ANTHROPOMETRY TRAINING: GUATEMALA
WHY HAPIN?
By Stephannie Covarrubias

The World Health Organization has estimated that almost 3 billion people, mainly in lower and middle income countries, still rely on solid fuels such as wood, agricultural waste and dung.[1] This burning of solid fuels produces large quantities of black smoke or household air pollution, (HAP) which upon continual exposure and inhalation, has been shown to be associated with numerous negative health outcomes such as; pneumonia,[2] which is the leading killer of young children in low-income countries, restricted growth and low birth weight in children,[3,4] increased blood pressure, stroke, cancers and other cardiovascular and respiratory effects in adults.[5–7] The WHO estimated that HAP was responsible for 7.7 % of deaths worldwide in 2016.[1]

The HAPIN trial aims to reduce the burden of disease from household air population within vulnerable populations, in particular women and children who still rely on solid fuels for cooking, heating and lighting within their homes. The HAPIN trail was designed as a randomized controlled trial taking place in four countries: Guatemala, India, Peru and Rwanda. In each country, 800 pregnant women and their infants, as well as 200 older adult women living in the home of the pregnant women, will be recruited in total. Half of the participants will be randomly assigned to receive a liquefied petroleum gas (LPG) stove at less than 20 weeks gestation. The other half will serve as a control group, continuing to use their biomass stove during the trial. The participating women and children will be monitored over the course of 18 months. During which time, the team will be monitoring the use of both the LPG stove and the traditional biomass stove (within the control group) as well as the personal air pollution exposure within the household. Extensive health outcomes will be assessed for both the women and children, such as: preterm birth outcomes, child birth weight, child developmental growth and stunting, childhood pneumonia, and blood pressure, and cardiovascular inflammation, and respiratory disease in adult women. Completion of the trial will provide guidance to policy groups, including local governments and non-governmental

organizations with the necessary evidence to inform and encourage the creation of new policies to extend the use of clean cookstoves in vulnerable populations.

Anthropometric Measures

Anthropometry is the science behind the study of measurements and dimensions of the different parts of the human body. The primary anthropometric measures that will be taken during the HAPIN trial are, low birth weight and weight-for-length z-score of newborns and infants, as an indicator of stunting. Secondary measures include: head circumference of newborns and infants, severe malnutrition in children with pneumonia, height and weight of pregnant and elder adult women; as well as blood pressure and blood samples from the pregnant and elder adult women.

Low Birth Weight:

Low birth weight was selected as an anthropometric measure because although the majority of literature has associated exposure to HAP during pregnancy as cause of pre-term births, small for gestational age and low birth weight, this has not been the case in all studies.[2,8,9] Hence, one of the major goals of the HAPIN trial is to try and rectify the discrepancy within the literature and give a more complete look at the affects of HAP during pregnancy. Our hope is that by setting all other exposures and settings equally, through our process of randomization, we are hoping to detect weight differences between newborns exposed to traditional cookstoves as compared to newborns exposed to the LPG cookstoves with the goal of providing more definitive evidence of the benefits of a clean cookstove intervention on infant birth weight.

Stunting:

Stunting (measured using length-for-age z-scores) was selected as an anthropometric measure because, although it may have complex causes such as malnutrition and disease status[10], it serves as a useful estimate for overall health of vulnerable populations. For example, stunting is associated with infections such as pneumonia and 20% of stunting has in utero origins[11] and can result in small for gestational age. Stunting can serve as a predicting factor for other health and life

outcomes such as: increased risk of illness through reduced immune function, shorter adult height, lower school attainment, reduced adult earning potential, reduced cognitive function and increased risk of chronic diseases in adulthood, such as diabetes, hypertension and high blood lipids.[12–14] Further, because HAP affects several of the same health pathways that contribute to stunting.[15] our randomized trial may provide more direct evidence of a causal association between HAP and stunting.

Other Measures:

Infant head circumferences was also measured because of its association with neurodevelopmental and cognitive function in children.[16] Weight-for-length z-scores will be assessed to detect possible malnutrition in the children because very low Weight-for-length z-scores are heavily associated with child mortality.[17] For adult women, height and weight were measured. These measures have been associated with diabetes, certain cancers and heart disease in older women.[18,19]

Procedures:

All anthropometrists were trained to read an oral screening consent in order to inform the mother of the measurements that would be taking place as well as obtain permission from the mothers to allow their child to participate in the anthropometric standardizing session. This included taking all the standardization measurements (head circumference, weight, and length) of the newborns/infants as well as establishing permission to take photos or videos of the child as associated with the anthropometric training. The goal of filming and photo capturing was to create a standardizing video for the retraining practices that are required to take place every 3 months during the HAPIN trial. Mothers were not excluded from standardization trainings if they did not consent to filming or photo capturing. Only children whose mothers were comfortable with having their child filmed or photographed were captured.

Standardization:

Standardization is vital to maintain accurate and precise measurement values throughout the study and reduces measurement bias. When anthropometrical measures are taken, there will often be variability between measures as a result of technical execution by each anthropometrist. However, the goal is to maintain both a precise and accurate measurement processes among trainees. This is achieved by having a relatively small standard deviation and relatively stable, average measurement-value among all trainees. To achieve this a "gold standard" is set by selecting a lead anthropometrist to train and observe all trainees during the training process. For each pair of measurements that are taken by a trainee, a second pair of measurements are made by the lead anthropometrist to assure that all trainees have unbiased measurements.

Measuring Process:

For each training session, a pair of trainees alternated between being the "leading" or the "assisting" anthropometrist. Following SOP protocol, the leading anthropometrist took the first measures, and the assisting anthropometrist was responsible for holding the child in the proper position so that the leading anthropometrist could achieve the best measurement. The assistant was also responsible for writing down the correct measurement observed by the leading anthropometrist. In some cases, a third assistant was responsible for documenting the measurement values. Once the measure was recorded, and if the child was still cooperating, the leading anthropometrist and the assisting anthropometrist would switch positions to take a third set of measurements. Upon completion of the pair of measurements, each anthropometrist would ensure that their measurements were within the maximum allowed differences (see appendix for SOP protocol); if not, a third measurement was taken. However, only the two closest measurements were used for analysis. Lastly, the "gold standard" anthropometrist would take a final pair of measurements for comparison of all trainee's measurements.

RESULTS-Summary

Only two people were retrained on infant measurement and seven people were retrained on adult height measurement. As described by the individual results section, each trainee had a good overall intra-individual and inter-individual precision as well as a low bias. Where intra-individual precision is defined as the measurements made by each trainee on a particular participant. High intra-individual precision was to be expected because individual trainees will rarely allow their two measurements, of each individual, to deviate significantly. Further, because they are expected and trained to retake an additional third measurement, if the two original measurements deviate above protocol, the third measurement will most likely reflect one of the two original measurement's. And although intra-individual precision is necessary for a good antrhopometrist, intra-individual precision needs to be compared alongside inter-individual precision. Where inter-individual precision is the precision of all of the trainees in relationship to the "gold standard". Where it would be expected that each individual was consistently making measurements within acceptable range of the "gold standard". Because 84% of length measurements were within 0.5 cm of the expert measurement, we can conclude that the majority of trainees were both accurately and precisely measuring the majority of participants. Further, as seen by our individual bias calculations, each trainee maintained an excellent overall bias with each trainee that was measured. For anthropometric measures, keeping bias to a minimum is critical for accurate results. Thus, taking into consideration all forms of analysis that were used to measure the reliability and efficacy of each trainee, the standardization session was seen as an overall success within the Jalapa team.

DISCUSSION: Lessons Learned

Overall the Guatemalan team proved extremely successful during its standardization training. Working in groups of three for infant/newborn measuring proved to be more efficient that groups of two, but we realize that will not be possible during the majority of the cases within the HAPIN trial.

An important lesson to note is that the conditions of the room in which measurements were to be taken can greatly affected the ease and speed of measurements. Rooms that are well lit, protected from the elements and with flat floors are optimal for accurate measurements. However, it is not always possible to obtain all of the desired characteristics that best accommodate the measuring equipment. In these cases, it is important that trainees find clever ways of accommodation the room to the best of their abilities, such as: using wood planks; rocks or other items to stabilize tables; or equipment, bringing reliable light sources for extremely dark rooms, bringing a complete set of transportable tables and chairs, and closing off doors or sections that are too heavily exposed to the outside. It is important to keep in mind the comfort of the child. A heavily unprotected room could expose the child to heavy breezes or sun exposure. Mothers are particularly cautious of exposing their children to extreme cold for fear of illness. In these situations, have a blanket or cover available to shield the child until the very last moment, when the child is to be measured. Hence, it is always important to be properly set up before any measurements are taken. That is; having all cleaning materials ready for quick wipe down and rotation, setting up all equipment on flat and stable ground, setting up tablets and forms for easy access and documentation of measurements, keeping this organized and arranged to facilitate access based on importance and use, and obtaining bins or storage units that are easily transportable for easy pack up and pack down.

Lastly and most importantly, anthropometrists had to work quickly but calmly. The energy and disposition of the anthropometrists is easily felt by both the children and the mothers and thus, it is extremely important to maintain a cheerful disposition while handling the children. This ensures a calmer disposition and a sense of security for the mother. Having children be overly distressed could limit mothers' agreeableness or willingness to participate in the standardization. Careful attention must be paid to behavior of the anthropometrist to remind them that each child needs to be handled with utmost patience and care.

APPENDIX:

SOPs:

HAPIN SOP CIC-03b Anthropometry Quality Control V2 Español_clean July 2018

HAPIN SOP CIC-03 Anthropometry and Blood Pressure V5 Espanol_clean July 2018

HAPIN SOP CIC-03b Anthropometry Quality Control V2

HAPIN SOP CIC-03 Anthropometry and Blood Pressure V5

Guidelines:

DMC-III Form BILINGUAL 2018.7.17

DMC-III Manual SPANISH 2016-11-22

DMC-III Manual ENGLISH 2016-11-22

CXX cognitive Qs to DMC-II_Bilingual SPA ENG 15 Jan 2018

Maternal Qs to DMC - Bilingual 06.13.18

Training Documents:

Anthropometry in HAPIN_Day 1

Anthropometry training_MAIN

Quality control_SPAN

Anthropometry in HAPIN_Day 1_SPAN

Anthropometry training_MAIN_SPAN

Weight-for-length z-score tables_SPAN

Quality control_ENG

Anthropometry training_MAIN_ENG

Weight-for-length z-score tables_ENG

References:

1.   WHO | Household air pollution. *WHO*. 2018.
     http://www.who.int/gho/phe/indoor_air_pollution/en/. Accessed August 29, 2018.

2.   Dherani M, Pope D, Mascarenhas M, Smith KR, Weber M, Bruce N. Indoor air

pollution from unprocessed solid fuel use and pneumonia risk in children aged under five years: a systematic review and meta-analysis. *Bull World Health Organ.* 2008;86:390-398C. doi:10.1590/S0042-96862008000500017

3.   Milanzi EB, Namacha NM. Maternal biomass smoke exposure and birth weight in Malawi: Analysis of data from the 2010 Malawi Demographic and Health Survey. *Malawi Med J.* 2017;29(2):160-165. http://www.ncbi.nlm.nih.gov/pubmed/28955426. Accessed August 28, 2018.

4.   Khan MN, B. Nurs CZ, Mofizul Islam M, Islam MR, Rahman MM. Household air pollution from cooking and risk of adverse health and birth outcomes in Bangladesh: a nationwide population-based study. *Environ Heal.* 2017;16(1):57. doi:10.1186/s12940-017-0272-y

5.   WHO | Household air pollution: Disease impacts. *WHO.* 2017. http://www.who.int/airpollution/household/health-impacts/diseases/en/. Accessed August 29, 2018.

6.   Klepac P, Locatelli I, Korošec S, Künzli N, Kukec A. Ambient air pollution and pregnancy outcomes: A comprehensive review and identification of environmental public health challenges. *Environ Res.* 2018;167:144-159. doi:10.1016/j.envres.2018.07.008

7.   Apte K, Salvi S. Household air pollution and its effects on health. *F1000Research.* 2016;5. doi:10.12688/f1000research.7552.1

8.   Zhang J (Jim), Smith KR. Indoor air pollution: a global health concern. *Br Med Bull.* 2003;68(1):209-225. doi:10.1093/bmb/ldg029

9.   Pope DP, Mishra V, Thompson L, et al. Risk of Low Birth Weight and Stillbirth Associated With Indoor Air Pollution From Solid Fuel Use in Developing Countries. *Epidemiol Rev.* 2010;32(1):70-81. doi:10.1093/epirev/mxq005

10. Black RE, Victora CG, Walker SP, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet.* 2013;382(9890):427-451. doi:10.1016/S0140-6736(13)60937-X

11. Christian P, Lee SE, Donahue Angel M, et al. Risk of childhood undernutrition related to small-for-gestational age and preterm birth in low- and middle-income countries. *Int J Epidemiol.* 2013;42(5):1340-1355. doi:10.1093/ije/dyt109

12. Adair LS, Fall CHD, Osmond C, et al. Associations of linear growth and relative weight gain during early life with adult health and human capital in countries of low and middle income: findings from five birth cohort studies. *Lancet (London, England).* 2013;382(9891):525-534. doi:10.1016/S0140-6736(13)60103-8

13. WHO | Stunting in a nutshell. *WHO.* 2015. http://www.who.int/nutrition/healthygrowthproj_stunted_videos/en/. Accessed August 30, 2018.

14. Stunting later in childhood and outcomes as a young adult: Evidence from India. *World Dev.* 2018;104:344-357. doi:10.1016/J.WORLDDEV.2017.12.019

15. Balietti A, Datta S. *Growth Lost to Smoke: Household Air Pollution, Stunting, and Wasting of Children in India*.; 2018. https://www.wider.unu.edu/sites/default/files/Events/PDF/Slides/slides-NCDE2018-Datta.pdf. Accessed August 30, 2018.

16. Sniderman A. Abnormal head growth. *Pediatr Rev.* 2010;31(9):382-384. doi:10.1542/pir.31-9-382

17. Barros FC, Rossello JLD, Matijasevich A, et al. Gestational age at birth and morbidity, mortality, and growth in the first 4 years of life: findings from three birth cohorts in Southern Brazil. *BMC Pediatr.* 2012;12(1):685. doi:10.1186/1471-2431-12-169

18. Peeters GMEE (Geeske), Herber-Gast G-CM, Dobson AJ, Brown WJ. Changes in the Relationships Between Body Mass Index and Health Outcomes Across Middle Age and Older Adulthood. *Mayo Clin Proc.* 2015;90(7):903-910. doi:10.1016/j.mayocp.2015.04.006

19. Lewis CE, McTigue KM, Burke LE, et al. Mortality, Health Outcomes, and Body Mass Index in the Overweight Range: A Science Advisory From the American Heart Association. *Circulation.* 2009;119(25):3263-3271. doi:10.1161/CIRCULATIONAHA.109.192574