**A heart-healthy preconception diet for the prevention of hypertensive disorders of pregnancy: what do we know and where to next?**

Danielle A.J.M. Schoenaker1, 2, Nisreen A. Alwan1, 2, 3

1 School of Primary Care, Population Sciences and Medical Education, Faculty of Medicine, University of Southampton, Southampton, United Kingdom

2 NIHR Southampton Biomedical Research Centre, University of Southampton and University Hospital Southampton NHS Foundation Trust, Southampton, United Kingdom

3 NIHR Applied Research Collaboration Wessex, Southampton, United Kingdom

Address for correspondence: Danielle Schoenaker, School of Primary Care, Population Sciences and Medical Education, University of Southampton, Southampton General Hospital, Tremona Road, Southampton SO16 6YD, United Kingdom. Email: D.Schoenaker@soton.ac.uk.

Hypertensive disorders of pregnancy (HDP), including preeclampsia and gestational hypertension, are among the leading causes of maternal and perinatal mortality and morbidity worldwide (1). Declining rates of HDP have been found between 1997 and 2007 in northern Europe and Australia (2), while the proportion of women diagnosed with severe preeclampsia may be increasing in the US (3). HDP remain common, affecting up to 10% of pregnancies and accounting for one in six maternal deaths in high-income countries (1-3). Following pregnancy, HDP are associated with an increased risk for the mother to develop chronic hypertension, cardiovascular disease and type 2 diabetes (4). Increasing evidence also suggests that in utero exposure to preeclampsia has long-term consequences for offspring cardiovascular health (4). Effective prevention strategies are urgently needed to reduce these lifelong and intergenerational risks of non-communicable diseases in mothers and children.

 Despite major medical advances, delivery of the fetus and placenta remains the only known cure for preeclampsia. Evidence-based recommendations for the prevention of preeclampsia currently only include low-dose aspirin and calcium supplementation for women at high risk (1). The uncertainty around the precise cause(s) of preeclampsia complicates the development of effective prevention strategies. It is known, however, that alterations in placental development and growth in the first weeks of pregnancy, when many women are not aware they are pregnant, determine whether they will develop preeclampsia (5). Moreover, epidemiologic research suggests that diet-related risk factors present before pregnancy – including obesity, chronic hypertension and pregestational diabetes – may play a role in placental development and preeclampsia risk (1). Strategies that help women optimize their dietary behaviors before pregnancy may reduce these risk factors, and thereby present an untapped opportunity for preeclampsia prevention.

In this issue of *The American Journal of Clinical Nutrition*, Arvizu et al. (6) add to the growing evidence that women’s preconception dietary intake may have a role in the prevention of HDP. In their analysis of the relationship between the American Heart Association (AHA) diet recommendations and the Dietary Approaches to Stop Hypertension (DASH) diet and risk of developing HDP among 11,535 participants from the Nurses’ Health Study II, they found that better adherence to both diets in the years leading up to pregnancy was associated with a lower risk of preeclampsia but not gestational hypertension (6). Results were strongest for the DASH diet, showing a clear trend in lower preeclampsia risk with an increasing DASH diet score, and a 35% lower risk in the top vs bottom quintile (95% CI 13%-52%). Comprehensive sensitivity analyses demonstrated that findings were robust in subgroups of women based on maternal age, parity, history of preeclampsia, smoking status, and gestational age at birth (6).

In addition to diet quality, weight and weight change before and between pregnancies are strongly associated with HDP (7, 8). The findings reported by Arvizu et al. were adjusted for preconception BMI, and for interconception weight change among women who contributed at least two pregnancies to the study, demonstrating the importance of diet quality beyond weight (6). Interestingly, the authors highlight their findings show differences in the magnitude of the association between the DASH diet and preeclampsia risk based on maternal preconception BMI, observing a stronger association between higher DASH diet scores and reduced preeclampsia risk among women with a BMI <25 kg/m2 compared with ≥25 kg/m2. They postulate “this finding could suggest that the strong impact of excess weight on risk of preeclampsia may negate any benefits diet may have” (6). While the results showed a statistically significant interaction between the DASH diet and BMI and a difference in magnitude of preeclampsia risk in the top vs bottom quintile of the DASH diet score (40% vs 18% lower risk among women with a BMI <25 vs ≥25 kg/m2), these findings point towards a beneficial effect irrespective of BMI. It remains unclear if any variations in risk reflect common limitations associated with the observational study design or if they reflect true physiological differences (9), which may be confirmed in ongoing trials of preconception nutrition interventions (10). Conclusions on a potential differential effect by BMI are in contrast to those from a large individual participant data meta-analysis of over 12,500 women globally, showing no evidence of variation in the effect of antenatal dietary interventions on maternal pregnancy complication risk based on preconception or early pregnancy BMI (11). These antenatal interventions have had no significant effect on common adverse pregnancy outcomes including preeclampsia, and suggest intervening in pregnancy may be too late (11). Findings from a prospective cohort study among over 3,000 Australian women showed the relationship between a preconception Mediterranean-style dietary pattern and HDP was not modified, and only partly mediated, by preconception BMI, suggesting preconception diet quality is important in addition to BMI (12). The large proportion of women of reproductive age, including those planning pregnancy, who consume an unhealthy diet and have overweight or obesity is a major public health concern (7, 13). Population-level efforts that support people to consume a dietary pattern in line with recommendations for cardiovascular disease prevention such as the DASH diet would benefit the health of all women, with the potential to reduce a variety of adverse maternal and child health outcomes and reduce health inequalities.

Although further high-quality studies are needed to confirm whether improving women’s diet quality prior to pregnancy reduces the risk of HDP, the findings based on the unique longitudinal preconception data collected as part of the Nurses’ Health Study II are an important contribution to the literature. They add to the compelling evidence that preconception health behaviors set the foundation for a healthy pregnancy and the subsequent lifelong health of the next generation (13). Despite the scientific evidence and the broad interest in women’s health before and between pregnancies, awareness of the importance and opportunities of the preconception and interconception periods for improving maternal and child health is not widespread among the public, healthcare professionals, and governments. To achieve improvements in preconception diet, collective action is needed. Recognition and advocacy for initiatives to improve preconception nutrition is increasing internationally (14). Efforts in high-income countries to date have often focused on educating women about the need to improve their dietary behaviors, thereby overlooking the social, environmental, economic and political context and motivations that shape people’s dietary behaviors (14). National strategies setting out plans to implement strategies that improve preconception and interconception health and nutrition, to address the wider determinants of health, and to monitor and report on progress – such as outlined in the Action Plan for the National Initiative on Preconception Health and Health Care 2012-2014 in the US (15) – are needed globally. Findings from the study by Arvizu et al. (6) support the need for population-level action to create supportive food environments that remove barriers, promote and enable healthy food choices, in particular among women during the preconception period, to contribute to the prevention of preeclampsia and reduce its long-term adverse consequences for women and offspring.

**Conflicts of interest:** the authors have no conflicts of interest to disclose.

**Funding:** DS is supported by the NIHR Southampton Biomedical Research Centre.

**Author contributions:** DS prepared the first draft. NA reviewed and edited the manuscript for important intellectual content. Both authors approved the final manuscript.

**References**

1. Committee on Practice Bulletins-Obstetrics. Gestational Hypertension and Preeclampsia: ACOG Practice Bulletin Summary, Number 222. Obstet Gynecol. 2020;135(6):1492-5. doi: 10.1097/aog.0000000000003892.

2. Roberts CL, Ford JB, Algert CS, Antonsen S, Chalmers J, Cnattingius S, Gokhale M, Kotelchuck M, Melve KK, Langridge A, et al. Population-based trends in pregnancy hypertension and pre-eclampsia: an international comparative study. BMJ Open. 2011;1(1):e000101. doi: 10.1136/bmjopen-2011-000101.

3. Ananth CV, Keyes KM, Wapner RJ. Pre-eclampsia rates in the United States, 1980-2010: age-period-cohort analysis. BMJ. 2013;347:f6564. doi: 10.1136/bmj.f6564.

4. Goffin SM, Derraik JGB, Groom KM, Cutfield WS. Maternal pre-eclampsia and long-term offspring health: Is there a shadow cast? Pregnancy Hypertens. 2018;12:11-5. doi: 10.1016/j.preghy.2018.02.003.

5. Hoek J, Steegers-Theunissen R, Sinclair K, Schoenmakers S. The science of preconception. In: Shawe J, Steegers E, Verbiest S. (eds) Preconception Health and Care: A Life Course Approach. Springer, Cham; 2020. doi:10.1007/978-3-030-31753-9\_3.

6. Arvizu M, Stuart JJ, Rich-Edwards JW, Gaskins AJ, Rosner B, Chavarro JE. Prepregnancy adherence to dietary recommendations for the prevention of cardiovascular disease in relation to risk of hypertensive disorders of pregnancy. Am J Clin Nutr. [published online ahead of print, 2020 Aug 10]. doi: 10.1093/ajcn/nqaa214.

7. Poston L, Caleyachetty R, Cnattingius S, Corvalán C, Uauy R, Herring S, Gillman MW. Preconceptional and maternal obesity: epidemiology and health consequences. Lancet Diabetes Endocrinol. 2016;4(12):1025-36. doi: 10.1016/s2213-8587(16)30217-0.

8. Martínez-Hortelano JA, Cavero-Redondo I, Álvarez-Bueno C, Sanabria-Martínez G, Poyatos-León R, Martínez-Vizcaíno V. Interpregnancy weight change and hypertension during pregnancy: A systematic review and meta-analysis. Obstet Gynecol. 2020;135(1):68-79. doi: 10.1097/aog.0000000000003573.

9. Schoenaker DA, Dodd JM. Does preconception body mass index modify the effect of maternal diet on hypertensive disorders of pregnancy? BJOG. 2019;126(5):674. doi: 10.1111/1471-0528.15596.

10. Barker M, Dombrowski SU, Colbourn T, Fall CHD, Kriznik NM, Lawrence WT, Norris SA, Ngaiza G, Patel D, Skordis-Worrall J, et al. Intervention strategies to improve nutrition and health behaviours before conception. Lancet. 2018;391(10132):1853-64. doi: 10.1016/s0140-6736(18)30313-1.

11. The International Weight Management in Pregnancy (i-WIP) Collaborative Group. Effect of diet and physical activity based interventions in pregnancy on gestational weight gain and pregnancy outcomes: meta-analysis of individual participant data from randomised trials. BMJ. 2017;358:j3119. doi: 10.1136/bmj.j3119.

12. Schoenaker DA, Soedamah-Muthu SS, Mishra GD. Quantifying the mediating effect of body mass index on the relation between a Mediterranean diet and development of maternal pregnancy complications: the Australian Longitudinal Study on Women's Health. Am J Clin Nutr. 2016;104(3):638-45. doi: 10.3945/ajcn.116.133884.

13. Stephenson J, Heslehurst N, Hall J, Schoenaker DA, Hutchinson J, Cade JE, Poston L, Barrett G, Crozier SR, Barker M, et al. Before the beginning: nutrition and lifestyle in the preconception period and its importance for future health. Lancet. 2018;391(10132):1830-41. doi: 10.1016/s0140-6736(18)30311-8.

14. Vogel C, Kriznik N, Stephenson J, Barker M. Preconception nutrition: building advocacy and social movements to stimulate action. J Dev Orig Health Dis. Published ahead of print. doi: 10.1017/S2040174420000197.

15. Floyd RL, Johnson KA, Owens JR, Verbiest S, Moore CA, Boyle C. A national action plan for promoting preconception health and health care in the United States (2012-2014). J Womens Health. 2013;22(10):797-802. doi: 10.1089/jwh.2013.4505.