Antenatal tobacco use and iron deficiency anemia: integrating tobacco control into antenatal care in urban India

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Abstract

Background: In India, tobacco use during pregnancy is not routinely addressed during antenatal care. We measured the association between tobacco use and anemia in low-income pregnant women, and identified ways to integrate tobacco cessation into existing antenatal care at primary health centers.

Methods: We conducted an observational study using structured interviews with antenatal care clinic patients (n = 100) about tobacco use, anemia, and risk factors such as consumption of iron rich foods and food insecurity. We performed blood tests for serum cotinine, hemoglobin and ferritin. We conducted in-depth interviews with physicians (n = 5) and auxiliary nurse midwives (n = 5), and focus groups with community health workers (n = 65) to better understand tobacco and anemia control services offered during antenatal care.

Results: We found that 16% of patients used tobacco, 72% were anemic, 41% had iron deficiency anemia (IDA) and 29% were food insecure. Regression analysis showed that tobacco use (OR = 14.3; 95%CI = 2.6, 77.9) and consumption of green leafy vegetables (OR = 0.6; 95%CI = 0.4, 0.9) were independently associated with IDA, and tobacco use was not associated with consumption of iron-rich foods or household food insecurity. Clinics had a system for screening, treatment and follow-up care for anemic and iron-deficient antenatal patients, but not for tobacco use. Clinicians and community health workers were interested in integrating tobacco screening and cessation services with current maternal care services such as anemia control. Tobacco users wanted help to quit.

Conclusion: It would be worthwhile to assess the feasibility of integrating antenatal tobacco screening and cessation services with antenatal care services for anemia control, such as screening and guidance during clinic visits and cessation support during home visits.

Plain english summary

Tobacco use and anemia are harmful to pregnant women and their fetuses. In India, tobacco use during pregnancy is not addressed when woman receive antenatal care, while anemia and other nutritional problems, which are more common, make up key components of care. We studied the relationship between tobacco use and anemia to find opportunities to integrate tobacco cessation into antenatal care at governmental health centers in Mumbai, India. We interviewed patients and did blood tests for tobacco use, anemia and iron-deficiency. We also interviewed providers and had focus group discussions with community health workers who worked at antenatal care clinics.

We found that 16% of patients used tobacco, 72% were anemic, 41% had iron deficiency anemia (IDA) and 29% were food insecure. Tobacco use dramatically increased the risk of IDA and consumption of green leafy vegetables lowered the risk. Tobacco users compared to non-users were just as likely to consume iron-rich foods and to be food secure. Clinics had a system for screening, treatment and follow-up care for anemic and iron-deficient patients, but no services were present for tobacco use. Clinicians and community health workers were interested in integrating tobacco screening and cessation services with antenatal care services for anemia control, such as screening and guidance during clinic visits and cessation support during home visits.
cessation services with current maternal care services such as anemia control. Tobacco users wanted help to quit. It would be worthwhile to assess the feasibility of integrating antenatal tobacco screening and cessation services with antenatal care services for anemia control, such as screening and guidance during clinic visits and cessation support during home visits.

**Background**

The rate of tobacco use among adult women and pregnant women in India is about 10% with widely varying rates by region [1, 2]. Despite the harms associated with tobacco use, tobacco cessation services are not routine parts of reproductive health care, including antenatal care. In contrast, the prevalence of anemia in India is 65% [3], and anemia prevention and control are key components of antenatal care services [4]. The National Health Missions’ (NHM) guidelines require every pregnant woman be tested for anemia and iron deficiency, and anemic women be given a free 90-day supply of iron folic acid (IFA) tablets. The NHM uses antenatal clinics and a cadre of community health workers (CHWs) called ASHA workers (Accredited Social Health Activist) to provide pregnant women relevant healthcare, education and support. In contrast, even though many women in India use tobacco even during pregnancy, there is no national scheme to address antenatal tobacco use, despite international recommendations [5].

Antenatal tobacco use and anemia appear to be correlated [6, 7], and are important risk factors for poor pregnancy outcomes [8–11]. Biochemically, tobacco use may affect iron metabolism [12], iron stores [13], inflammation [14], and hemoglobin levels [6]. Behaviorally, tobacco use may act as an appetite suppressant [15–17], and has been linked with lower food intake and household food insecurity [18–20], while tobacco abstinence may increase appetite [16, 21]. It is unclear how the relationships between tobacco use, anemia and iron status may be relevant to the delivery, uptake and efficacy of tobacco cessation services during pregnancy. We examined the links between tobacco use, anemia and iron deficiency anemia in the context of antenatal care in Mumbai, India to explore ways to integrate tobacco control services into routine antenatal care services.

In observational studies of clinical settings in India, tobacco use screening and motivational guidance to quit have been reported [22–24]. In a study of pregnant women, patients were screened [25] and users were monitored and counseled about the harms of tobacco use on the mother and fetus, but there was no effect on cessation rates. Also in a clinical setting, an observational study of tuberculosis patients used a brief application of 5-A’s model (Ask, Advise, Assess, Assist and Arrange) to help tobacco users to quit and showed promise [26].

From a community-based perspective, CHWs at antenatal clinics can help address antenatal tobacco use during home visits and community events. Their health promotion activities involve frequent contact with pregnant women at home, including coordination with antenatal care visits. When employed to address antenatal tobacco use, CHW strategies appear feasible in observational studies from India [25, 27] and elsewhere in the region [28]. One cluster randomized trial in low-income communities in India [29], used a brief (2 session) CHW delivered intervention and showed a small positive effect, a 2% improvement in cessation rates.

The current study, conducted at urban governmental Primary Health Centers (PHCs) aimed to: 1) measure the association between tobacco use and anemia; 2) assess the role of iron-rich food consumption and household food insecurity; 3) identify ways to integrate tobacco cessation services with existing antenatal care services. We hypothesized that tobacco use would be strongly associated with anemia and iron deficiency anemia and consumption of iron-rich foods and household food insecurity would be associated with tobacco use, anemia and IDA. We identified opportunities to address tobacco use as part of antenatal anemia care.

**Methods**

**Design**

This observational study was conducted in Mumbai, India at antenatal clinics in 5 PHCs. We recruited 100 pregnant women (20 per clinic) from waiting areas by approaching all patients. A research staff person recruited patients, screened for eligibility, and enrolled those who gave informed consent. Inclusion criteria were: receiving antenatal care at the PHCs; first or second trimester; no major pregnancy complications; and age 18–45. We also recruited 75 antenatal care providers from the five clinics (five doctors, five auxiliary nurse midwives (ANMs), and 65 CHWs). Current antenatal providers at the PHCs were eligible. Data were collected from April 2015 to April 2016.

**Measures**

**Pregnancy questionnaire**

We conducted 60-min face-to-face structured interviews in Marathi with pregnant women in private settings after antenatal care appointments.

**Tobacco use**

Tobacco use items were adapted from the Global Adult Tobacco Survey [30]. Current tobacco use was defined as past 30-day use of smoked / chewed / applied tobacco. Amount of tobacco use was measured as...
number of days and number of times per day in the last 30 days tobacco was smoked / chewed / applied. We measured reasons for using tobacco (helps with morning motions, satisfies craving, helps to relax, etc.); desire to quit and to receive cessation counseling; and antenatal cessation services received (screening, cessation guidance and referral).

Consumption of iron-rich foods
We administered a 31-item food frequency questionnaire to assess past 90-day consumption of iron-rich foods, vitamin A and folate as well as foods high in facilitators (e.g., ascorbic acid) and inhibitors (e.g., tannins) of iron absorption. The food list was adapted from a previously validated tool used in a similar context to our study population [31]. We measured weekly beef, lamb, chicken (meat/poultry) consumption by taking the median frequency value (0.35) for these items and grouping the sample into no weekly consumption (0), less than median weekly consumption (< 0.35) or more than median weekly consumption (≥ 0.35). A similar approach was used to categorize weekly consumption of fenugreek greens, spinach, black-eyed pea greens, and mustard greens (dark green leafy vegetables). The median value was 0.5 times a week. Because only one respondent reported no weekly consumption of green leafy vegetables, we combined that group with the “less than median weekly consumption” group.

Iron supplementation
Women were asked if they currently take an iron-folic acid tablet (Yes/No).

Household food insecurity
Household food insecurity (HFI) was measured using the Household Food Insecurity and Access Scale (HFIAS) [32], which includes nine Yes or No questions focused on three dimensions of household food access—anxiety about food access, food quality and food quantity—and a series of sub-questions to define the frequency of experiencing conditions linked to these three dimensions. We categorized HFI into four levels (i.e., food secure, mildly food insecure, moderately food insecure, and severely food insecure) based on standard protocols [32]. For the purpose of data analysis, we combined the moderately and severely food insecure categories because some cell sizes were small.

Socio-demographics covariates
We measured age, education (none, primary school, middle school, secondary school, college graduate, post-graduate), employment in the past 12 months, wealth index of household assets [33], religion (Hindu, Muslim or other) and parity (zero, one, two or more).

Blood tests
All blood tests were done as part of routine antenatal care clinic visits. Blood samples were stored and tested by labs used by the PHCs. In total, 9 mL of blood was drawn from each participant. Portable Hemocue photometers (Hemocue, Inc., Brea, CA) were used to assess hemoglobin (Hb). Serum cotinine and serum ferritin (SF) were assessed using Chemiluminescence Immunoassay and Chemiluminescent Microparticle, respectively. Cutoffs were as follows: tobacco use (cotinine ≥15 ng/mL), anemia (Hb < 110 g/L), iron deficiency (SF < 15 μg/L) and IDA (SF < 15 μg/L and Hb < 110 g/L).

Key informant interviews and focus groups
We conducted Key Informant Interviews (KIs) with physicians and auxiliary nurse midwives (ANMs) and Focus Group Discussion (FGDs) with CHWs to determine the content of services provided during antenatal clinic and home visits. We asked to what extent anemia and tobacco use were evident among antenatal clinic patients; the content of anemia, IDA and nutrition-related services; how tobacco use is identified; what tobacco cessation services were provided; and how tobacco cessation could fit into the existing structure of care? We asked about the role of clinicians and CHWs in antenatal care including about anemia and tobacco use. We audiotaped all interviews and FGDs with prior permission of respondents.

Data analysis
Quantitative data analysis was conducted using Stata 12. First, we examined the distribution of study variables to characterize the sample with respect to socio-demographic factors and other measures. Secondly, because we examined both self-reported tobacco use and serum cotinine we measured the sensitivity and specificity of the self-reported use against the serum cotinine cut-off described above. Sensitivity was defined as the proportion of self-reporting tobacco users who had cotinine levels at or above the cut-off. Specificity was defined as the proportion of women not reporting tobacco use who had cotinine levels below the cut-off. Third, in order understand the role of iron-rich food consumption and food insecurity, we measured the bivariate association (chi-squared test or Fisher’s exact tests when cell sizes were < 5) between tobacco use based on serum cotinine levels (n = 16, cotinine ≥15 ng/mL), anemia, IDA, IFA supplementation, consumption of iron-rich foods and HFI. Fourth, we used logistic regression to measure the association between IDA and tobacco use based on serum cotinine (n = 16, cotinine ≥15 ng/mL), controlling for IFA supplementation, consumption iron-rich foods, HFI and socio-demographic factors. We used the Stata’s cluster subcommand to
account for nesting of pregnant women within clinic sites. Finally, we measured the Variance Inflation Factor (VIF) for each covariate to identify multicollinearity in our regression model [35].

We used a standard approach to conduct qualitative data analysis [36, 37]. In addition to the written notes taken during qualitative interviews and FGDs, the audio recordings were transcribed verbatim. The notes and transcripts were reviewed and discussed by members of the research team. We identified themes based on our discussions about the data. In our effort to accurately make sense of the qualitative data, we corroborated our interpretations throughout the data analysis process by checking with all members of the research team, including the field investigators.

**Results**

All antenatal care patients were married, mostly young, educated up to secondary school, and lived in low-income households (Table 1). The sample was 66% Hindu and 22% Muslim. There were high levels of anemia (72%), iron-deficiency (44%), and IDA (41%). No one reported past 30-day smoking tobacco use, but 13% reported past 30-day smokeless tobacco use. In contrast, 16% had cotinine levels indicating tobacco use. The sensitivity and specificity of self-reported tobacco use was 92.3% and 95.4%, respectively. **Mishri**, a form of dried and powdered tobacco rubbed on gums, was the most common form of tobacco used (54%). Every tobacco user reported using 20 or more days out of 30 days, and 69% used two to five times a day. The top reported reasons for using tobacco were: helps with morning motions (46%), satisfies a craving (46%), enjoy using (38%), and helps when upset or relaxes (23%). One (8%) woman said she used when feeling hungry. Ninety-two percent wanted to quit, and 77% wanted help to quit. Tobacco use was not well addressed during antenatal care visits; only two tobacco-using women were asked about tobacco use and advised to quit.

Tobacco user had higher rates of anemia (p = .13 and IDA (p < .05) than non-using pregnant women (per cotinine blood tests) (Table 2). There was no statistically significant difference in past 30-day intake of IFA supplementation among those who used (33%) and those who did not (24%) (p > .05). Green leafy vegetable consumption was less common in tobacco users (31%) than non-users (52%), but the difference was not statistically significant (p = .12). Nearly one-third of households were food insecure (29%), but HFI was not associated with tobacco use status or IDA. None of the tobacco users reported ‘mild’ food insecurity, while 12% of non-users did. Table 3 shows that IDA was strongly associated with tobacco use (OR = 14.3, 95% CI [2.6, 77.9]), and negatively associated with weekly meat (OR = 0.1, 95% CI [0.03, 0.6]) and green leafy vegetable consumption (OR = 0.

| Table 1 Characteristics of pregnant participants (n = 100) |
|----------------------------------------------------------|
| Age in years (mean = 25.5; SD = 0.5)                     |
| 18–19                                                    | 7 |
| 20–29                                                    | 72 |
| 30–39                                                    | 18 |
| 40–41                                                    | 1 |
| Missing                                                  | 2 |
| Parity                                                   |
| 0                                                        | 43 |
| 1                                                        | 32 |
| 2 or more                                                | 25 |
| Currently Married                                        | 100 |
| Education                                                |
| None                                                     | 6 |
| Primary or middle school (grade 1–7)                     | 22 |
| Secondary school (grade 8–12)                            | 62 |
| College or more                                          | 10 |
| Monthly household income                                 |
| Less than 10,000 INR                                     | 39 |
| 10,001–15,000 INR                                        | 43 |
| More than 15,000 INR                                     | 15 |
| Don’t Know                                               | 3 |
| Employed in the last 12 months                           |
| Yes                                                      | 28 |
| No                                                       | 71 |
| Missing                                                  | 1 |
| Religion                                                 |
| Hindu                                                    | 66 |
| Muslim                                                   | 22 |
| Other                                                    | 12 |
| Current smoking tobacco use (self-report)                |
| Current smokeless tobacco use (self-report)              |
| Current tobacco use (serum cotinine)                     |
| Anemia                                                   |
| Iron deficiency                                          |
| Iron deficiency anemia                                   |

| cotinine $\geq$ 15 ng/dL                                |
| hemoglobin $< 110$ g/L                                  |
| ferritin $< 5$ mg/L                                     |
| hemoglobin $< 110$ g/L & ferritin $< 15$ mg/L           |

6, 95% CI [0.4, 0.9]), and not associated with HFI. There was no indication of multicollinearity in our regression analysis (VIF mean = 1.47, range [1.17, 2.28]).

**Key informant interviews with physicians and nurses**

There was no systematic approach to address tobacco use during antenatal care at the PHCs. Services for
anemia screening, treatment and supportive services were provided during clinic visits by nurses and doctors and home visits by CHWs. Clinics conducted anemia screenings at every visit and provided appropriate treatment, which included iron supplementation, guidance about nutrition, and other services as needed. Anemic patients were referred to a CHW program. Antenatal anemia was of high priority. Antenatal tobacco use was seen as a concern but not as common in the patient population. There were no systematic services in place for tobacco use screening and cessation. Providers advised known tobacco users to quit, but were not trained to provide cessation guidance and had nowhere to refer patients for cessation services, which were said to be offered at addiction centers. Providers wanted to learn about integrating tobacco use screening and cessation guidance into their routine practices. There was some concern about competing health priorities.

CHW focus groups
CHWs were provided with a list of pregnant mothers from the PHCs, including anemia status. Their main role was to provide supportive services for anemia control during home visits that include dietary guidance, provision of and guidance about taking IFA supplementation, and reminders for follow-up clinic visits. Anemia during pregnancy was seen as a major problem. CHWs were trained to identify signs of anemia, provide advice about taking IFA tablets and offer dietary advice to pregnant women about eating iron-rich foods. They also helped women address any logistical barriers to accessing antenatal care and delivery care.

There was variability in the perception that tobacco use was a problem. At an FGD in one clinic, CHWs reported that 40% of pregnant women used tobacco, while tobacco use was not perceived as a problem at an FGD in a different clinic. CHWs do not provide any tobacco control services. They had some knowledge about the harms of smoking tobacco use, but not specifically about harms during pregnancy. Smokeless tobacco use was not universally seen as harmful. Some CHWs noted that they used fear tactics to encourage users to quit. In addition, CHWs did not receive training to deliver cessation guidance and support, but wanted to be trained, particularly if they were paid to deliver services.

Table 2 Distribution of antenatal anemia, iron status and other nutritional factors by tobacco use and iron deficiency anemia (n = 100)

| Percent | Tobacco use | Iron deficiency anemia | Overall Sample |
|---------|-------------|------------------------|----------------|
|         | User        | Non-user               | (n = 100)      |
| Anemia a | 88          | 69                     | 72             |
| Iron deficiency b | 69 | 40                | 44             |
| Iron deficiency anemia c | 69 | 36               | 41             |
| Taking iron / folic acid supplements | 33 | 24               | 25             |
| Meat / Poultry Consumption | | | |
| None (0) | 13 | 19               | 18             |
| Less than median | 50 | 42              | 50             |
| More than median | 38 | 39             | 32             |
| Green Leafy Vegetable Consumption | | | |
| Less than median | 69 | 48           | 65             |
| More than median | 31 | 52            | 34             |
| Household Food Insecurity | | | |
| Food secure | 75 | 70          | 71             |
| Mildly food insecure | 0 | 12            | 10             |
| Moderate or severely food insecure | 25 | 18          | 19             |
| Overall Sample | 16 | 84           | 100            |

a hemoglobin < 110 g/L
b ferritin < 15 mg/L
c hemoglobin < 110 g/L & ferritin < 15 mg/L
d cotinine > 15 ng/dL
e p = 0.13
f p = 0.12
*p < 0.10, ** p < 0.05
Note: Since only one person reported no weekly consumption of green leafy vegetable, she was grouped with the less than median category.
We found that almost nine out of ten tobacco users were anemic and that tobacco use was strongly, positively and independently associated with IDA. This has important implications for antenatal care visits. In low- and middle-income countries, antenatal care, particularly anemia control services, are missed opportunities for addressing antenatal tobacco use. Tobacco control services could parallel and be integrated with anemia control services, because nearly all tobacco users appear to be anemic and would therefore receive services for anemia. Providers in our study did not screen for tobacco use, but sometimes provide quit guidance if they notice use (e.g. stained teeth or gums). They said that tobacco use screening and cessation services at clinics and home visits would be useful and feasible, especially if they integrated with current practices. Given the link between tobacco use and iron deficiency anemia found in our current study and elsewhere [6, 12–14], when discussing harms of tobacco with patients antenatal care providers can inform anemic tobacco users that their use may worsen anemia.

The integration of antenatal tobacco cessation services could face many challenges. First, CHWs and clinicians are not currently trained to look for and address tobacco use in their patients. There is a need to increase awareness about the prevalence and risks associated with antenatal smokeless tobacco use (including the increased risk of anemia and IDA) as well as to increase the clinics capacity to provide evidence-based cessation guidance and support. Unfortunately, the literature about effective antenatal smokeless tobacco cessation strategies is sparse, particularly in India. Second, the antenatal care system appears burdened. Competing demands was an important concern raised by providers. Antenatal tobacco cessation services should not be resource intensive, and should be well integrated with current practices. Third, the rate of current IFA supplementation in anemic women is already low at 25%, while the rate of anemia and IDA is high. This indicates that the current approaches to address anemia and IDA need improvement, and may portend a relatively small impact on antenatal tobacco use, if parallel tobacco use screening and cessation services are added. Finally, in an environment of scarce resources, additional funds will be required, particularly for capacity building activities and labor costs.

**Strengths and limitations**

The key strength of this study is the use of multiple data sources (questionnaires administered to patients, biomarkers from blood tests, and qualitative information from providers) to make a careful assessment of tobacco use, anemia and iron deficiency in pregnant. Although we collected data from multiple sources, our sample size of pregnant women was not large, but it was sufficient.

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**Table 3** Logistic regression of maternal iron deficiency anemia\(^2\) (n = 98)

| Variable                                      | OR     | 95% CI      |
|-----------------------------------------------|--------|-------------|
| Tobacco use                                   | **14.3 | (2.6, 77.9) |
| Taking iron-folic acid supplements            | 0.6    | (0.1, 4.0)  |
| Meat Consumption                              |        |             |
| None (0)                                      | Referent| –           |
| Less than median                              | **0.3  | (0.1, 0.7)  |
| More than median                              | **0.1  | (0.03, 0.6) |
| Green Leafy Vegetable Consumption\(^2\)       |        |             |
| None or less than median                      | Referent| –           |
| More than Median                              | *0.6   | (0.4, 0.9)  |
| Household Food Insecurity                     |        |             |
| Food secure                                   | Referent| –           |
| Mildly food insecure                          | 2.3    | (0.4, 11.5) |
| Moderately or severely food insecure          | 1.6    | (0.7, 3.8)  |

\(^2\) hemoglobin < 110 g/L & ferritin < 15 mg/L
\(^b\) cotinine > 15 ng/dL
\(^*\) p < 0.05
\(^**\) p < 0.001

Note: Adjusted for age, education, employment, wealth index, religion and parity

**Discussion**

We hypothesized that tobacco-using pregnant women would have lower consumption of iron-rich foods (i.e. meats and green leafy vegetables) and higher household food insecurity, and therefore would be at increased risk of anemia and IDA. This hypothesis was not fully supported. The regression analysis suggested that there were independent associations between IDA and tobacco use as well as consumption of iron-rich foods (meats and green leafy vegetables), but not household food insecurity. The rate of anemia was higher in tobacco users than non-users but the difference was not statistically significant, though almost every tobacco-using pregnant women was anemic. In addition, tobacco-users compared to non-users tended to eat less than the median frequency of green leaf vegetable consumption. There was no notable difference in meat consumption between users and non-users.

We also hypothesized that tobacco use would be more common among individuals from food insecure households, assuming that tobacco was used to increase satiety/lower appetite, and would therefore help cope with psychological effects of food insecurity. We found no evidence that HFI was associated with tobacco use or IDA. None of the tobacco users reported ‘mild food insecurity’, that is, anxiety about food access, while 12% of non-users did. In addition, only one (8%) participant reported that tobacco was used to address hunger, while 23% said they used when upset or for relaxation.

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to detect moderate effects. Smaller effects, such as those found for the association between food insecurity and tobacco use (odds ratios between 1.6 and 2.3), we not detected. The data were cross-sectional, and the observed relationships between indicate direction rather than magnitude of association or causation. The self-reported measures of tobacco use, dietary practices, IFA supplementation and HFI are prone to social desirability and recall bias. However, measures of this type are routinely used in public health surveillance systems. We used biomarkers to supplement the self-report measures. For example, our self-reported measure for tobacco use had very good but not perfect sensitivity and specificity when compared to our serum cotinine cut-off. Our cut-off was higher (≥15 ng/ml) than recommended to identify smokeless tobacco use (≥5 ng/ml) [38, 39], which was the only form of tobacco used by the participants. Our budget limited our ability to use a more sensitive blood test for cotinine. It is likely that the true rate of tobacco use in our sample was higher than 16%.

Conclusions

We found that antenatal tobacco use was strongly associated with maternal anemia and iron status. There was less supportive evidence of the involvement of nutritional factors such as consumption of iron-rich foods and HFI. Tobacco-using pregnant women were highly interested in receiving cessation services. There were missed opportunities for addressing tobacco use as part of antenatal care. Although antenatal clinics did not have a formal strategy to address tobacco use, there was interest among providers to add routine tobacco control services, if they were integrated with current practices such as services which address anemia and iron deficiency.

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Availability of data and materials

After data collection is completed, de-identified data from the study will be made available from the corresponding author on reasonable request.

Authors’ contributions

RM and AJ conceived of the original study. MP provided critical inputs in the development of the study. RM drafted the paper, and all authors contributed to the implementation of the study, edited drafts of the paper, and agreed to the content of the submitted version. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The current study was approved by the Institutional Review Boards at the Healis Sekhsaria Institute for Public Health and the University of Michigan.

Competing interests

The authors declare that they have no competing interests.

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