**Developing an integrated, community-based model combining contraception and preconception care to address reproductive health needs across the lifecourse**

Jennifer Hall, PhD1

Mehar Chawla, MBBS1,2

Daniella Watson, PhD3

Chandni Maria Jacob, PhD4

Danielle Schoenaker, PhD5,6

Anne Connolly, MRCGP7

Geraldine Barrett, PhD1

Prof. Judith Stephenson, MD1

1Sexual and Reproductive Health Research Team, UCL EGA Institute for Women’s Health, London, UK

2Department of Obstetrics and Gynaecology, West Middlesex University Hospital, Chelsea and Westminster NHS Foundation Trust, London TW7 6AF, UK

3Global Health Research Institute, Human Development and Health, Faculty of Medicine, University of Southampton, United Kingdom

4Institute of Developmental Sciences, Faculty of Medicine, University of Southampton, Southampton, UK

5School of Primary Care, Population Sciences and Medical Education, Faculty of Medicine, University of Southampton, Southampton, UK

6NIHR Southampton Biomedical Research Centre, University of Southampton and University Hospital Southampton NHS Foundation Trust, Southampton, UK

7GP, Bevan Healthcare CIC, Bradford, UK

Corresponding Author

Dr Jennifer Hall

jennifer.hall@ucl.ac.uk, 0203 108 2040

Sexual and Reproductive Health Research Team, UCL EGA Institute for Women’s Health, London, UK

Summary

Prevention of pregnancy (contraception) and preparation for pregnancy (preconception care) are services that most people need during their reproductive lifecourse. Despite increased attention, and growing recognition that health before pregnancy is vital to addressing disparities in maternity outcomes, service provision is far from routine. We bring together evidence from the literature, new quantitative and qualitative data on women’s preferences, and case studies of existing practice, to develop an integrated, community-based model that synthesises reproductive life planning, contraception, and preconception care. Our model provides a holistic, life course approach, encompassing school-based education, social media, and national campaigns, and highlights the need for training and system-level support for the range of healthcare professionals who can deliver it. This high-level model can be adapted across settings, leading to a step-change in the provision of preconception care in the community with consequent improvements in health and wellbeing, and reductions in inequalities at population level.

Introduction

Preparation for a healthy pregnancy, through preconception care, and the prevention of unplanned pregnancies, has attracted more attention in recent years,1-4 but still falls far short of being provided routinely. The aim of preconception care is to intervene before pregnancy to improve short and long-term health and well-being outcomes for people of reproductive age, and any future children they may have. Previous studies have found evidence for a range of preconception exposures, including physical and mental health, social and psychological well-being, on fertility and increased risk of adverse outcomes, such as pre-eclampsia, gestational diabetes, and infant admission to hospital for injury.5-7 However, pregnancy planning and preparation remains more of a concept than a reality. This may be due to two key policy challenges in promoting preconception health: the whole of reproductive life is a very wide time window; and interventions to support preconception health can be hard to distinguish from broader public health goals around healthy lifestyles.8 Yet 90% of women of reproductive age have at least one modifiable risk factor affecting pregnancy,3 making the health of women before they become pregnant an important factor in maternal deaths and inequalities in maternal outcomes,9-19 as identified by the UK Government’s Maternity Disparities Taskforce.11

The Lancet Series on Preconception Health was published in 2018,2,13,13 at the same time that Public Health England produced a suite of resources making the case for preconception care.1 These reports emphasised the need to address inequalities and upgrade prevention efforts through embedding universal (population) and targeted (individual) preconception care in a lifecourse framework. The World Health Organization (WHO) recommends action for preconception care by leveraging existing public health programmes, including ‘community-based healthcare’, and by exploring ‘innovative channels’.14 ‘Community-based healthcare’ covers primary care services including all healthcare professionals (HCP) in general practice (GP) and sexual and reproductive health (SRH) services, midwives, health visitors, and community pharmacies. ‘Innovative channels’ covers digital interventions, school-based education, and social media campaigns that do not rely on contact with health services. We build on these resources by summarising the evidence for components of effective and acceptable pre- and interconception care interventions and by considering opportunities for integration of these interventions in community-based care. In taking a lifecourse perspective we highlight the need to consider pregnancy prevention and preparation simultaneously,15 and develop an adaptable community-based model that bridges the gap between contraception and preconception care using available opportunities across the lifecourse, so that a more integrated approach to address reproductive health needs is embedded within existing services.

*Development of a community-based model combining contraception and preconception care*

We took a mixed-methods approach, including reviewing the literature, analysis of existing survey data, case studies of current practice, and discussion with women of reproductive age, to collate and synthesise the evidence. Further details on the methods are provided in appendix (p2-3).

In the absence of an existing model, the findings from these workstreams were then integrated to develop a model of universal community-based preconception care, including contraception, and consider its application. We based the initial model of pre- or interconception (hereafter preconception) intervention around the recommendations of de Weerd,17 that an ideal preconception visit should include risk identification, education, and intervention, as required, and building on a previous model of preconception care delivery through attendance at primary care.18 Given the more extensive evidence base on the provision of contraception service, our model concentrates on illuminating the components of effective preconception care. We first drew on the consistencies identified by the studies found in the scoping review to populate the three components of a preconception intervention. We identified themes based on setting and method of delivery, and considered feasibility, acceptability, and cost-effectiveness, where available. Secondly, we incorporated reproductive healthcare needs across the lifecourse,19 bringing pregnancy prevention and pregnancy preparation together,15 clarifying the need for an ‘entry point’ to the model to determine needs at that point in time. Recognising that most people will need both contraception and preconception advice across their reproductive lifecourse, and at times may be undecided or ambivalent, and in line with the desire expressed by women in the online discussion for tailored follow-up advice, we therefore included contraception services in our model. We discussed entry points, based on preferences from the data analysis, with women through online discussions which, in combination with the literature on reproductive life planning, were used to determine how and when individuals could or should be approached and in what way. Thirdly, we included all possible points of contact, either within primary care or outside the health service, per WHO recommendations,14 and in line with women’s preferences from the data analysis and online discussions, and incorporated the growing availability and use of digital health interventions and social media to raise awareness among the public and HCPs. Finally, we highlighted the range of HCPs who could be involved based on the literature, women’s preferences, case studies and ‘making every contact count’.20

*Role of the funding source*

The funding source had no role in the study design; collection, analysis, and interpretation of data; in the writing of the paper; or in the decision to submit.

*Existing evidence for community-based models of preconception care*

Our search found no universal model of integrated community-based preconception care, therefore we explored studies on targeted community-based models or standalone preconception services, highlighting relevant features. We found 52 studies of which half were in the USA (n=26), 20 were in Europe, including four in the UK, and two were in Australia. Full details on the search can be found in the appendix (p4) as can the studies included in the review (p5-11). We summarised studies into the themes related to intervention, delivery method or setting. The seven themes were: technology assisted interventions; clinic-based counselling; motivational interviewing; education; campaigns and social media-based interventions; provision of supplements; and interconception interventions, as well as looking at cost-effectiveness.

.

*Technology assisted interventions*

We identified 19 studies of 15 technology assisted interventions, ranging from educational videos to conversational agents, based in the UK, USA, Netherlands, and Italy.21-39 Studies largely used web-based methods to assess baseline risk factors and aimed to provide tailored information to participants. Women were followed up for behaviour changes such as folic acid uptake, alcohol consumption, smoking, nutrition, and engagement with healthcare providers. Two studies found increased engagement with healthcare providers after tailored web-based intervention within a 6-month period.21,22 “Gabby”, an online conversational agent that identifies individual risk factors, assesses degree of progress, readiness to change, and subsequently provides counselling, showed effectiveness in changing African-American women’s behaviours.30,31 Improved behaviours were also observed in web-based interventions that contained non-tailored, generic preconception health information.25,29-31 The majority of users appear to have a positive attitude to, and greater compliance with, web-based provision, enjoying its usability and demonstrating feasibility.25,30,31,37,38 Generally, studies with a longer period of intervention and/or with frequent interventions found greater maintenance of effects, and a greater effect was seen in couples who participated together.38

*Clinic-based counselling*

We found eight studies of six community clinic-based interventions in Hungary,40,41 Sweden,42 The Netherlands,43 the UK,32,33 and the USA.44,45 In Hungary a stand-alone preconception service was established in primary care across 32 centres and showed significant improvements in health behaviours and in foetal outcomes, including reduction in pre-term births and congenital abnormalities at 10 and 27-year evaluations, though secular effects cannot be ruled out.40,41

In the UK a community-based integrated model for women with diabetes who were planning pregnancy was shown to be feasible and improved glycaemic control, folic acid uptake, and reduced foetal congenital abnormalities and stillbirths.32,33 Randomised control trials delivering aspects of preconception care to targeted populations in primary care clinics in the USA and Netherlands showed reduced alcohol intake and smoking, increased folic acid consumption,43,44 and a lower, though non-significant, percentage of adverse pregnancy outcomes.43

Opportunistic preconception care counselling was investigated at family planning clinics in Sweden and the USA, resulting in greater likelihood of planning pregnancies.42,45 While diverse, these studies show that clinic-based intervention, whether opportunistic or standardised, can be effective.

*Motivational interviewing*

Five studies focused on reducing the risk of alcohol-exposed pregnancies through motivational interviewing, all based in the USA.26,28,46-49 Overall, motivational interviewing showed significant reductions in alcohol drinking and increased effective contraception use with effects sustained at 9-month follow up. Motivational interviewing was found to be effective in demographic groups including college students, ethnic minorities, and lower socioeconomic classes.26,28,46,47

*Education*

Education about preconception care was explored in eight studies, one each in the UK and the Netherlands, and six in the USA.23,24,39,50-54 A UK study focused on education for women with diabetes, through leaflets, local and regional educational events, and education and support to HCPs which showed greater folic acid uptake, improved glycaemic control, and overall higher levels of “optimal” pregnancy.39 In the Netherlands a similar dual approach of a local campaign, to raise awareness in couples wishing to conceive, and simultaneous development of a preconception care pathway for health care providers showed a significant reduction in alcohol consumption, and non-significant improvements in other behaviours.50 One-to-one and small group sessions have both been shown to be an effective method for education and counselling, with long-term sustained behavioural changes, including during the interconception period.23,24,51-54

*Campaigns and social media-based interventions*

Local and national campaigns to raise awareness of preconception health have been explored in 13 studies based in countries including the Netherlands, Australia, USA, Norway, Belgium, Germany, and Denmark.50,55-66 Campaign delivery via posters, flyers, billboards, and social media feeds such as twitter, news-items, magazines, and TV spots have been conducted. Generally, TV spots were found to be the least effective.55 One-off national campaigns showed positive behavioural changes, although most campaigns were evaluated shortly after their implementation.56,58-62,66 While the national campaign in the Netherlands remained effective for promotion of folic acid at 10 years, studies consistently found a large and growing gap in uptake between women of different socioeconomic class.58-62

*Provision of supplements*

Although focused on a narrow part of preconception health care, brief counselling and supplement provision result in greater uptake than supplement provision alone at up to 12 months in the USA,35,67-70 as did computer-assisted counselling software.35 In the Netherlands folic acid use was also increased where information was given with oral contraception.71 In some studies effectiveness was limited by lack of engagement by HCPs, highlighting the challenge of adding additional responsibilities to already over-burdened staff.68

*Interconception interventions*

Effective interconception interventions included risk assessments leading to tailored care and multiple intervention and education components such as counselling, multi-vitamin supplementation, peer support groups, contraception, mental health, and substance support.16 Outcomes including post-partum weight retention and glycaemic control after gestational diabetes are potential proxy measures for health in any future pregnancies, and post-partum interventions that address these risk factors show promise. Interventions include postpartum weight loss programmes, where a combination of diet support and physical activity showed the most significant weight reduction in mothers.16 Higher health literacy, use of behaviour change strategies, and digital interventions were associated with effectiveness.16

*Cost effectiveness*

Around 45% of pregnancies in the UK are unplanned,72 costing the NHS £193,200,000 in 2010.73 Formal cost-effectiveness data is limited, but preconception care is likely to be highly cost-effective through reducing adverse outcomes that carry a high financial burden, including pre-term births, congenital abnormalities, and prolonged maternal and neonatal admissions. One costed preconception care model for women with diabetes in the UK estimated the cost of providing care at £49,476 per annum;39 another study estimated savings of £68,000.32,33 This can be contrasted with the cost of managing one neural tube defect of £666,098.39  Preconception care has also been shown to be cost-effective in the USA, where preventing 0·6 unplanned pregnancies offset the cost of the READY-Girls programme,23 and reduced hospital stays resulted in cost savings of USD$34,000 per annum,53 and in South Australia, where a AUD$40,000 programme showed significant uptake of folic acid and reduction in neural tube defects.55

*Women’s preferences*

In quantitative data from the P3 Study (https://p3-study-ucl.co.uk/), most women (80%) wanted to be asked about their pregnancy preferences online and receive links to online advice based on their answers, the next most popular was to be asked online and then discuss with a health professional, followed by being asked in person. A very small number (<1%) said they did not want to be asked. Preferences did not differ by age, ethnicity, or gravida, however, both younger women and those who had not been pregnant before more frequently selected options involving in person advice.

A large proportion of women (39%) expressed no preference regarding which health professional they spoke to. Where a health professional was specified, GP was most popular, followed by a doctor or nurse at a SRH clinic; <1% did not feel that they needed to be asked by anyone. Younger women and those who had never been pregnant before were more likely to declare a preference for the SRH clinic. Women who had been pregnant before were more likely to suggest both midwives and health visitors; preferences are likely to reflect patterns of health care use and familiarity. More detail is shown in the appendix (p 12-14). These findings are in line with those of the SOPHIE study.74

Among 12 women who participated in online discussions, 11 had been pregnant before, several were currently pregnant, and two had at least one child. Women were mostly in their 20s and 30s, were a mixture of ethnicities, and were from across the UK. Across the two groups, women were open to discussions about future pregnancies with healthcare professionals, under certain conditions. This included the rationale for asking being clear, assumptions not being made based on age or marital status, having a good rapport with the health professional, privacy, and the provision of tailored follow-up advice.

As entry points, posters or leaflets in a variety of settings (healthcare and non-healthcare), or a woman’s health information pack including information on contraception, general women’s health issues, preconception health and other health promotion information, were considered acceptable. Women found it more acceptable if they did not feel personally targeted but saw it as information that should be available for everyone of reproductive age. They felt that this would normalise the topic, triggering conversations both internally to the person (and couple) and externally (with friends and HCPs) and would help shift the focus from pregnancy being the woman's sole responsibility.

In the discussions there were clear examples of missed opportunities. Women talked about having their coil taken out with no mention of folic acid or being given no advice on what to expect next when trying to become pregnant after miscarriage. While most women had not considered seeing their GP for preconception advice, one had and was met with the response that ‘*[the GP] had never been asked for advice on how to plan pregnancy before'*. As another woman said, *'you're either on contraception or you're pregnant, and that middle step is missing'* highlighting the gap between services*.*

*Case studies*

Preconception care, in a variety of forms, is currently being developed or delivered in England as shown in Box 1. Further information on the case studies is in the appendix (p15-20).

* Social media campaigns eg #ReadyforPregnancy by the Southeast Clinical Delivery and Network, and Tommy’s #AreYouReady
* Health visitor training by the Institute of Health Visiting
* General Practice e.g. The Ridge Medical Practice in Bradford
* Local Maternity Systems e.g. West Yorkshire & Harrogate

Box 1 Case studies of implementation of preconception care in England.

Using this evidence base we developed the model, shown in Figure 1. The model has been presented confidentially at national and international fora, and has been well received suggesting good face validity.

Figure 1 Proposed integrated, community-based model combining contraception and preconception care to address reproductive health needs across the lifecourse.

Application of the model

In order to determine what people want and need at any given point in time, and to fill the gap between contraception and antenatal services, there needs to be an entry point, which could be a simple enquiry, a set of screening questions, or a more structured reproductive life plan, which has been associated with more planned pregnancies.42,45 A reproductive life plan “is a set of personal goals about having (or not having) children”, including the means by which the goals will be met, all while emphasizing personal values and resources available to the individual.75 Any HCP could discuss reproductive life planning with people of reproductive age at any contact, in line with ‘make every contact count’20, though women’s preference was for consultations relating to women’s health, or women could complete it themselves digitally. At other health care contacts this should be considered, but it is important to preface it with a rationale. Further work is ongoing with women and HCPs to explore how best to do this; incorporation into the wider prevention agenda e.g. for obesity and mental health may enhance both acceptability and success76.

Our model recommends a community-level increase in awareness of reproductive life planning and the importance of health before pregnancy in the general public through societal and school-based interventions, which will help to normalise these discussions, was found to be effective,50,55-66 and is in line with WHO and other recommendations.14,76 While such bottom-up mobilisation of communities and individuals is important in improving preconception health, this will have limited effectiveness unless complemented by a top-down approach to create an enabling environment.77,78 This includes focused policy initiatives e.g., folic acid fortification as well as addressing wider determinants of health and inequalities.

Once the person’s needs and desires have been assessed, this should then lead on to individualised advice and information on contraception or preconception health. It is unrealistic to expect HCPs to undertake face-to-face reproductive life planning with everyone of reproductive age every year; most people could be signposted to online sources/apps, which are effective and highly acceptable,22,31,33 through general social media, NHS campaigns, school-based education, or by any HCP. Non-digital platforms should also be available for those who cannot access or do not like digital interventions, or the HCP could use the online tool with the woman in a face-to-face encounter; an approach that might be particularly suitable to vulnerable individuals.

Having expressed their desire for, or to avoid, pregnancy, the person would then be directed to further resources as applicable. If they do not want any(more) children, they would be referred to a source of information on contraception and on to how to access it. If they want (more) children, but not in the next year, they would be directed to a source of information on the importance of health before pregnancy, and then on to information on contraception. At each contraception review, the HCP should check whether the person’s view on pregnancy has changed and support them accordingly. For individuals who are considering a pregnancy in the next year, they could be directed to an online tool or app to self-complete a risk screening for tailored advice on how to improve their health before pregnancy.

Based on any identified risks people should then be guided to appropriate interventions. This could be to specialised services for those with pre-existing conditions, or through social prescribing to a link worker who can provide support across health, housing, financial and other social issues. For the UK, the content of preconception care provided is outlined in a NICE Clinical Knowledge Summary.79 A 2022 review found 11 freely available clinical practice guidelines for preconception care from USA, Canada, Australia and India, demonstrating the global relevance of preconception care.80 The interventions that have been most effective are those that have had repeated contact (either virtual or in person); have sought to reduce barriers, for example, providing supplements rather than just advising people to take them;35,67-70 and which include the partner, if there is one.38 In line with the empowering approach of reproductive life planning, interventions comprising motivational interviewing or an interactive component,30,31 to encourage people to take ownership of developing their own plan to address the issues that have arisen are more effective.26,28,46-49 Our findings suggest that developing a digital intervention that tackles several related issues together, such as diet and physical activity, that incorporates behaviour change strategies and, in the case of interconception care, is delivered soon after birth, would likely be most effective and acceptable.16

During pregnancy, the benefits of spacing pregnancies with at least 18 months from delivery to conception should be explained by the midwife or obstetrician, postnatal contraception should be discussed and a plan made before delivery; women do not want to discuss contraception in the immediate postpartum period. A range of methods of contraception should be made available on discharge from midwifery care (either in the hospital or at home). This will require discussions with commissioners, review of commissioning pathways and (re)training of midwives. Health visitors should confirm women are using contraception in line with their wishes, and support the delivery of interconception care to prepare for the next pregnancy if or when it is desired. Health visitors should support women/couples to reflect on and review their reproductive life plan during at least two of their visits at six, 12, 18 and, 24 months postpartum, drawing on their knowledge of the family to determine when is most appropriate, and direct them to the preconception risk screening tool if/when needed. The application of the model is further illuminated by the vignettes in the appendix which consider the current ‘typical’ journey, an ‘ideal’ journey, which would be the outcome of implementing the model, and an example of how the model may be applied to a woman with vulnerabilities (p21-23).

*Delivery*

There is a lack of clarity on who should deliver preconception care which hampers its implementation. A 2016 review found consensus among HCPs that primary care is the right location for preconception care but no agreement on with which professional group the responsibility should lie.81 This was evident in our women's accounts of missed opportunities and unsuccessful efforts to seek advice for pregnancy planning. Existing time and resource pressures are further barriers. We contend that there is not one right HCP; it depends on where the person is in their reproductive lifecourse, which services they access and how the health system is structured, but HCPs in primary care are key. The interconception period is a crucial time and an opportunity that has not yet been fully realised.16

To deliver this programme of work, HCPs need to have suitable training82. A recent assessment of the preconception content of various undergraduate and postgraduate medical curricula showed that this was lacking (MSc thesis, Hanson 2020, unpublished data). It will be important to engage with health professionals to understand the perceived barriers and facilitators of integrating pre- and interconception care into routine practice. However, the health visitor case study shows that suitable training can be developed and provided.

In terms of outcomes, assessing the level of unplanned pregnancy will provide evidence for the effectiveness of the overall programme. This should be done using the London Measure of Unplanned Pregnancy, a validated measure of the degree of pregnancy intention,83 at both antenatal booking appointments and in termination services, or through regular nationally-representative surveys. Improvements in indicators such as key health behaviours at antenatal booking and increase in uptake of long-acting reversible contraception will also demonstrate effectiveness. At a population-level, preconception health should be monitored through annual reporting of key indicators using metrics from multiple routine data sources.4,84 Longer-term outcomes, such as the impact on child health and development will require sustained implementation of the model at scale.76

*Limitations*

We limited our search to studies published in English and in high-income country settings which may have limited the generalisability of the model. However, our initial scoping reviews were not limited in such a way and most studies that would have been excluded on setting were not relevant, all relevant studies had an English translation available, though not having searched in multiple languages it is possible that other studies were missed. Wider considerations of healthcare systems for the delivery of preconception care, stakeholders involved, and socio-cultural practices influencing health behaviours in the preconception period may need to be taken in to account when considering the translation of this model to low- and middle-income countries.

The literature on preconception care has grown in recent years, yet there is still a dearth of evidence on the impact of preconception interventions on outcomes such as preterm birth or child health and development. Instead, most studiesare either small scale before and after or cross-sectional surveys, prospective cohorts that look at behaviour change only, or randomised controlled trials of individual interventions. This limits our ability to quantify potential effectiveness and cost-effectiveness and highlights the need for larger scale comprehensive interventions with sufficient duration of follow up. Some studies experience selection bias, with wealthier and more highly educated participants, but others focus on women from more deprived areas or with lower education levels.

Conclusion

We have developed an evidence-based model of universal integrated community-based preconception care that includes contraception. This model is deliberately high-level, offering a framework that should be contextualised in different settings and adapted to the health system, rather than being prescriptive in content. This, combined with the international literature underpinning it, mean that it is applicable to other settings.

The model looks beyond healthcare, to wider policy, schools and social media, can be implemented across the reproductive lifecourse and by a range of HCPs. This can only be provided within a supportive health economy, which values reproductive health and rights for all, and is structured to enable individuals to develop and achieve their own goals. This individualistic approach needs to be balanced with top-down policies that address the structural determinants of preconception health and inequalities,1 that embed preconception health within the preventative agenda and align health service provision to provide holistic care rather than the current fragmented, disease-oriented model which inefficiently requires patients to access multiple services while still leaving gaps in care provision. Although preconception care is gaining a higher policy profile, it is not yet established in the minds of most health care providers, their training or service delivery plans, nor is it normalised for the public. Charities such as Tommy’s and First Steps Nutrition advocate and support the preconception agenda, yet more accountability is required from local and national governments, and other stakeholders who have influence including insurance companies, the food and drink industry, and marketing agencies.

This model should be piloted and evaluated to develop and test the specific elements and connections that are likely to work in each context; implementation strategies are likely to differ across groups and settings. Evaluation of the model should ui a range of relevant indicators (process, behavioural, and biological) . Successful models should be extended through the relevant professional networks such as the Royal Colleges, NICE, and the Office for Health Improvement and Disparities, supported though commissioning networks and pathways, and will also contribute to evidence of what works. Some interventions have been ineffective due to the barriers faced by HCPs, despite recognition of its importance81. Implementation research can be useful for understanding this and improving intervention design. It is vital that HCPs receive training on how to raise the topic and the advice to give, and are supported by the system to implement it, such as having sufficient time within routine appointments or via a separate mechanism, and it being a recognised activity, such as a pay-for-performance indicator.

The review of evidence and model put forward here show how preconception healthcare in the community can shift from concept to reality and how the gap between contraception and antenatal services can be bridged to holistically support women’s needs across their reproductive life course.

Contributors

Conceptualisation JH, data curation MC JH DW CMJ GB DS, formal analysis JH MC DW CMJ DS, funding acquisition JH GB DS JS, investigation JH MC DW CMJ DS GB, methodology JH, supervision JH AC JS, visualisation JH MC, writing – original draft All authors, and writing – review & editing All authors.

Funding sources

This project was funded by a grant from Public Health England to Dr Jennifer Hall in November 2020. Funding was used towards salary support for work relating to this manuscript for MC and GB. JH, Advanced Fellow, PDF-2017-10-021 is funded by the NIHR for work relating to this research project. The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR, NHS or the UK Department of Health and Social Care. DS is supported by the National Institute for Health and Social Care Research (NIHR) Southampton Biomedical Research Centre [IS-BRC-1215-20004]. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care. CMJ is supported by the European Union’s Horizon 2020 LifeCycle Project under grant agreement No. 733206.

Declaration of interests

AC has received payment for providing consultancy for Bayer, MSD, Gedeon Richter, HRA Pharma and has received payment from Bayer, MSD, Pfizer, Gedeon Richter, Consilient for lecturing healthcare professionals on provision of contraception. The other authors declared no conflicts of interest.

Ethical Approval

We received ethical approval from the UCL Research Ethics Committee for data collection in the P3 Study (ref 3974.003).

Acknowledgments

We would like to thank Catherine Stewart, UCL EGA Institute for Women’s Health Sexual and Reproductive Health team Research Assistant, for her support with preparing the manuscript for submission. We would also like to thank Tommy’s Charity for arranging and facilitating the online discussion groups, and all the women who took part in them and the P3 Study.

References

1. Public Health England. Preconception care: making the case. England: PHE, 2018.

2. Stephenson J, Heslehurst N, Hall J, et al. Before the beginning: nutrition and lifestyle in the preconception period and its importance for future health. *Lancet* 2018; **391**(10132): 1830-4.

3. Stephenson J, Schoenaker DA, Hinton W, et al. A wake-up call for preconception health: a clinical review. *Br J Gen Pract* 2021; **71**(706): 233-6.

4. Stephenson J, Vogel C, Hall J, et al. Preconception health in England: a proposal for annual reporting with core metrics. *Lancet* 2019; **393**(10187): 2262-71.

5. Daly M, Kipping RR, Tinner LE, Sanders J, White JW. Preconception exposures and adverse pregnancy, birth and postpartum outcomes: Umbrella review of systematic reviews. *Paediatr Perinat Epidemiol* 2022; **36**(2): 288-99.

6. Oostingh EC, Hall J, Koster MPH, Grace B, Jauniaux E, Steegers-Theunissen RPM. The impact of maternal lifestyle factors on periconception outcomes: a systematic review of observational studies. *Reprod Biomed Online* 2019; **38**(1): 77-94.

7. Harron K, Gilbert R, Fagg J, Guttmann A, van der Meulen J. Associations between pre-pregnancy psychosocial risk factors and infant outcomes: a population-based cohort study in England. *Lancet Public Health* 2021; **6**(2): e97-e105.

8. Hill B, Hall J, Skouteris H, Currie S. Defining preconception: exploring the concept of a preconception population. *BMC pregnancy and childbirth* 2020; **20**(1): 280-.

9. Knight M, Bunch K, Tuffnell D, on behalf of MBRRACE-UK. Saving lives, improving mothers’ care — lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2015–17, 2019.

10. Knight M, Bunch K, Tuffnell D, et al. Saving Lives, Improving Mothers’ Care - Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2017-19. Oxford National Perinatal Epidemiology Unit, 2021.

11. Care DoHaS. Maternity Disparities Taskforce explores women's health before and during pregnancy. 2022.

12. Fleming TP, Watkins A, Velazquez MA, et al. Origins of lifetime health around the time of conception: causes and consequences. *The Lancet* 2018; **391**(10132): 1842-52.

13. Barker M, Dombrowski SU, Colbourn T, et al. Intervention strategies to improve nutrition and health behaviours before conception. *The Lancet* 2018; **391**(10132): 1853-64.

14. World Health Organisation. Preconception care: Maximizing the gains for maternal and child health, 2013.

15. Hall JA, Mann S, Lewis G, Stephenson J, Morroni C. Conceptual framework for integrating ‘Pregnancy Planning and Prevention’ (P3). *Journal of Family Planning and Reproductive Health Care* 2016; **42**: 75-6.

16. Watson D, Jacob C, Giles G, McAuliffe F, Godfrey K, Hanson M. A scoping review of nutritional interventions and policy guidelines in the interconception period for prevention of noncommunicable diseases. *Reprod Female Child Health* 2022: 1-24.

17. de Weerd S, Steegers EA, Heinen MM, van den Eertwegh S, Vehof RM, Steegers-Theunissen RP. Preconception nutritional intake and lifestyle factors: first results of an explorative study. *Eur J Obstet Gynecol Reprod Biol* 2003; **111**(2): 167-72.

18. Shannon GD, Alberg C, Nacul L, Pashayan N. Preconception healthcare delivery at a population level: construction of public health models of preconception care. *Matern Child Health J* 2014; **18**(6): 1512-31.

19. RCOG. Better for Women: A life course approach. London: RCOG, 2019.

20. Public Health England. Making Every Contact Count (MECC): Consensus Statement: Public Health England, 2016.

21. Agricola E, Pandolfi E, Gonfiantini MV, et al. A cohort study of a tailored web intervention for preconception care. *BMC Medical Informatics and Decision Making* 2014; **14**.

22. Batra P, Mangione CM, Cheng E, et al. A Cluster Randomized Controlled Trial of the MyFamilyPlan Online Preconception Health Education Tool. *American Journal of Health Promotion* 2018; **32**: 897-905.

23. Rodgers Fischl AF, Herman WH, Sereika SM, et al. Impact of a preconception counseling program for teens with type 1 diabetes (READY-Girls) on patient-provider interaction, resource utilization, and cost. *Diabetes Care* 2010; **33**: 701-5.

24. Charron-Prochownik D, Sereika SM, Becker D, et al. Long-term effects of the booster-enhanced READY-girls preconception counseling program on intentions and behaviors for family planning in teens with diabetes. *Diabetes Care* 2013; **36**: 3870-4.

25. Delrahim-Howlett K, Chambers CD, Clapp JD, et al. Web-Based Assessment and Brief Intervention for Alcohol Use in Women of Childbearing Potential: A Report of the Primary Findings. *Alcoholism: Clinical and Experimental Research* 2011; **35**: 1331-8.

26. Farrell-Carnahan L, Hettema J, Jackson J, Kamalanathan S, Ritterband LM, Ingersoll KS. Feasibility and promise of a remote-delivered preconception motivational interviewing intervention to reduce risk for alcohol-exposed pregnancy. *Telemedicine and e-Health* 2013; **19**: 597-604.

27. Gootjes DV, van Dijk MR, Koster MPH, Willemsen SP, Steegers EAP, Steegers-Theunissen RPM. Neighborhood deprivation and the effectiveness of mobile health coaching to improve periconceptional nutrition and lifestyle in women: Survey in a large urban municipality in the Netherlands. JMIR mHealth and uHealth: JMIR Publications Inc.; 2019.

28. Hanson JD, Miller AL, Winberg A, Elliott AJ. Prevention of alcohol-exposed pregnancies among nonpregnant American Indian women. *American Journal of Health Promotion* 2013; **27**.

29. Holmes VA, Hamill LL, Alderdice FA, et al. Effect of implementation of a preconception counselling resource for women with diabetes: A population based study. *Primary Care Diabetes* 2017; **11**: 37-45.

30. Jack B, Bickmore T, Hempstead M, et al. Reducing preconception risks among African American women with conversational agent technology. *Journal of the American Board of Family Medicine* 2015; **28**: 441-51.

31. Jack BW, Bickmore T, Yinusa-Nyahkoon L, et al. Improving the health of young African American women in the preconception period using health information technology: a randomised controlled trial. *The Lancet Digital Health* 2020; **2**: e475-e85.

32. King P, Gale K, Ashton-Cleary S, Dhindsa P, Ruston S, Westcott C. Does the PROCEED (Preconception Care for Diabetes in Derby and Derbyshire) model deliver quality preconception care? *Diabetic Medicine* 2013; **30**(1): 167.

33. King P. Advance to Derby: it's not about the journey, it's about the destination. *Practical Diabetes* 2017; **34**: 245-9.

34. Milan JE, White AA. Impact of a stage-tailored, Web-based intervention on folic acid-containing multivitamin use by college women. *American Journal of Health Promotion* 2010; **24**: 388-95.

35. Schwarz EB, Sobota M, Gonzales R, Gerbert B. Computerized Counseling for Folate Knowledge and Use. A Randomized Controlled Trial. *American Journal of Preventive Medicine* 2008; **35**: 568-71.

36. Sijpkens MK, van Voorst SF, Rosman AN, et al. Change in Lifestyle Behaviors After Preconception Care: A Prospective Cohort Study. *American journal of health promotion :* *AJHP* 2021; **35**(1): 116-20.

37. Tenkku LE, Mengel MB, Nicholson RA, Hile MG, Morris DS, Salas J. A web-based intervention to reduce alcohol-exposed pregnancies in the community. *Health Education and Behavior* 2011; **38**: 563-73.

38. Van Dijk MR, Huijgen NA, Willemsen SP, Laven JSE, Steegers EAP, Steegers-Theunissen RPM. Impact of an mhealth platform for pregnancy on nutrition and lifestyle of the reproductive population: A survey*. JMIR mHealth and uHealth* 2016; **4**(2): e53.

39. Yamamoto JM, Hughes DJF, Evans ML, et al. Community-based pre-pregnancy care programme improves pregnancy preparation in women with pregestational diabetes. *Diabetologia* 2018; **61**: 1528-37.

40. Czeizel AE. Ten years of experience in periconceptional care. *European Journal of Obstetrics and Gynecology and Reproductive Biology* 1999; **84**: 43-9.

41. Czeizel AE. Experience of the Hungarian Preconception Service between 1984 and 2010. *European Journal of Obstetrics and Gynecology and Reproductive Biology* 2012; **161**: 18-25.

42. Stern J, Larsson M, Kristiansson P, Tydén T. Introducing reproductive life plan-based information in contraceptive counselling: An RCT. *Human Reproduction* 2013; **28**: 2450-61.

43. Elsinga J, de Jong-Potjer LC, van der Pal-de Bruin KM, le Cessie S, Assendelft WJJ, Buitendijk SE. The Effect of Preconception Counselling on Lifestyle and Other Behaviour Before and During Pregnancy. *Women's Health Issues* 2008; **18**.

44. Manwell L, Fleming M, Mundt M, Stauffacher K, Barry K. Treatment of problem alcohol use in women of childbearing age: results of a brief intervention trial - PubMed. *Alcohol Clin Exp Res* 2000; **24**: 1517-24.

45. Moos MK, Bangdiwala SI, Meibohm AR, Cefalo RC. The impact of a preconceptional health promotion program on intendedness of pregnancy. *American Journal of Perinatology* 1996; **13**: 103-8.

46. Ingersoll KS, Ceperich SD, Nettleman MD, Karanda K, Brocksen S, Johnson BA. Reducing alcohol-exposed pregnancy risk in college women: Initial outcomes of a clinical trial of a motivational intervention. *Journal of Substance Abuse Treatment* 2005; **29**: 173-80.

47. Ingersoll KS, Ceperich SD, Hettema JE, Farrell-Carnahan L, Penberthy JK. Preconceptional motivational interviewing interventions to reduce alcohol-exposed pregnancy risk. ***Journal of Substance Abuse Treatment***2013; **44**: 407-16.

48. Group PCIR. Reducing the risk of alcohol-exposed pregnancies: a study of a motivational intervention in community settings - PubMed. *Pediatrics* 2003; **111**: 1131-5.

49. Floyd RL, Sobell M, Velasquez MM, et al. Preventing alcohol-exposed pregnancies: a randomized controlled trial. *Am J Prev Med* 2007; **32**(1): 1-10.

50. Poels M, van Stel HF, Franx A, Koster MPH. The effect of a local promotional campaign on preconceptional lifestyle changes and the use of preconception care. *The European Journal of Contraception & Reproductive Health* Care 2018; **23**: 38-44.

51. Cena ER, Joy AB, Heneman K, et al. Learner-Centered Nutrition Education Improves Folate Intake and Food-Related Behaviors in Nonpregnant, Low-Income Women of Childbearing Age. *Journal of the American Dietetic Association* 2008; **108**: 1627-35.

52. Dejoy SB. Pilot Test of a Preconception and Midwifery Care Promotion Program for College Women. *Journal of Midwifery and Women's Health* 2014; **59**: 523-7.

53. Herman W, Janz N, Becker M, Charron-Prochownik D. Diabetes and pregnancy. Preconception care, pregnancy outcomes, resource utilization and costs - PubMed. *J Reprod Med* 1999; **44**: 33-8.

54. Hillemeier MM, Downs DS, Feinberg ME, et al. Improving Women's Preconceptional Health. Findings from a Randomized Trial of the Strong Healthy Women Intervention in the Central Pennsylvania Women's Health Study. *Women's Health Issues* 2008; **18**.

55. Chan A, Pickering J, Haan EA, et al. "Folate before pregnancy": The impact on women and health professionals of a population-based health promotion campaign in South Australia. *Medical Journal of Australia* 2001; **174**: 631-6.

56. Daltveit AK, Vollset SE, Lande B, Oien H. Changes in knowledge and attitudes of folate, and use of dietary supplements among women of reproductive age in Norway 1998 - 2000. *Scandinavian Journal of Public Health* 2004; **32**: 264-71.

57. De Jong-van Den Berg LTW, De Walle HEK, Van Der Pal-de Bruin KM, Buitendijk SE, Cornel MC. Increasing awareness of and behaviour towards periconceptional folic acid consumption in The Netherlands from 1994 to 1995. *European Journal of Clinical Pharmacology* 1998; **54**: 329-31.

58. De Walle HEK, Van Der Pal KM, De Jong-Van Den Berg LTW, et al. Effect of mass media campaign to reduce socioeconomic differences in women's awareness and behaviour concerning use of folic acid: Cross sectional study. *British Medical Journal* 1999; **319**: 291-2.

59. Van Der Pal-De Bruin KM, De Walle HEK, Jeeninga W, et al. The Dutch 'Folic Acid Campaign' - Have the goals been achieved? Paediatric and Perinatal Epidemiology 2000; 14: 111-7.

60. De Walle HEK, Cornel MC, De Jong-Van Den Berg LTW. Three years after the Dutch folic acid campaign: Growing socioeconomic differences. *Preventive Medicine* 2002; **35**: 65-9.

61. De Walle HEK, De Jong-Van Den Berg LTW. Growing gap in folic acid intake with respect to level of education in the Netherlands. *Community Genetics* 2007; **10**: 93-6.

62. De Walle HEK, De Jong-Van Den Berg LTW. Ten years after the Dutch public health campaign on folic acid: The continuing challenge. *European Journal of Clinical Pharmacology* 2008; **64**: 539-43.

63. Delvoye P, Guillaume C, Collard S, Nardella T, Hannecart V, Mauroy MC. Preconception health promotion: Analysis of means and constraints. *European Journal of Contraception and Reproductive Health Care* 2009; **14**: 307-16.

64. Egen V, Hasford J. Prevention of neural tube defects: Effect of an intervention aimed at implementing the official recommendations. *Sozial- und Praventivmedizin* 2003; 48: 24-32.

65. Flores AL, Prue CE, Daniel KL. Broadcasting Behavior Change: A Comparison of the Effectiveness of Paid and Unpaid Media to Increase Folic Acid Awareness, Knowledge, and Consumption Among Hispanic Women of Childbearing Age. *Health Promotion Practice* 2007; **8**: 145-53.

66. Knudsen VK, Orozova-Bekkevold I, Rasmussen LB, Mikkelsen TB, Michaelsen KF, Olsen SF. Low compliance with recommendations on folic acid use in relation to pregnancy: is there a need for fortification? *Public Health Nutrition* 2004; **7**: 843-50.

67. Chilukuri N, Cheng TL, Psoter KJ, et al. Effectiveness of a Pediatric Primary Care Intervention to Increase Maternal Folate Use: Results from a Cluster Randomized Controlled Trial. *Journal of Pediatrics* 2018; **192**: 247-52.e1.

68. Lawrence JM, Watkins ML, Ershoff D, et al. Design and evaluation of interventions promoting periconceptional multivitamin use. *American Journal of Preventive Medicine* 2003; **25**: 17-24.

69. Robbins JM, Cleves MA, Collins HB, Andrews N, Smith LN, Hobbs CA. Randomized trial of a physician-based intervention to increase the use of folic acid supplements among women. *American Journal of Obstetrics and Gynecology* 2005; **192**: 1126-32.

70. Upadhya KK, Psoter KJ, Connor KA, Mistry KB, Levy DJ, Cheng TL. Cluster Randomized Trial of a Pre/Interconception Health Intervention for Mothers in Pediatric Visits. *Academic Pediatrics* 2020; **20**: 660-9.

71. Meijer WM, de Smit DJ, Jurgens RA, de Jong-van den Berg LTW. Improved periconceptional use of folic acid after patient education in pharmacies: promising results of a pilot study in the Netherlands. International *Journal of Pharmacy Practice* 2005; **13**: 47-52.

72. Wellings K, Jones KG, Mercer CH, et al. The prevalence of unplanned pregnancy and associated factors in Britain: Findings from the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3). *The Lancet* 2013; **382**: 1807-16.

73. Montouchet C, Trussell J. Unintended pregnancies in England in 2010: Costs to the National Health Service (NHS). *Contraception* 2013; **87**: 149-53.

74. Daly MP, White J, Sanders J, Kipping RR. Women’s knowledge, attitudes and views of preconception health and intervention delivery methods: A cross-sectional survey. *medRxiv* 2022.

75. Morse JE, Moos MK. Reproductive Life Planning: Raising the Questions. *Maternal & Child Health Journal* 2018; **22**(4): 439-44.

76. Walani S, Moley K. Global Strategies for Change. In: J S, EAP S, S V, eds. Preconception Health and Care: A Life Course Approach: Springer International Publishing; 2020: 287-97.

77. World Health Organisation. An evidence map of social, behavioural and community engagement interventions for reproductive, maternal, newborn and child health, 2017.

78. Hanson M, Barker M, Dodd JM, et al. Interventions to prevent maternal obesity before conception, during pregnancy, and post partum. *The lancet Diabetes & endocrinology* 2017;**5**(1):65-76.

79. NICE. Pre-conception - advice and management, 2021.

80. Dorney E, Boyle JA, Walker R, et al. A Systematic Review of Clinical Guidelines for Preconception Care. *Semin Reprod Med* 2022; 40(03/04): 157-169.

81. Steel A, Lucke J, Reid R, Adams J. A systematic review of women's and health professional's attitudes and experience of preconception care service delivery. *Fam Pract* 2016; **33**(6): 588-95.

82. Manze MG, Calixte C, Romero DR, et al. Physician perspectives on routine pregnancy intention screening and counseling in primary care. *Contraception* 2020; **101**(2):91-96.

83. Barrett G, Smith SC, Wellings K. Conceptualisation, development, and evaluation of a measure of unplanned pregnancy. *J Epidemiol Community Health* 2004; **58**(5): 426-33.

84. Schoenaker DA, Stephenson J, Connolly A, et al. Characterising and monitoring preconception health in England: a review of national population-level indicators and core data sources. *J Dev Orig Health Dis* 2021; **13**(2): 137-50.