diabetes	**4.06 (1.2, 14.0)**	**3.94 (1.5, 10.2)**	2.64 (0.82, 8.5)
High blood pressure	**3.63 (1.2, 10.7)**	1.5 (0.71, 3.2)	2.0 (0.87, 4.6)
Underestimate body size			
Diabetes	0.44 (0.14, 1.4)	1.78 (0.80, 3.9)	0.90 (0.44, 1.9)
High blood pressure	1.79 (0.73, 4.4)	0.85 (0.44, 1.6)	0.65 (0.37, 1.1)

Bold indicates statstical significance.

of diabetes and hypertension in any site. Ghanaian men who underestimated their body size had 1.8 odds of high blood pressure (CI: 0.73, 4.4). While this was not statistically significant, it may be clinically significant as this expresses increased odds of high blood pressure in those who underestimate body size and can be important to health promotion.

DISCUSSION

Our results reinforce previous findings that African-origin women and men spanning the epidemiological transition have poor body size perception and high rates of body size dissatisfaction. Our data also show that as an individual's BMI increases, they are less likely to perceive their body size accurately and more likely to be dissatisfied with their body size.

Previous research has demonstrated that there are differences in perceived body image between traditional African views which favour a larger body size, and Western ideals favouring lower total body weight and size.[11 12 14] We show that when compared with LMICs like Ghana, more women from high-income countries such as the USA and Seychelles underestimate their current body size compared with their measured body size, while simultaneously also having a greater body size dissatisfaction and desire to be thinner. This also supports previous studies demonstrating higher tolerance for obesity and the positive cultural connotations associated with larger body size in African women outside of the USA.[14]

Similarly, among the men, US participants had the highest prevalence of body size dissatisfaction, with the majority wanting to be larger, followed by their Seychellois and then their Ghanaian counterparts. However, our results also support previous research demonstrating that across all sites, men tend to desire larger body size.[15–18] When comparing participants' self-reported feel silhouette compared with their measured BMI, the data show that as BMI increases, participants across all three sites tended to perceive their weight status less accurately and were more likely to be dissatisfied with their body size. By sex, women in all three sites had higher prevalence of body size dissatisfaction when compared with men. This may indicate that Westernised body image may have a larger impact on US women when compared with the other site-sex categories. However, it is interesting that prevalence of obesity was highest in the US women.

To our knowledge, few studies have investigated the impact of underestimating body size and health outcomes. We found that underestimating one's body size was associated with health outcomes such as type 2 diabetes and high blood pressure after adjustment for sex, age and obesity. Indeed, we documented significant associations between underestimating body size and a desire to be smaller in overweight/obese participants. However, it is possible that those who are overweight or obese are more likely to underestimate their body size or want a smaller body, or simply that they are unaware that their body size may be linked with health outcomes. It is, however, also plausible that as individuals become more obese, they may have a distorted (underestimated) view of their current weight status, possibly leading to less engagement with weight-loss strategies and engagement with medical or public health interventions. Previous studies have found that body image dissatisfaction was positively associated with cardiovascular disease risk factors like smoking and emotional stress.[34 41] Similar to previous research, we identified associations between body image dissatisfaction and poor health outcomes (ie, obesity, type 2 diabetes and hypertension).[34] We were surprised to document a stronger relationship between wanting smaller body and poor health outcomes when compared with underestimating body size. It seemed intuitive that those who were unaware of their body size would be less aware of their health and, consequently, more likely to have type 2 diabetes or hypertension. It is possible that those who wanted a smaller body size were more aware of their large body size due to their concomitant illness and wanted to lose weight for their health. Weight loss is a common recommendation for management of type 2 diabetes and hypertension. Perhaps the health education these patients are receiving encourages these participants to want a smaller body size. However, 95.3% of those who wanted a smaller body size already presented as overweight or obese. Although the management of type 2 diabetes and hypertension focuses on better health practices, health promotion strategies may need to specifically emphasise weight-loss strategies.

With this insight, the results of our study not only support the presence of differences in the perception of body image across the epidemiological transition but also highlight possible barriers to the prevention and management of obesity. Our study has shown that both men and women in high-income countries tend to be obese, underestimate their weight and have high rates of body size dissatisfaction. These findings highlight that the intrinsic and extrinsic motivational factors surrounding successful behaviour change models need to be further investigated. Further assessment of body image through this lens could allow for more culturally informed methods for the prevention and management of obesity.

Although standardised questionnaires, protocols, analysis and methodology allowed us to make comparisons across the three international sites, it is important to recognise limitations to our study. First, while approximately 69% of our sample populations identified as black or African American, approximately 31% identified as mixed ancestry, including Caucasian, Indian, Chinese, Creole and Native American. While many of these participants were from the African archipelago, the Republic of Seychelles and their contribution has been noted in prior studies involving the silhouette use in Seychelles, their significance should be considered when applying the silhouette showcard more broadly to African-origin populations. Also, all participants were between 30 and 68 years of age, making the generalisability of the silhouette showcards to elderly and paediatric populations not as

applicable. Second, the nine-character silhouette showcard tool used has only a defined number of options for participants to select from, which tends to limit the extreme spectrums of body size, namely the very thin and very obese, in choosing an appropriate image. Therefore, these silhouettes may not be appropriate in populations comprised primarily of underweight or extremely obese individuals. Third, during the survey administration, participants were presented with the silhouettes in one image in increasing order from thinnest to heaviest. As a result, this could lend itself to reporting bias. In future studies, a possible way to avoid such bias could be to present the silhouettes in random order and have participants select the perceived silhouette through that method. Fourth, our study may overstate the validity of silhouette showcards in different survey settings given that our survey interviews were conducted face-to-face, potentially biasing the respondent's choice in perceived silhouette since they were being asked and observed by centrally trained staff. In addition to this, other measures of adiposity, such as waist circumference and dual-energy X-ray absorptiometry scans, could have been used. Finally, although our study controls for different types of sociodemographic and cultural variability in its participant pool, it is possible that the specific subsample used for this study was not necessarily be representative of that country as a whole.

Despite the above limitations, our study provides new and valuable insight and evidence on the use of silhouette showcards for measuring body size discrepancy and body size dissatisfaction in African-origin populations across the epidemiological transition.

CONCLUSION

This study highlights that silhouette showcards have some association with body image survey tool for measuring body size discrepancy and body size dissatisfaction in African-origin populations across the epidemiological transition. This study showed that most women and men perceived their body size inaccurately while also being dissatisfied with their body size. Our study also suggests that as BMI increases, an individual's body image perception becomes less accurate and that such altered body perception is more pronounced in individuals with overweight or obesity in countries with a higher HDI. Our study is also unique in that it identified that body size dissatisfaction is positively associated with diabetes and hypertension. This study further emphasises that different perceptions of body size in different countries could have implications for weight-control strategies.

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Contributors CC-K, TOR, LD, LKM and PB conceived and wrote the manuscript. AL, LD, TF, JP-R, PB and EVL all conceived the METS Study and developed the study methodology. CC-K, TOR, LD and PB conducted the statistical analysis and assisted in writing the manuscript. LD is the guarantor. All authors provided critical revisions of the manuscript and approved the final manuscript.

Funding METS and METS-Microbiome are funded in part by the National Institutes of Health (NIH, R01DK080763 and R01DK111848).

Disclaimer The funding body had no role in the study's design, data collection, data analysis or interpretation of data.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Obtained.

Ethics approval The METS-Microbiome protocol was approved by the Institutional Review Board of Loyola University Chicago, Chicago, Illinois, USA (LU 209537); the National Research Ethics Committee of Seychelles; and the Committee of Human Research Publication and Ethics of Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. Written informed consent was obtained from all participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

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