Effect of pregnancy gestation on food insecurity in HIV-positive women from Kisumu and Migori Counties in Western Kenya

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Abstract

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Background: Food insecurity has been associated with adverse health outcomes among vulnerable populations including women, children, and persons infected with HIV. Little is known about the relationship between pregnancy and food insecurity among HIV-positive women.

Methods: A cross-sectional analysis of data from HIV-infected women in Migori and Kisumu Counties in western Kenya was performed using univariate and multivariate linear regression to examine the association between pregnancy, modeled as gestational age (0->40 weeks), and food insecurity based on the Household Food Insecurity Access Scale (HFIAS). A subgroup analysis restricted to the pregnant women only was performed to examine this association.

Results: A total of 1034 HIV-positive women were included in this study, of whom 106 (10.3%) were pregnant, and 928 (89.8%) were not pregnant at enrollment. Participants ranged in age from 18-49 years, with a median age of 30 years (inter-quartile range [IQR] 25-35) for non-pregnant women and 26 years (IQR 23-29) for pregnant women. The median gestational age among 106 pregnant women was 19 (IQR 13-27) weeks. Among all women, 227/1034 (23%) did not experience any food insecurity. The median food insecurity score was 6 for non-pregnant (IQR 2-12) and 6 for pregnant women (IQR 0-12). In unadjusted analysis, there was a weak negative association between gestational age and HFIAS score (β=-0.048, 95% confidence interval [CI] -0.096, 0.000, p=0.049) which was of borderline statistical significance This association was no longer present after adjusting for age, marital status, education, and CD4 count in (β=-0.016, 95% CI -0.064, 0.035, p=0.504). A number of covariates were significantly associated with HFIAS scores. These included age (β=0.131, 95%, CI, 0.089, 0.0175, p<0.001 , being married (β=-0.742, 95%, CI,-1.400,-0.085, p=*0.027*), and having secondary (β=-1.722, 95% CI -2.434,-1.010, p<0.001 or college/university (β=-3.833, 95% CI -5133,-2.533, p<0.001 education compared to primary education or less.

Conclusions: In this population of HIV-positive women, there was no association between advancing gestational age and food insecurity Younger age, higher education, and being married were associated with less food insecurity, suggesting that social, cultural, and economic factors may be drivers of food insecurity in HIV-positive women.

INTRODUCTION

Every day nearly 800 million people across the globe suffer from hunger and food insecurity, leading to poor health and development.[1] Food insecurity occurs when individuals and families lack physical, social, or economic access to sufficient, safe, and nutritious food that meets their dietary needs.[2,3] Households with food insecurity may lack money to buy food, experience reduced food intake, have problems with food quantity and quality, and miss meals or have disrupted eating patterns.[4]

The Millennium Development Goals (MDGs) formulated in 2000 by the United Nations targeted several major achievements by 2015,[5] and identified eradication of extreme poverty and hunger as the top MDG priority. Specifically, this goal was targeted to reduce the proportion of people suffering from extreme hunger by 50% between 1990 and 2015.[6] While the proportion of undernourished people globally declined from 23.3% in 1990 to 12.9% in 2015,[7] close to 795 million people worldwide still faced food insecurity at the end of the MDG period,[8] with 98% (780 million) residing in developing regions. The State of Food Security and Nutrition Report 2017 identified the following five regions to have the highest levels of food insecurity as a proportion of the population: sub-Saharan Africa: 22.7%, Caribbean: 17.7%, Southern Asia: 14.4%, Southeastern Asia: 11.5%, and Western Asia: 10.6%.[9]

Kenya is considered by the Food and Agriculture Organization of the United Nations (FAO), World Food Program (WFP), and UNICEF to be one of the food insecure countries in sub-Saharan Africa.[10] At any one time, an estimated two million people in Kenya will need assistance to access food, with this number often doubling during droughts, flooding, and excessive rains.[11] Persistent food insecurity is due to a complicated mix of farming reliant on rainwater rather than irrigation, seasonal variability, climate change leading to extreme weather events including recurrent droughts and flooding, and increasing dependency on food imports to meet food production deficits, which in turn results in fluctuating and higher food costs compounded by high poverty levels.[10-11]

One such example was a maize shortage that struck Kenya in 2017, causing a national food crisis.[12] The price of maize meal, a dietary staple, spiraled to one of its highest points in over six years,[13] pushing more than three million people to food insecurity.[14] With a population estimated to grow from the current 44 million to close to 60 million by 2030,[15,16] rapid urbanization, low food production, and rising food prices,[17,18] more than 25% of the families in Kenya may be faced with food insecurity if current trends remain unchecked.

Food insecurity is a modifiable risk factor for adverse health outcomes among vulnerable populations including persons infected with HIV, women, and children.[4, 19] Food insecure children experience developmental impairment which limits their physical, intellectual and emotional potential, perpetuating poverty and food insecurity. Pregnant women facing food insecurity may experience increased mortality, anemia, micronutrient deficiency, low birth weight, and obesity.[19–22] Laraia et al. identified three factors with the potential to increase food insecurity among pregnant women as gestation advances. These factors include increased nutritional needs to meet fetal growth demands, declining physical ability to obtain and prepare food, and lost income due to reduced ability to engage in economic labor.[21] A qualitative study of women attending antenatal services in Johannesburg revealed that pregnancy reduced participants' earning potential.[22] Other studies have shown that pregnant women from low-income households are more likely to experience food insecurity than those from households with high income.[23–25]

In people living with HIV, nutritional and micronutrient deficiencies may be associated with more rapid degradation of the immune system.[26] A vicious cycle characterizes the bidirectional relationship between HIV and food insecurity in sub-Saharan Africa, where a generalized HIV epidemic co-exists with food insecurity.[19] A majority of women in sub-Saharan Africa are of low socioeconomic status, and often depend on others for their livelihood.[27] This dependence exposes them to food insecurity, which has been associated with sexual risk-taking behaviors including having multiple partners, inconsistent condom use, sex exchange, coerced sex, and intergenerational sex which could lead to HIV.[28] On the other hand, mortality and morbidity related to HIV infection may push families to FI. Households with an HIV-infected member may experience heightened expenses due to the cost of medical care, lost income from having an ill family member, and opportunity costs related to caring for the chronically ill family member.[26]

Among HIV-positive pregnant women, food insecurity may undermine efforts for preventing mother-to-child transmission of HIV through a number of pathways. First, pregnant women may avoid antenatal and maternity care due to costs.[19] Second, food insecurity may contribute to poor adherence to antiretroviral therapy (ART) and unsuppressed viremia.[29] Third, food insecurity can promote risky infant feeding practices such as mixed feeding, due to inadequate breastmilk production caused by undernutrition.[30] Each of these pathways results in increased risk of perinatal transmission of HIV. Because of the linkages between food insecurity and HIV, the World Health Organization (WHO), UNAIDS, and the World Food Program (WFP) have suggested integrating efforts to alleviate food insecurity into HIV/AIDS programming activities.[2, 36]

Several studies have examined the effect of food insecurity on maternal and infant outcomes,[32,33] HIV infection,[19,28] stress, depression, and anxiety during pregnancy.[23, 32] The present analysis tested the hypothesis that gestational age (from non-pregnant = 0 weeks through 42 weeks gestation) is associated with food insecurity measured by the Household Food Insecurity Access Scale (HFIAS) in a population of HIV-seropositive women in the Nyanza region of Kenya.

METHODS

Population and Procedures:

This was a cross-sectional analysis of baseline data from the Adaptive Strategy for Preventing and Treating Lapses of Retention in Adult HIV Care (AdaPT-R) study, an ongoing sequential multiple assignment randomized trial evaluating strategies for optimizing retention of HIV-seropositive individuals in care. The Adapt-R study enrolled HIV-infected patients meeting eligibility criteria while attending routine clinic visits at study facilities. Eligible and consenting participants completed a standardized face-to-face survey that collected information on social and demographic characteristics, food insecurity, quality of life, mental well-being, and alcohol use. Surveys took approximately 30 minutes to complete, and were conducted in English, Kiswahili, or Dholuo by a Kenyan research assistant. Additional clinical data were collected from medical records, including date of enrollment in HIV care, pregnancy status, expected date of delivery, CD4 count, and plasma HIV viral load.

The AdaPT-R study was conducted in Kisumu and Migori counties in the Nyanza region of western Kenya. Health facilities included in the study were supported by Family AIDS Care and Education Services (FACES) and the University of Maryland Baltimore (UMB) Global Health Initiative. Both are U.S. President's Emergency Plan for AIDS Relief (PEPFAR) supported programs for HIV prevention, care, and treatment.

The AdaPT-R study included individuals who were HIV-seropositive, ≥18 years old, and planning to remain in the (Nyanza region) for the duration of the study. Additional eligibility criteria included ART initiation within the past 90 days, access to a cell phone, ability to read or be read SMS messages, and willingness to be contacted by clinic staff if appointments were missed. Individuals were excluded if they were acutely ill (requiring hospitalization) or participating in other studies with potential to influence retention behaviors.

The study exposure was gestational age estimated using the Medscape online gestational age calculator, which uses the current date (date of enrollment into Adapt-R) and expected date of delivery (EDD) as inputs.[35] The pregnancy status and EDD were retrieved from patient records during study enrollment.

The study outcome variable was the number of points on the Household Food Insecurity Access Scale (HFIAS) developed by Coates et al.[36] The HFIAS comprises two types of questions: a food insecurity occurrence question, followed by a frequency of occurrence question, asking the participant how often each item related to food insecurity occurred during the last four weeks. For each two-part question, responses break down into the categories never=0, rarely=1, sometimes=2, and often=3. This 9-item scale is made up of two sub-scales that measure mild to moderate food insecurity (items 1-6), and more severe food insecurity (items 7-9). The Adapt-R study utilized items 1-6 with a total score range of 0 to 18. Higher scores indicate more severe food insecurity. The overall HFIAS and the subscales within it have been validated among rural poor households in Tanzania and showed strong reliability, validity, and contextual relevance.[37] The primary endpoint in this study examined food insecurity as a continuous variable. A sub-group analysis was conducted to examine the association between advancing pregnancy and household food insecurity after excluding women who were non-pregnant.

Study power:

Given the fixed sample size in the existing dataset from the Adapt-R study, we determined whether this analysis was well powered to estimate the correlation between HFIAS score and gestational age. A slope with a beta of 0.1 was hypothesized. We used an alpha level of 0.05 and a two-sided hypothesis test. Given the sample of 1109 women, this analysis had >90% power to detect a slope of 0.1.

Statistical analysis:

To examine the relationship between pregnancy gestation (including non-pregnant [gestation=0 weeks] and pregnant gestation >0 through 42 weeks of gestation) and household food insecurity, we examined all women of reproductive age (18-49 years) enrolled in the Adapt-R study. The age limit of 49 years was used as a proxy for menopause, based on the median age at menopause of 48.3 years for women in Western Kenya.[38]

Descriptive analyses of socio-demographic and clinical characteristics included medians and interquartile ranges (IQR) for continuous variables and frequency and percent for binary and categorical variables. We compared the medians of continuous variables between pregnant and non-pregnant women using the Wilcoxon rank-sum test and a Chi-squared test for categorical variables.

For the primary analysis, univariate and multivariate linear regression were performed with week of gestation as the predictor variable and HFIAS score as the outcome. The beta coefficient from this linear regression represented the mean change in HFIAS score for each week of gestation. Additional variables for inclusion in the multivariate model were selected *a priori* based on known or predicted associations with pregnancy and food insecurity. These included age, education, marital status, and CD4 lymphocyte count. Directed acyclic graphs were used to theoretically confirm that adjustment for this set of variables was well suited to address confounding of the relationship between gestational age and HFIAS score.

Because potentially important differences were observed between pregnant and non-pregnant women, a sensitivity analysis was performed after restricting to the subset of pregnant women. This analysis used the same univariate and multivariate linear regression approach as the primary analysis.

RESULTS

Participant characteristics are presented in Table 1, stratified by pregnancy status. A total of 1034 HIV-positive women were included in this study, of whom 106 (10.3%) were pregnant during their baseline visit to the parent study. The median gestational age among pregnant women was 19 (IQR 13-27) weeks. The median age of non-pregnant women was 30 years (IQR 25-35), while the median age of pregnant women was 26 years (IQR 23-29; $p<0.001$). The median HFIAS score was 6 (IQR 2-12) for non-pregnant women, and 6 (IQR 0-12) for pregnant women ($p=0.11$).

In unadjusted analysis, each additional week of gestational age was associated with a 0.048 point lower HFIAS score (β=-0.048, 95% confidence interval [CI] -0.096, 0.000, p=0.049), and this association was of borderline statistical significance (Table 2) The association between gestational age and HFIAS score was attenuated, and no longer statistically significant, after adjusting for age, marital status, education and CD4 lymphocyte count (β=-0.016, 95% CI -0.064, 0.035, p=0.504).

A number of covariates were independently associated with HFIAS scores (Table 2). These included age (*β*=0.117, 95%, CI, 0.074, 0.159, *p*<0.001), being married (*β*=-0.85, 95%, CI,-1.493,-0.207, *p*=0.01), and having secondary (*β*=-1.578, 95% CI -2.281,-0.875-, *p*<0.001), or college/university (*β*=-3.685,--4.973,-2.396, *p*<0.001) education compared to primary education or less.

Similar to the primary analysis, a subgroup analysis restricted to the 106 pregnant women found a small negative association between advancing pregnancy gestation and HFIAS score in univariate analysis (*β*=-0.063, 95% CI -0.173, 0.048, *p*=0.262), although this was not statistically significant. The relationship remained similar in the multivariate analysis (*β*=-0.055, 95% CI -0.165, 0.055, *p*=0.320) (Table 3). In addition, some of the covariates associated with HFIAS scores in the analysis that included pregnant and non-pregnant women were not associated with HFIAS scores in the subgroup analysis that only included pregnant women, these included age (*β*=0.081, 95%, CI, -0.139, 0.300, *p*=0.467), and being married (*β*=0.147, 95%, CI,-2.667,2.960, *p*=0.918). As in the primary analysis, higher education was associated with a lower HFIAS score; secondary (*β*=-3.727, 95% CI -6.067,-1.388, *p*=0.002), or college/university (*β*=-3.984,-7.550,-0.417, *p*=0.029) education compared to primary education or less.

DISCUSSION

In this population of HIV-seropositive women, a substantial proportion was experiencing some food insecurity, as measured by the HFIAS score. However, these data did not support the hypothesis that pregnancy, measured in terms of increasing gestational age, is associated with food insecurity. A number of demographic factors including younger age, being married, and higher educational attainment were associated with less household food insecurity.

These results contrast those of studies that have found pregnant women to be more vulnerable to food insecurity because of increased nutritional demands and declining ability to obtain and prepare food.[20–22] A number of factors may help explain the somewhat unexpected absence of an association between advancing gestational age and food insecurity in the present study. First, food insecurity was measured at the household level, rather than at the individual level. It is possible that the HFIAS misclassified individual women's degree of food insecurity depending on how they interpreted these questions. Second, respondents may have difficulty distinguishing the different frequency categories within the HFIAS scale, which could impact both the accuracy and precision of this tool for measuring food insecurity.[41] Third, the HFIAS questionnaire in this study utilized only

the mild to moderate HFIAS subscales, and could have failed to capture severe food insecurity. Finally, the inclusion criteria for the parent study required that women have access to mobile phones and the ability to read text messages. As a result, the poorest and least educated women, who might also have had the highest levels of food insecurity, may have been excluded.

The large sample size of this study was an important strength, allowing for a well-powered examination of the dose-response relationship between gestational age and food insecurity. In addition, the use of a standardized instrument for measuring food insecurity will allow comparison to other studies using the HFIAS.

The study also had a number of limitations. First, compared with non-pregnant women, the pregnant women were younger, more likely to be married, and had higher levels of education, all of which were associated with less food insecurity. As a result, inclusion of the non-pregnant women (gestational age = 0) in the analysis could have biased the result towards finding no association between gestational age and increasing HFIAS score. Although our adjustment moved our findings from statistical significance to non-significance, restricting the analysis to pregnant women did not change the results meaningfully. Second, the relationship between gestation and food insecurity may be different in nulliparous versus multiparous women, [43] but our data did not include information on parity. Third, relationships between pregnancy and food insecurity in HIV-positive women are likely to be context specific, so these findings are not expected to be generalizable to all populations. Nonetheless, there is value in results that add to a limited body of literature addressing this important health risk facing HIV-positive pregnant women in resource-limited settings.

CONCLUSION

In this population of HIV-positive women, there was no association between advancing gestational age and food insecurity. Younger age, higher education, and being married were associated with less food insecurity, suggesting that social, cultural, and economic factors may be drivers of food insecurity in HIV-positive women.

REFERENCE

1. Zero Hunger [Internet]. [cited 2018 May 17]; Available from: http://www1.wfp.org/zero-hunger

2. Broca S. Food Insecurity, Poverty and Agriculture: A Concept Paper [Internet]. Agricultural and Development Economics Division of the Food and Agriculture Organization of the United Nations (FAO - ESA); 2002. Available from: https://ideas.repec.org/p/fao/wpaper/0215.html

3. Pinstrup-Andersen P. Food security: definition and measurement. Food Sec [Internet] 2009 [cited 2017 May 28];1(1):5–7. Available from: https://link.springer.com/article/10.1007/s12571-008-0002-y

4. Ivers LC, Cullen KA. Food insecurity: special considerations for women. Am J Clin Nutr 2011;94(6):1740S-1744S.

5. WHO | Millennium Development Goals (MDGs) [Internet]. WHO. [cited 2017 Jun 22];Available from: http://www.who.int/topics/millennium_development_goals/about/en/

6. WE CAN END POVERTY, MILLENNIUM DEVELOPMENT GOALS AND BEYOND 2015 [Internet]. Available from: http://www.un.org/millenniumgoals/pdf/Goal_1_fs.pdf

7. United Nations. The Millennium Development Goals Report [Internet]. 2015;Available from: http://www.un.org/millenniumgoals/2015_MDG_Report/pdf

8. The State of Food Insecurity in the World: Meeting the 2015 international hunger targets: taking stock of uneven progress. Rome [Internet]. 2015;Available from: http://www.fao.org/3/a-i4646e.pdf

9. FAO, editor. Building resilience for food and food security. Rome: FAO; 2017.

10. Kenya | Food Security Portal [Internet]. [cited 2017 May 24];Available from: http://www.foodsecurityportal.org/kenya/resources

11. The Issue of Food Security in Kenya [Internet]. ResearchGate. [cited 2017 May 28];Available from: https://www.researchgate.net/publication/273932878_The_Issue_of_Food_Security_in_Kenya

12. Kenyans staring hunger in the face as maize prices skyrocket [Internet]. [cited 2018 Jun 12];Available from: http://www.kenyafreepress.com/top-stories/national/1242/kenyans-staring-hunger-in-the-face-as-maize-prices-skyrocket

13. Letter from Africa: Why has Kenya's staple food gone into hiding? [Internet]. BBC News. 2017 [cited 2017 May 31];Available from: http://www.bbc.com/news/world-africa-40093215

14. FAO seeks to address Kenya's food crisis [Internet]. Daily Nation. [cited 2018 May 17];Available from: https://www.nation.co.ke/news/FAO-Kenya-food-crisis-2017/1056-4122444-gtk7g1/index.html

15. Kenya Population Situation Analysis [Internet]. 2013;Available from: https://www.unfpa.org/sites/default/files/admin-resource/FINALPSAREPORT_0.pdf

16. Kenya Population | 1960-2017 | Data | Chart | Calendar | Forecast | News [Internet]. [cited 2017 May 29];Available from: tradingeconomics.com/kenya/population

17. Kenya - Comprehensive Food Security and Vulnerability Analysis (CFSVA), June 2016 | WFP | United Nations World Food Programme - Fighting Hunger Worldwide [Internet]. [cited 2017 May 28];Available from: https://www.wfp.org/content/kenya-comprehensive-food-security-and-vulnerability-analysis-cfsva-june-2016

18. Kenya | World Food Programme [Internet]. [cited 2017 May 24];Available from: http://www1.wfp.org/countries/kenya

19. Weiser SD, Young SL, Cohen CR, et al. Conceptual framework for understanding the bidirectional links between food insecurity and HIV/AIDS. Am J Clin Nutr 2011;94(6):1729S-1739S.

20. Kenya-National-Nutrition-Action-Plan-2012-2017-final.pdf [Internet]. [cited 2017 May 28];Available from: https://scalingupnutrition.org/wp-content/uploads/2013/10/Kenya-National-Nutrition-Action-Plan-2012-2017-final.pdf

21. Laraia BA, Siega-Riz AM, Gundersen C. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain, and pregnancy complications. J Am Diet Assoc 2010;110(5):692–701.

22. Scorgie F, Blaauw D, Dooms T, Coovadia A, Black V, Chersich M. “I get hungry all the time”: experiences of poverty and pregnancy in an urban healthcare setting in South Africa. Global Health [Internet] 2015;11. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4549107/

23. Gamba R, Leung CW, Guendelman S, Lahiff M, Laraia BA. Household Food Insecurity Is Not Associated with Overall Diet Quality Among Pregnant Women in NHANES 1999–2008. Matern Child Health J [Internet] 2016 [cited 2017 Sep 8];20(11):2348–56. Available from: https://link.springer.com/article/10.1007/s10995-016-2058-1

24. Nyariki DM, Wiggins S. Household food insecurity in sub-Saharan Africa: lessons from Kenya. British Food Journal; Bradford [Internet] 1997;99(7):249–62. Available from: https://search-proquest-com.offcampus.lib.washington.edu/docview/225151976/abstract/F5501D76A9F46A8PQ/1

25. Nnakwe NE. The Prevalence of Food Insecurity Among Pregnant Women in a Community-based Intervention Program. FASEB J [Internet] 2017 [cited 2017 Jul 28];31(1 Supplement):791.11-791.11. Available from: http://www.fasebj.org/content/31/1_Supplement/791.11

26. Bloem MW, Saadeh R. Foreword: The Role of Nutrition and Food Insecurity in HIV and Tuberculosis Infections and the Implications for Interventions in Resource-Limited Settings. Food and Nutrition Bulletin [Internet] 2010 [cited 2018 May 17];31(4_suppl4):S289–91. Available from: http://journals.sagepub.com/doi/10.1177/15648265100314S401

27. Ramjee G, Daniels B. Women and HIV in Sub-Saharan Africa. AIDS Res Ther [Internet] 2013 [cited 2018 May 14];10:30. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3874682/

28. McCoy SI, Ralph LJ, Njau PF, Msolla MM, Padian NS. Food Insecurity, Socioeconomic Status, and HIV-Related Risk Behavior Among Women in Farming Households in Tanzania. AIDS Behav [Internet] 2014;18(7):1224–36. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3977025/

29. Does Food Insecurity Undermine Adherence to Antiretroviral Therapy? A Systematic Review. - PubMed - NCBI [Internet]. [cited 2017 Jun 29];Available from: https://www.ncbi.nlm.nih.gov/pubmed/25096896

30. Young SL, Plenty AHJ, Luwedde FA, et al. Household food insecurity, maternal nutritional status, and infant feeding practices among HIV-infected Ugandan women receiving combination antiretroviral therapy. Matern Child Health J 2014;18(9):2044–53.

31. Anema A, Vogenthaler N, Frongillo EA, Kadiyala S, Weiser SD. Food insecurity and HIV/AIDS: Current knowledge, gaps, and research priorities. Curr HIV/AIDS Rep [Internet] 2009 [cited 2017 May 23];6(4):224–31. Available from: https://link.springer.com/article/10.1007/s11904-009-0030-z

32. Addo AA, Marquis GS, Lartey AA, Pérez-Escamilla R, Mazur RE, Harding KB. Food insecurity and perceived stress but not HIV infection are independently associated with lower energy intakes among lactating Ghanaian women. Matern Child Nutr [Internet] 2011;7(1):80–91. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3053124/

33. Hadley C, Patil CL. Food insecurity in rural Tanzania is associated with maternal anxiety and depression. Am J Hum Biol [Internet] 2006 [cited 2017 May 23];18(3):359–68. Available from: http://onlinelibrary.wiley.com/doi/10.1002/ajhb.20505/abstract

34. Laraia BA, Siega-Riz AM, Gundersen C, Dole N. Psychosocial Factors and Socioeconomic Indicators Are Associated with Household Food Insecurity among Pregnant Women. J Nutr [Internet] 2006 [cited 2017 May 28];136(1):177–82. Available from: http://jn.nutrition.org/content/136/1/177

35. Gestational Age from Estimated Date of Delivery (EDD) Calculator [Internet]. [cited 2018 May 16];Available from: https://reference.medscape.com/calculator/gestational-age-est-delivery-date

36. Jennifer Coates, Anne Swindale, Paula Bilinsky. Household Food Insecurity Access Scale for Measurement of Food Access: Indicator Guide- Version 3.

37. Knueppel D, Demment M, Kaiser L. Validation of the Household Food Insecurity Access Scale in rural Tanzania. Public Health Nutr 2010;13(3):360–7.

38. Noreh J, Sekadde-Kigondu C, Karanja JG, Thagana NG. Median age at menopause in a rural population of western Kenya. East Afr Med J [Internet] 1997 [cited 2018 May 27];74(10):634–8. Available from: http://europepmc.org/abstract/med/9529744

39. Ivers LC, Cullen KA. Food insecurity: special considerations for women. Am J Clin Nutr [Internet] 2011 [cited 2017 Sep 8];94(6):1740S-1744S. Available from: http://ajcn.nutrition.org/content/94/6/1740S

40. Casey P, Goolsby S, Berkowitz C, et al. Maternal depression, changing public assistance, food security, and child health status. Pediatrics 2004;113(2):298–304.

41. Deitchler M, Ballard T, Swindale A, Coates J. Introducing a Simple Measure of Household Hunger for Cross-Cultural Use. :16.

Table 1: Demographic and clinical characteristics of women participating in the Adapt-R study, in Kisumu and Migori Counties, Western Kenya

Variable	Non-pregnant (N=928)	Pregnant (N=106)	p-value*
Participant age, median (IQR)	30.0 (25.0, 35.0)	26.0 (23, 29)	<0.001
Married	533 (57.4%)	88 (83.4%)	<0.001
Education			0.13
At most Primary	615 (66.3%)	62 (58.5%)	
At most secondary	257 (27.7%)	33 (31.1%)	
College/University	56 (6.0%)	11 (10.4%)	
CD4 count, median (IQR)	361.5 (188.0, 479.0)	475.0 (289.5, 633.5)	<0.001
CD4 count			<0.001
<=200	157 (16.9%)	7 (6.6%)	
201-350	132 (14.2%)	21 (19.8%)	
351-500	173 (18.6%)	17 (16.0%)	
>500	124 (13.4%)	35 (33.0%)	
Unknown	342 (36.9%)	26 (24.5%)	
Food insecurity, median (IQR)	6.0 (2.0, 12.0)	6.0 (0.0, 12.0)	0.11

* Wilcoxon rank-sum test for comparison of medians, Chi-squared test for comparison of categories.

Table 2: Linear regression analyses of the association of gestational age (weeks) and Household Food Insecurity Access Scale score

	Unadjusted			Adjusted		
Variable	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Gestation week	-0.048	(-0.096, -0.000)	0.049	-0.016	(-0.064, 0.035)	0.504
Participant age	0.131	(0.089, 0.175)	<0.001	0.117	(0.074, 0.159)	<0.001
Marital status						
Married	-0.742	(-1.400, -0.085)	0.027	-0.85	(-1.493, -0.207)	0.01
Education						
At most primary*				0		
At most secondary	-1.722	(-2.434, -1.010)	<0.001	-1.578	(-2.281, -0.875)	<0.001
College/University	-3.833	(-5.133, -2.533)	<0.001	-3.685	(-4.973, -2.396)	<0.001
CD4 count categories						
<=350*				0		
351-500	-0.91	(-0.942, 0.761)	0.834	0.214	(-0.610, 1.038)	0.61
>500	0.784	(-0.586, 0.603	0.261	1.147	(-0.183, 2.478)	0.091
Unknown	-0.192	(-0.988, 0.603)	0.635	-0.165	(-0.930, 0.601)	0.673

*Reference category

Table 3: Linear regression analyses of the association of gestation period (weeks) and food insecurity score, among pregnant women n=106

	Unadjusted			Adjusted		
Covariate	Coefficient.	95% CI	p-value	Coefficient.	95% CI	p-value
Gestation week	-0.063	(-0.173, 0.048)	0.262	-0.055	(-0.165, 0.055)	0.32
Participant age	0.103	(-0.115, 0.321)	0.35	0.081	(-0.139, 0.300)	0.467
Marital status						
not married*				0		
Married	0.648	(-2.208, 3.504)	0.654	0.147	(-2.667, 2.960)	0.918
Education						
At most primary*				0		
At most secondary	-3.641	(-5.90, -1.384)	0.002	-3.727	(-6.067, -1.388)	0.002
College/University	-3.944	(-7.371, -0.517)	0.025	-3.984	(-7.550, -0.417)	0.029
CD4 count categories						
<=350*				0		
351-500	-1.27	(-4.054, 1.515)	0.368	-0.79	(-3.520, 1.940)	0.567
>500	-2.34	(-5.802, 1.124)	0.183	-1.73	(-5.221, 1.762)	0.328
Unknown	-0.58	(-3.59, 2.43)	0.703	-1.125	(-4.067, 1.816)	0.45

*Reference category