Hair Care Product Use Among Women Of Color: A Northern Manhattan Intervention

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Background

Recent trends suggest a convergence in breast cancer (BC) incidence rates in black and white women due to the stability in incidence trends in white women compared to the steady annual increase in black women (0.3% per year) (1,2). These changing incidence patterns over a short time period cannot be attributed to changing genetic factors. While reproductive trends have been proposed to drive some of the health disparities,(3) endocrine disruptor chemical (EDC) exposures during BC susceptibility windows may also play a role in breast cancer health disparities (4,5) as EDC exposure patterns differ by race and ethnicity (6,7).EDCs disrupt reproductive development and increase cancer risk through their ability to have a direct, indirect, or interactive action on cellular processes within the mammary tissues. These actions include, but are not limited to, acting upon hormone receptors, the ability to behave agonistically or antagonistically on nuclear receptors, and confer epigenetic changes that increase oncogenic susceptibility (8-11). EDCs may have the most influence during periods of dynamic structural and functional changes in the mammary glands, (4,5,12) such as during pregnancy and the postpartum windows (5,13).

Hair care products (HCPs) are a class of personal care products (PCPs) that contain EDCs; there are stark differences in HCP use by race (6,14-17). In a group of racially and ethnically diverse women (n=301), compared to non-Hispanic white women, women of African descent were more frequent users of hair oils, lotions, leave-in conditioner, root stimulator and perm/relaxers (14). The Sister Study has also shown where 67% of Black women were users of hair pomades and straighteners, only 3% of White women were users (7). Differences in hair texture may explain differences in use. Nevertheless, of major concern, clinical, epidemiological, and laboratory studies have suggested HCPs are associated with earlier pubertal events, (6,18-21) where the timing of pubertal maturation is an established risk factor for BC risk (22-24). Additional studies have shown that compared to infrequent users, women classified as moderate or frequent users of PCPs had a 10-15% higher BC risk,(25) dark hair dye is associated with a 52-72% increased BC risk, (17,26) a history of chemical relaxer or straightener use is associated with a 64-74% increase in BC risk, (17,27) and in 454 Mexican women (233 cases) urinary concentrations of monoethyl phthalate (MEP) were positively associated with BC [OR 2.2. (1.33, 3.63)], with stronger associations observed for pre-menopausal women [OR 4.1. (1.6, 10.7)] (28).

Evidence is emerging on EDC exposures across the pregnancy/postpartum periods. This is of importance because while pregnancy is associated with a long-term reduced risk of BC, it also confers an increased risk of BC for at least a decade after birth (1,2,8,9). EDC exposure during this period of increased risk could promote ‘activation’ effects for BC following pregnancy. In pregnant women, PCP use is correlated with higher concentrations of urinary phthalates, (29-31) urinary metabolite concentrations vary by PCP type,(32,33) and urinary metabolite concentrations differ by sociodemographic factors and across racial and ethnic populations (34). For example, a multiethnic cohort of 446 pregnant women found that urinary phthalate metabolites were significantly higher among WOC (34). However, while studies assess knowledge and attitudes of PCPs during the pregnancy/postpartum periods, no study has implemented a behavioral intervention. Five cross-sectional studies have examined knowledge,

attitudes, and prevention behaviors in pregnant women. Four studies with women of Frenchdescent focused on intent to change cosmetic use during pregnancy (32,35-37) and TIDES, a US based pregnancy cohort (n=894), surveyed health attitudes around PCP use (38).

These studies are not reflective of PCP practices among pregnant WOC. An intervention to reduce phthalate exposures during the pregnancy/postpartum window would have both fetal/early and maternal health implications. First, behavioral changes during pregnancy could mitigate EDC exposures that exert in utero effects that may program long term risk for hormone-related disease for the child. Second, behavioral changes could reduce 'activation' effects for BC following pregnancy (12). Pregnant women are primed to change behaviors for their babies' health. Therefore, we propose an educational intervention during pregnancy to promote reduced use of phthalate-containing HCPs. We focus on phthalates because of the well documented animal (39,40) and human (41-45) evidence on their effects on reproductive health and development, (11,41) they are ubiquitous46 and added to HCPs to provide scent, (6,19) detected in human breast milk, urine, amniotic fluid and placenta (suggesting fetal exposure), (11,41) and phthalate interventions have proven successful (47-49).

Study Design

Objective:

To reduce use of personal care products that contain endocrine disrupting chemicals among women. For this pilot intervention, we focus on the hair care product class of personal care products, the reduction in use of phthalate-containing Hair Care Products (HCPs) and use among pregnant Women of Color (WOC).

Study Aims:

This pilot interventional study will include prospective data collection, including questionnaire data and urinary metabolite measures. We will also conduct key informant sessions and interviews and focus groups. This pilot proposal will apply the Precaution Adoption Process Model (PAPM), a 7-stage theoretical model for health behavior change that attempts to explain how an individual comes to decisions to take action and how the individual then translates that decision into action (Glanz K, et al. Health Behavior and Health Education: 4th Ed.; 2008).

Therefore, among WOC, defined as Black or Hispanic women, residing in Manhattan, Bronx, Queens, Brooklyn, and Staten Island and in the 3rd trimester of pregnancy, we propose the following:

Specific Aims:

1. Qualitative Approaches across 5-10 groups (n=50-100 total participants), we will:

    a. Deliver an educational intervention on harmful chemical exposures, such as phthalates, found i hair care products, developed by the research team using empirical evidence with key informant feedback.

b. Through focus groups gather participant feedback on content and questions pertaining to intervention and attributes women of color consider when deciding on Hair Care Product use, using a semi-structured guide.

2. Quantitative Approaches using repeat measures, we will:

a. Using repeated questionnaires to assess PAPM stages, we will assess self-reported behavioral changes in the use of phthalate-free hair care products comparing stage at enrollment to

- Stage after the intervention (post-test1),
- Stage at 1- month post-intervention (post-test2), and
- Stage at 1-month postpartum (post-test3).

b. Examine the correlation between self-reported behavioral change assessed by the PAPM questionnaire and
    - Change in self-reported Hair Care Product exposure measured via questionnaire (n=50),
    - Change in internal dose of urinary phthalate metabolites (targeted gas chromatography/high resolution mass spectrometry (known as GC/HRMS) Orbitrap; n=25 with 3-repeat samples),
    - (Exploratory) change in internal dose of all-other detectable urinary metabolites (untargeted GC/HRMS-Orbitrap; n=25 with 3-repeat samples).

Remote Option for Study Aims:

We have included a description of how each element of the protocol will be administered if remote is necessary.

Hypothesis: We hypothesize that the pilot intervention will increase awareness of phthalate chemicals in hair care products and women progressing across the PAPM stages. We expect an inverse association between participants who adopt the use of phthalate-free hair care products and self-reported phthalate-containing hair care products and urinary phthalate concentrations. We compare phthalate concentrations in the 3rd trimester when catabolic activity peaks (Zeng et al. Annals of Nutrition and Metabolism. 2017;70(1):59-65) and subsequently measure sustained behavioral changes 1-month postpartum. We will explore metabolite concentrations across the whole period recognizing the possible limitation of changes in metabolism across the follow-up period.

Potential Risks

This is a minimum risk protocol. Participants will receive the following information about potential risks on the consent form:

Participants may feel uncomfortable answering some of the questions on the questionnaires, but they have been informed that they have the right to refuse to respond to any questions they do not wish to answer. They are informed that the information they provide on the questionnaire will be

kept entirely confidential. However, any time personal information is released, there is a possibility of confidentiality being compromised.

We have provided participants with the following information about the potential for a breach in confidentiality on the consent form:

Despite all of our efforts, unanticipated problems, such as a stolen computer may occur, although highly unlikely. Please note the following process will be adhered to for ANY and ALL aspects of the study in which your research data is labeled with your unique code number (aka study ID): Your unique code number (aka study ID) will be separated from your name or any of your information that could identify you. The research file that links your name to the code number will be kept in a locked file cabinet and / or an encrypted data file and only the investigator and study staff will have access to the file. Your name or any of your information that can identify you will not be used in any reporting of the study results.

Potential Benefits

There are no direct benefits to participation. The consent form states, "You may or may not receive personal benefit from taking place in this study."

Participants can choose not to participate in any parts of the study or can choose to withdraw from the study at any time. This study does not present greater than minimal risk.

Subject Population Justification

This study concerns health risks for pregnant women associated with increased levels of EDC chemicals through the use of personal care products that contain EDCs. EDCs may have the most influence during periods of dynamic structural and functional changes in the mammary glands (4,5,12) such as during pregnancy and the postpartum windows (5,13). This is import because pregnancy confers an increased risk of breast cancer for at least a decade after birth (1,2,8,9). EDC exposure during this period of increased risk could affect the fetus and promote 'activation' effects for BC following pregnancy. An intervention during pregnancy on EDC exposures and HCPs could have intergenerational health implications for mother and child, which is why we are targeting pregnant women. We are obtaining remote e-consent from this vulnerable population due to restrictions posed by the COVID-19 pandemic.

Statistical Procedures

For the Pilot Intervention:

Aim 1 Analysis. All sessions (whether conducted in person or remote via Zoom) will be recorded and transcribed verbatim by a professional transcription service. We will use Dedoose to code using grounded theory and qualitative content analysis focusing on the questions and content feedback of the educational intervention and attributes pertaining to PCP use. Dr. Lauren Houghton will oversee the creation of the codebook and train the research staff involved in coding transcripts. We believe with n=50-100, we will meet our goal of saturation and finalized thematic codes will aid in improving the educational intervention and provide an exhaustive categorization of attributes WOC consider for HCP product selection.

Aim 2b Analysis: Please see Study Procedures section (under 'Metabolomics' heading) for an explanation of Kurt Pennell and his team at Brown University's involvement in the analysis portion of this study. In brief, this exploratory analysis, performed by our partner collaborators at Brown University, will conduct Hair Care Product descriptive analyses, including the frequency of phthalate-containing products, by category and overall. They will conduct urinary phthalate descriptive analyses (log transformed concentrations) comparing detectable ranges for each of the urinary phthalate exposure constructs and comparing with national levels from biomonitoring reports. They will also conduct untargeted descriptive analyses by characterizing the patterns in chemical exposures over time through principle component analyses (PCA) (Gibson et al. Current environ health reports. 2019;6(2):53-61). Using spearman correlations, they will independently examine the correlation between PAPM and a) change in phthalate containing PCPs, and b) change in PCA patterns. Results: We expect the intervention will result in an association between PAPM progresses and a decreased use of phthalate-containing HCPs and lower concentration levels of MEP (and LMW metabolites).

Privacy and Data Security

In Person: All hard copy questionnaires will be stored in locked cabinets in the Epidemiology department at CUIMC. Only personnel who have completed human subjects training and are on this protocol have access to these files. No names or other personal- identifying information will be attached to any computerized data.

Remote Option: In the event that the consent process (remote e-consent) and questionnaires are administered to participants remotely (sent to participants via email or text message), we will use Columbia's Qualtrics site to obtain e-consent and collect questionnaire data directly from participants. The data generated from the electronically administered questionnaires will be coded and a key will be kept separately on encrypted computers. Only Columbia investigators will have access to the key code. Access to the surveys is available exclusively through an anonymous online link, which is sent directly from Columbia research staff to participants. Access to aggregate data is granted solely to authorized staff via password-protected accounts. All respondent data is saved as a downloadable CSV file in Qualtrics, with information on whether a participant has started, is completing, or has finished the questionnaire, as well as start and end date information. Once data is entered into Qualtrics, data will be downloaded from Qualtrics by Columbia staff and saved on an encrypted endpoint (desktop or laptop computer).

Please note the following process will be adhered to for ANY and ALL aspects of the study in which participant research data is labeled with either their study ID and specimen ID:

Overall: The research file that links any information that can identify the participant to the code number will be kept in a locked file cabinet, an encrypted data file, and/or CUIMC IRB approved and encrypted hard or shared drives. Questionnaires and biospecimens will be stored using participants' unique code number and will not be directly linked to any information that can identify the participant to the code number. Questionnaires, biospecimens, and recorded sessions will be kept in a locked file cabinet, an encrypted data file, and/or CUIMC IRB approved and encrypted shared drives. Only the principal investigator and study staff who have CUIMC IRB

approval for this study will have access to these files. Participant names or any of your information that can identify them will not be used in any reporting of the study results. Transfer of Biospecimen to Collaborators: The urine collection receptacles will have labels with a prepopulated participant specimen ID. Dr. Kurt Pennell, study collaborator and director of the 231 Engineering Research Center at Brown University and his team will analyze the biospecimens. We will deidentify the specimen before our collaborators at Brown receive them. Any unused samples will be destroyed by Brown University or mailed back to CUIMC. We are not collecting any genomic data and biospecimens will not be used for whole genome sequencing in this study.

All computers have been updated by the MSPH IT staff to comply with all university standards for encryption. All human subject data that is stored on an End User Devices is always protected by a strong password with the data encrypted at all times. Columbia University will not share or offer the raw data to any third party and we will not publish or disclose confidential data nor infringe on any privacy rights when processing the raw data.

Remote Option: Should the consent (remote e-consent) and questionnaires be administered remotely, information is collected online through Columbia's Qualtrics site. All staff interacting with participants are IRB approved and have completed the required HIPAA and Human Subjects training.

Recording of Group Sessions— We are asking for participants to allow us to record (both audio and video) the key informant and educational intervention sessions. The key informant sessions will not be transcribed.

Specific identifiers that will be recorded: The recordings will include full facial features and participants' first name. We are including this identifiable information in the recording so that we can keep track of what each participant says throughout the discussion. Participants will have the option to turn off their camera on the Zoom app if they prefer not to show their face, in which case they will be identified by their Zoom username that they register with.

People who will have access to the recordings: The transcription company, a registered vendor with Columbia University, will have access to the recording so that they can transcribe what is said during the discussion. We will provide the name of the transcription company and a Service Agreement in upcoming modifications. The key informant sessions will not be provided to the company for transcription.

Clear indication that recording(s) will be kept indefinitely: Identifiers might be removed from the identifiable information and, after such removal, the information or biospecimens could be used for future research studies without additional consent from the participant. Participants are informed in the consent process that their authorization to use and share their research information does not have an expiration (ending) date. They are told that they may revoke consent and authorization at any time and for any reason, and are provided with instructions and contact information for doing so.

Use(s) of the recording(s): The recordings will be used by the research team only for the purposes of analyzing the discussion and not for commercial or educational purposes.

Compensation: Participants will not be provided additional compensation for being recorded; please see the Compensation field of the Subjects section of the protocol for more details on compensation for overall participation.

Mechanisms in place to protect confidentiality of those being recorded: In order to protect participant privacy, the transcription company, FlatWorld Solutions, will only receive a recording of the session that includes the image of their face (should they choose to keep the camera on) and the name the participant provides when they register for the session (their Zoom user name). This is so they can create a "script" of the conversations that take place during the recorded group sessions and keep track of who said what. The transcription company will receive the recording through a secure file transfer system. The image of participants' face and / or Zoom user name will be attached to their study ID, but, only the CUIMC study team will have access to the file that links the information in the recording to their study ID and that file will be saved on an encrypted computer. Only the transcription company and the study team at Columbia will have access to the recording; study collaborators will only have access to the 'script' of the discussion after it has been transcribed by the transcription company. Our contract with the transcription company requires that they destroy the recordings as soon as the script of the session is submitted to and approved by the Columbia research team. After this point, recordings will be stored on an encrypted hard drive that only CUIMC staff has access to.

Clear indication that recording(s) will be kept indefinitely- Identifiers might be removed from the identifiable private information or identifiable biospecimens and, after such removal, the information or biospecimens could be used for future research studies without additional consent from the participant. Participants are informed in the consent process that their authorization to use and share your research information does not have an expiration (ending) date. They are told that they may revoke consent and authorization at any time and for any reason and are provided with instructions and contact information for doing so.

De-identified data will be shared with Rutgers University and WE ACT for Environmental Justice (partners) through an encrypted file sharing service.

Data is collected in private CUIMC offices by phone or mail or in person in the clinical research space provided through CUIMC and the CTSA. Data is only collected by staff members who have completed human subjects training and are approved as part of this protocol. Mechanisms in place to protect confidentiality of those being recorded: In order to protect participant privacy, the transcription company will only receive a recording of the session that includes the image of their face (should they choose to keep the camera on) and the name the participant provides when they register for the session (their Zoom user name). This is so they can create a "script" of the conversations that take place during the recorded group sessions and keep track of who said what. The transcription company will receive the recording through a secure file transfer system. The image of participants' face and / or Zoom user name will be attached to their study ID, but, only the CUIMC study team will have access to the file that links the information in the

recording to their study ID and that file will be saved on an encrypted computer. Only the transcription company and the study team at Columbia will have access to the recording; study collaborators will only have access to the 'script' of the discussion after it has been transcribed by the transcription company. Our contract with the transcription company requires that they destroy the recordings as soon as the script of the session is submitted to and approved by the Columbia research team. After this point, recordings will be stored on an encrypted hard drive that only CUIMC staff has access to.

Procedures

Objective: To reduce use of personal care products that contain endocrine disruptor chemicals among women.

The below details the Pilot Intervention

Study Overview: To reduce use of phthalate-containing hair care products among women of color. We will apply the Precaution Adoption Process Model (PAPM).

All activities will be performed remote or in person based on IRB mandates. We will submit Questionnaires and Facilitator Forms after initial IRB protocol approval.

Specific Aims:

1. Qualitative Approaches across 5 groups (n=50-100 total participants), we will:

    a. Deliver an educational intervention on harmful chemical exposures, such as phthalates, found in hair care products, developed by the research team using empirical evidence with key informant feedback.

    b. Through focus groups gather participant feedback on content and questions pertaining to intervention and attributes women of color consider when deciding on hair care product use, using a semi-structured guide.

2. Quantitative Approaches using repeat measures, we will:

    a. Using repeated questionnaires to assess PAPM stages, we will assess self-reported behavioral changes in the use of phthalate-free hair care products comparing stage at enrollment to:

        - Stage after the intervention (post-test1),
        - Stage at 1-month post-intervention (post-test2), and
        - Stage at 1-month postpartum (post-test3).

    b. Examine the correlation between self-reported behavioral change assessed by the PAPM questionnaire and
        - Change in self-reported HCP exposure measured via questionnaire (n=50),
        - Change in internal dose of urinary phthalate metabolites (targeted gas chromatography/high resolution mass spectrometry (GC/HRMS) Orbitrap; n=25 with 3-repeat samples),

- (Exploratory) change in internal dose of all-other detectable urinary metabolites (untargeted GC/HRMS-Orbitrap; n=25 with 3-repeat samples).

Questionnaire Constructs : All who wish to enroll and who enroll in the study will be asked to complete the following questionnaires which will be administered preferably via Qualtrix but in paper format if requested.

Eligibility Questionnaire: Confirm that potential participants meet the eligibility requirements (Black or Hispanic women, residing in Northern Manhattan and in the 3rd trimester of pregnancy).

Sociodemographic Questionnaire: Information that includes maternal age, gestational age, race/ethnicity, occupation and educational attainment, and reproductive characteristics and pregnancy details.

Hair Care Product Questionnaire: Asking participants to take stock of current / recent and past hair care product use. This questionnaire was developed by our colleagues at the Rutgers Center for Environmental Exposures and Disease based on / modified from the Women's Circle of Health Study questionnaire that captured a detailed list (including brand name and product) of each hair product each participant used in the last 24-48 hours. This questionnaire is best completed in the space where the woman conducts her everyday hair care routine as she will need to recall product type and name. Therefore, we are sending the questionnaire to be completed at home prior to the educational intervention.

Precaution Adoption Process Model Questionnaire: A 7-stage theoretical model for health behavior change that attempts to explain how an individual comes to decisions to act and how the individual then translates that decision into action. The 'change in PAPM variable' (PAPM) will illustrate how the intervention moves people across staging. Given movement can be fluid, (Rouillon et al. Int J Environ Res Public Health. 2018;15(10), participants will be categorized as progresses (i.e. advancing stage(s) from last reported stage), regresses (i.e. regressing stage(s) from last reported stage), or stagnant (i.e. not moving from last reported step), comparing: pre-test to post-test1, post-test1 to post-test2, and post-test2 to post-test3, and post-test1 to post-test3. Those who progress to Stage 4 will be labeled as negative progresses. We will provide descriptive statistics by pre-test, post-tests, and by the PAPM variable at each time point (when relevant). Using spearman correlations, we will examine independent correlations between PAPM stage at pre-test with each post-test (post-tests1-3). While PAPM staging is not a continuous parameter but ordinal,(Glanz et al. Health Behavior and Health Education: Theory, Research and Practice 4th Edition; 2008) correlations will inform how the intervention moves people across staging.

The PAPM stages for this study are described as follows:

Stage 1: Never heard of endocrine disrupting chemicals (EDCs), nor EDCs in hair care products (HCPs)

Stage 2: Never thought about using phthalate-free HCPs

Stage 3: Undecided about phthalate-free HCPs

Stage 4: Decided not to use phthalate-free HCPs

Stage 5: Decided to use phthalate-free HCPs

Stage 6: Procured and has used (at least once) phthalate-free HCPs

Stage 7: Use phthalate-free HCPs regularly

Research Guides – The Education Intervention Guide and the Focus Group Guide will be developed with the Key Informants and will be submitted for IRB review prior to administration.

Biospecimen Collection, Processing, and Analysis Urine is the preferred biomarker matrix for the hydrophilic phthalate metabolites, whose clearance time is a matter of days and is temporally stable in stored urine samples in spite of their relatively rapid clearance, urine phthalate biomarker measurements are relatively stable over time (days to months); this is likely because exposure sources and patterns of product use are common and fairly consistent. Thus, any changes observed in the urinary metabolites will most likely be due to changes in hair care product practices rather than within-individual variability.

For urine collection, we will follow the CDC urine collection protocol for processing phthalates, and we are asking participants for their first morning urine. Research staff will review the collection procedures with the participants over the phone. Participants will be asked to record date and time of their sample. Urine samples will be stored at or below -20 °C (per the CDC's phthalates urine protocol) within the Biomarkers Core Shared Resource Lab, affiliated with Herbert Irving Comprehensive Cancer Center (Directed by Dr. Regina Santella). The urine sample will be assessed for specific gravity to adjust for urine dilution using a refractometer (Adibi JJ, et al. Environ Health Perspect. 2008;116(4):467-473).

Metabolomics: The Biomarkers Core Lab, HICCC (Directed by Dr. Santella) will ship to the Kurt Pennell Lab at Brown University urine samples in cryovials that are packed securely in dry ice. The receiving lab at Brown University will conduct Gas Chromatography / High Resolution Mass Spectrometry-Orbitrap analyses (henceforth GC/HRMS)- Orbitrap analyses) on a random sample of 25 participants, prioritizing participants who have 3 repeat urinary measures and are categorized as progresses or stagnant between PAPM post-test1 to post-test3 (see the study procedure section for this definition). Kurt Pennell and team (Brown University) will follow an extensive and detailed standardized protocol from Pennell for sample preparation and for GC/HRMS for Targeted and Non-targeted Analyses within the HRMS facility located in the new Engineering Research Center at Brown University. In brief, urine samples will be extracted based on EPA Method 8016A for phthalates and phthalate esters (Silva MJ, et al. J Anal Toxicol. 2005;29(8):819-824). Plastics will be strictly avoided to prevent phthalate contamination. The team will assess at minimum 20 LMW phthalates that have been associated with healthier PCP

practices. Sample extracts will be analyzed by Pennell and team using a Thermo GC-Orbitrap Q Exactive mass spectrometer analysis performed using Thermo TraceFinder software.

Pennell and team will NOT seek to determine genetic predisposition of disease in subjects who are asymptomatic. Pennell and team will NOT be conducting any sequencing (whole genome/exome or RNA), nor will they be using any assay/platforms.

Phase I: Key Informant Session We will be conducting at least one Key Informant session with our collaborators and partners to design the group educational intervention and focus group session. The Key Informant session will take place via Zoom Webinar or an in-person meeting (dependent on current IRB regulations) and last about 2 hours. Sessions will be recorded. Discussions will include the questionnaire constructs, the content of the educational intervention and script, the message of the intervention and script, and the content of the semi-structured focus group and script. We will also seek feedback from collaborators and partners through Zoom or in-person meetings (dependent on current IRB regulations).

Phase II: Recruitment, Enrollment, Consent, and Retention Please see the "Recruitment and Consent" section of the protocol for details. In brief, we will check for participant eligibility, enroll, and consent 50-100 women of color within Northern Manhattan who are early in their 3rd trimester of pregnancy and speak English and/or Spanish.

Confidentiality:

All confidential information will remain strictly confidential. The information participants provide in the questionnaires (completed on paper, in person) as well as urine collection receptacles will be assigned a study ID. The urine collection receptacles will have labels with a prepopulated study ID. Each participant study ID will be separated from participant names or any identifiable information. The file that links participant names to Study IDs will be kept in a locked file cabinet and only the investigator and study staff will have access to the file.

The following people and/or agencies will be able to look at, copy, use and share participant research information:

-The principal investigator, Columbia University Medical Center and New York-Presbyterian Hospital study staff and other medical professionals who may be evaluating the study.

-Authorities from Columbia University and New York-Presbyterian Hospital, including the Institutional Review Board ('IRB'). An IRB is a committee organized to protect the rights and welfare of people involved in research.

-The Federal Office of Human Research Protections ('OHRP')

Identifiers might be removed from the identifiable private information or identifiable biospecimens and, after such removal, the information or biospecimens could be used for future research studies without additional consent from participants. Authorization to use and share participant research information does not have an expiration date. Participants have been told that they may change their mind and revoke consent and authorization at any time and for any

reason. They have been instructed to contact the Principal Investigator, whose contact information they have been given, should they decide at any point to revoke consent and authorization.

Benefit: There are no direct benefits to participating in this study. Risk: This is a minimum risk protocol. Participants may feel anxious by answering some of the questions but they do not have to answer any question that make them feel uncomfortable.

Retention: At enrollment, the research staff will complete a participant contact sheet, which includes the subjects' address, home number, cell number, e-mail address, social media information (e.g., Instagram, Facebook), and at least one contact through which the participant can be reached. Additionally, the contact sheet allows documentation of all phone, mail and in-person communication with the study participant. We will also discuss participants' follow-up preferences and safety issues with e-mail or postal mail. For every participant not successfully reached by phone or email, we will mail a letter to her last known address. Even if a participant has moved, mail is often forwarded to the new address.

Participants will be contacted via phone (call or text) and/or e-mail two to four days prior to the educational intervention/focus group session. Should a participant miss their session, we will follow-up via phone, mail, or email. If unable to contact during the follow-up period, we will also additionally contact participants through social media (direct message) (with permission) or through the alternative contact the participant provided upon enrollment. In addition, participants will have monthly check-ins through phone, mail, and/or e-mail.

Incentives: We will provide study participants a $40 Target gift card incentive per session ($20 Target gift card for urine sample submission and $20 Target gift card per questionnaire completed) and have budgeted an additional $20 per attendee to cover the cost of refreshments served at the educational intervention and to reimburse for up to $20 worth of travel to and from Columbia University (if in-person). If sessions are conducted remotely, participants will not be reimbursed for travel expenses. Additionally, we are looking to acquire free hair product samples from Shea Moisture, but in case they are not available, we will provide everyone with $10 Target gift cards to purchase a phthalate-free product from Target.

The Target Gift Card incentive structure will be a phased-out incentive system that will no longer be used where the new CUIMC Human Subject Clinical Trial participants Prepaid Visa Debit Cards will now be the default for providing compensation. Each participant will receive one card through the mail. Once the participant verifies that they have received the card, they can activate the card. Once the card is activated, each participant will begin to access funds that are pushed to their visa card as an incentive to study participation. The same amount of incentive per study part completion as described above will be provided. The participants will now have the flexibility of use outside of Target and eliminates multiple transactions per participant follow-up. If a visa card is lost, the card will be deactivated. If the visa card is lost with funds remaining on the visa card, the participant will contact the bank and study staff to go through the process of issuing a new card. We will abide by all policies that are in accordance with this CUIMC Incentive system.

We aim to make the Prepaid Visa incentive system the default incentive system beginning October 2021. The Prepaid Visa Registration System is an approved system for research participants through CUIMC. All currently enrolled participants will be re-consented using the updated consent form to this payment structure.

Phase III: Sending Study Materials Prior to the In-Person or Remote Session We are asking enrolled participants to consent to send the following items to their mailing address, email address, and text message link to cell phone prior to their in-person session (when applicable): the consent form, the Hair Care Product Questionnaire, and the urine sample collection kit (with icepack). Please see Consent Form for more details. In brief, once determined eligible, a trained study team member will email or text a link to the remote e-consent process and review the information with the participant over the phone to answer any questions they may have. Part of this process includes asking the participant for verbal consent to send the aforementioned items to a mail and email address of the participants choosing, as well as text message links. The participant will complete the remote e-consent process this same way. The Hair Care Product Questionnaire provided via Qualtrix is best to be completed in the space where the woman conducts her everyday hair care routine as she will need to recall product type and name. We are also asking for first morning urine to standardize collection of all urine samples over time.

In the case we do not get verbal consent to provide study materials using any of these methods, it will be difficult for them to participate in this study remotely. Therefore, we will then say during the consent process "If and when this study has an in-person component, could we contact you in the future?" and provide Yes and No options.

Phase IV: Educational Intervention and Focus Group Sessions – IN PERSON OR REMOTE Participants will be asked in the welcome letter and reminded during 'reminder' calls, emails, and text messages to:

1.Submit completed remote e-consent process to research staff at CUIMC or bring their consent form to an in person session or complete the paper consent form (once received in the mail) and send back to research staff within the prepaid return envelope.

2.Mail in the provided envelope the completed urine kit to the Biomarkers Shared Resource Lab, affiliated with Herbert Irving Comprehensive Cancer Center (Santella) or bring them to an in person meeting.

3.Have completed, via Qualtrics, the questionnaires before the educational intervention.

Based on discussion with the Key Informants, we will do one or a combination of the following for administering the Intervention and Focus Groups REMOTELY:

1.Sessions will be administered consecutively or in two separate sessions to the same group of women. n~50 women with groups of 8-12. Session lasting 1-1.5 hours or 2-2.5 hours, respectively.

2.The intervention session will be administered to n~50 women with groups of 8-12 and the Focus Group Session will be administered to a separate group of n~50 women with groups of 8-12 with each session lasting 1-1.5 hours.

The Educational Intervention:

The intervention will be followed by a question and answer session. The intervention will focus on phthalate reducing behaviors because of the well documented animal and human evidence on their effects on reproductive health and development, they are ubiquitous and added to HCPs to provide scent, detected in human breast milk, urine, amniotic fluid and placenta (suggesting fetal exposure) and phthalate interventions have proven successful. At the end of the intervention, we will also administer a similar Precaution Adoption Process Model Questionnaire to assess the impact of the intervention.

A trained staff member will prior to the start of the educational intervention if taking place in-person:

1.review the consent form with the participant and obtain written consent before the intervention begins

2.Administer the Sociodemographic Questionnaire (participant self-completes or if preferred, completed with interviewer) before the intervention begins.

3.Administer the Precaution Adoption Process Model Questionnaire (participant self-completes) before the intervention begins.

4.Provide the Hair Care Product Questionnaire to be self-completed if they did not complete the questionnaire prior to the session. Or, provide a return envelope if the participant forgot to bring the completed questionnaire with them.

Remote Option: A trained staff member will have gone over the consent process remotely and will send them links from Qualtrix to complete the Sociodemographic Questionnaire and the Precaution Adoption Process Model Questionnaire prior to the educational intervention.

The Focus Groups:

From consumer theory, when a rational consumer is faced with a set of options, the consumer will place values or preferences to each option, and then choose the preferred. However, consumers are making decisions based on multiple attributes that determine the hair care products' utility and therefore the purchase. Therefore, while we hypothesize that our educational intervention will make participants more aware of the importance of ingredients as an HCP attribute, women will unlikely make maintainable HCP use decisions based on ingredients alone. Thus, pulling from consumer discrete decision making, we will determine what attributes WOC apply when making decisions about HCPs. Factors identified will inform a behavioral

intervention that targets educational awareness plus other attributes that participants apply to HCP use decisions.

Phase V: Follow-Up – ALL REMOTE There will be two follow-up sessions conducted over the phone that will take place about Mid-Late 3rd trimester (Follow-Up 1) and 1-month postpartum (Follow-Up 2). At each follow-up, the following will be collected: repeat Hair Care Product Questionnaire, repeat Precaution Adoption Process Model Questionnaire, and first morning urine collection.

Recruitment and Consent

We will enroll n=50-100 adult pregnant women (18 years or older), who are within 0-4 weeks of the 3rd trimester of their pregnancy, speaks English and/or Spanish, and lives within Manhattan, Bronx, Queens, Brooklyn, Staten Island. We will recruit through (1) Instagram advertisements and (2) the OBGYN clinic. We have experience recruiting pregnant women through the Columbia Ambulatory Care Network for the Milk-Associated Markers And Breast Optical Spectroscopy Study (MAMA BOSS) pilot study (PI: McDonald, IRB# AAAR4711) which is a study designed to understand postpartum breast biology. We will be working alongside Dr. Ashanda Saint Jean who is the OB/GYN director of the Ambulatory Care Network, the site director at the Rangel Community Health Center, and an admitting physician at the New York Presbyterian/Allen Hospital to recruit participants. Dr. Saint Jean will approach potentially eligible or soon to be eligible mothers being seen at the ACN and provide them with a packet comprised of the study Consent Form and a Welcome Letter. Dr. Saint Jean will then allow the mother time to review the packet privately and will thereafter answer any questions and obtain the name and contact information of those who might be interested in being contacted. Dr. Saint Jean will provide the PI and research staff with the name and contact number of pregnant women who have expressed interest in the study and who have provided verbal permission to be approached by the study team for participation. The research team will then follow-up with the interested individual either by phone or by email and conduct the eligibility and enrollment process. If eligibility is confirmed, the participant will be scheduled to attend the educational intervention. Our current location for the intervention is the Community Engagement Core Community Space (affiliated with the Irving Medical Center) in Washington Heights.

We will also use the CCPH Columbia Community Partnership for Health and Community Engagement Core Resource based out of the Irving Medical Center to assist with recruitment.

Additional recruitment strategies will include:

1.We will contact the Directors and Chiefs of other Ambulatory Care Networks and Obstetrics & Gynecology Divisions here at Columbia Presbyterian and local facilities (e.g., Allen Hospital) in the CUIMC catchment area to see if we can leave fliers in the waiting areas.

2. Research flyer that will be distributed in locations throughout Manhattan, Bronx, Queens, Brooklyn, Staten Island, including but not limited to, public libraries, health food stores, coffee shops, and hospitals.

3. We also will have a short post for online local parent groups that allow postings. The post will include language as written on the flier and within the consent. Interested parties will be able to call or email us to get more information.

4.We will post the electronic version of the study flyer or a short post that includes language as written on the flyer on Craigslist, community websites, and other websites where research studies are appropriate for posting. Interested parties will be able to call or email us to get more information. For any referrals, the study coordinator will confirm eligibility by administering a short eligibility questionnaire over the phone or in-person. If eligible, a study coordinator will proceed with the consent process.

Consent: Once a woman has been identified as a potential participant by one of our recruitment partners, or if they reach out to us after having seen recruitment materials, they will be administered the eligibility screener questionnaire by a trained study team member (over the phone). If the participant is determined eligible, the study team member will email or text message the participant a link that takes them to the Remote Electronic Consent process on Qualtrics. The study team member will initiate the Informed Consent Process, which will begin with a concise and focused presentation of the key information about the research study. This will be accomplished by verbally reviewing the complete consent form with the participant (25-30 minutes) on the phone. In the beginning of the Informed Consent Process, the study team member will obtain verbal consent to share the study materials with the participant, either mailed or electronic. Mailed study materials would include a urine collection kit with instructions. Electronic study materials would include a link to the electronic version of this consent form, questionnaires, biospecimen collection forms, and study reminders. The participant can select from one of the following options:

1. Consent to having the study materials mailed to the address the participant provides

2. Consent to having the study materials e-mailed to the email address the participant provides

3. Consent to having the study materials texted to the cell phone number the participant provides

4. Not consenting to having study materials mailed or electronically sent. In the case of option 4, the study personnel will explain to them that it will be difficult for them to participate in this study remotely. Study personnel then read the participant the following, “If, and when, this study has an in-person component, may we contact you in the future? This will be the end of the consent process for this study. Thank you!” and the participant can answer “yes” or “no.” This will be the end of the consent process for this study.

The verbal consent obtained by the study staff from the participant is only so they can send the participant the study materials. They will also receive (via text or email) a link to the remote e-consent process administered on Qualtrics. They will provide written consent that applies to the entire study via the e-consent process administered on Qualtrics. Please note- the urine collection (biospecimen) process is not part of the screening process; participants are only asked to provide urine samples once they have consented to participate in the study.

In the case verbal consent is granted, the following options will ensue: If the study takes place in-person for the intervention or focus group, we will have obtained verbal consent, but will also obtain written consent at that time. We will provide the participant a copy of the signed consent form in person.

If the entire study takes place remotely, and the participant completes the remote E-Consent process at the time of consenting, a copy of the consent will be generated and emailed to the participant and available to them for the duration of the study. We will also, upon request, send a hard copy to the participants address.

In both cases, written consent will be obtained for the entirety of the study.

If the entire study takes place remotely, and the participant was unable to complete the E-Consent at the time of the phone call, we will ask the participant to e-consent at a later date and send reminders up until the day of the session. If the participant has chosen to consent through a hard copy, we will send the consent to an email address and to the provided address with a return email address and a pre-paid envelope to return via mail. If the participant does not econsent or provide written consent via email or mail, they will not be permitted to participate in the session.

Emails/texts will be sent by a Columbia Research team member through Outlook, Mailchimp or Qualtrics (or SMS if using study cellphone to text) and will include a link to a Qualtrics survey, which includes the e-Consent form. Written consent for the entire study will be obtained.

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