

ORIGINAL ARTICLE

Preconception Care to Improve Pregnancy Outcomes: The Science

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Abstract

Introduction: In the last decades, improvements in the care of pregnancy and child development have been observed worldwide. However, pregnancy problems remain high in most countries. There was a concentration of care in the prenatal period as the primary approach for improving pregnancy results. Currently, attention to the care of pregnant women, women who have recently given birth, and newborns are focused on the care of preconception to improve the results of pregnancy and improve the outcomes of child growth and development.

Objective: Describe the evidence for preconception care (PCC) and information to the health care provider, as well as describe instruments to present health care providers with PCC, its definition, its components, recommended interventions, and the scientific basis for recommendations.

Methods: There was a search for published and unpublished literature related to scientific evidence for the effectiveness of PCC in improving pregnancy results. The search was carried out based on Pubmed and using data scraping techniques, in the material available on the internet and disseminated by international organizations, such as the World Health Organization and reports by government agencies.

Results: It is reported that the literature on the scientific basis for PCC is fragmented, and most publications discuss evidence of one or a few interventions, with the majority of reports considering PCC for specific populations, such as women with chronic health problems and couples with infertility. However, these publications do not offer a realistic view of the proposed PCC interventions, with the scientific evidence that supports them. The general aspects of the existing literature and the recommended preconceived care interventions are described, together with the quality of the scientific evidence and the strength of the recommendations behind each of these interventions.

Conclusion: Many clinical interventions have been identified that could be offered to women before conception to help avoid adverse outcomes. Most of these interventions have scientific evidence to support their role in improving pregnancy outcomes. Therefore, it is recommended that clinical care providers incorporate evidence-based prejudice services in their daily care of women of reproductive age, in an effort to improve women's health before and during pregnancy, as well as improve pregnancy outcomes for women and their children.

Keywords: preconception care, preconception health, women's health, maternal health, infant health.

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Authors summary

Why was this study done?

- The last few decades witnessed substantial improvements in maternal and infant pregnancy outcomes all over the world. However, the levels of poor pregnancy outcomes in most countries continue to be very high.
- Most countries have relied on improving access to prenatal care to further improve pregnancy outcomes.
- There is scientific evidence that improving the health of women before pregnancy (preconception care) will improve maternal and infant pregnancy outcomes.
- Over 80 interventions have been recommended to be included in a preconception care package.
- We summarized the evidence for the effectiveness of preconception care to make the information available to health care providers.

What did the researchers do and find?

- We reviewed published and un-published literature related to the scientific evidence for the effectiveness of preconception care in improving pregnancy outcomes.
- We searched PubMed for published articles.
- We searched the internet for unpublished reports prepared by international organizations such as the World Health Organization and reports from governmental agencies.
- Many clinical interventions have been identified which could be offered to women prior to conception to help avoid adverse outcomes.
- Most of these interventions have scientific evidence to support their role in improving pregnancy outcomes.

What do these findings mean?

- There is scientific evidence that preconception care improves maternal and infant pregnancy outcomes.
- It is recommended that clinical care providers incorporate evidence-based preconception services into their daily care of women of reproductive age.

INTRODUCTION

Improving pregnancy outcomes and reducing maternal and infant mortality and morbidity has been a major priority for countries around the world, led by the World Health Organization (WHO). During the last 40 years, efforts to improve pregnancy outcome have mainly focused on the care and health of women during pregnancy and at the time of delivery by increasing prenatal care (PNC) coverage and ensuring deliveries by skilled birth attendants. Many countries succeeded in improving PNC coverage. According to the WHO, in 83 countries, 75% of pregnant women had at least 4 PNC visits in 2012¹. However, despite these improvements, the maternal and infant mortality rates, and the number of both pregnancy complications and adverse pregnancy outcomes, including congenital anomalies, low birthweight and preterm delivery, continue to be higher than desired. Globally, the WHO reported that maternal mortality continues to be unacceptably high: it was estimated that in 2017, about 295,000 women died during and following pregnancy and childbirth². The WHO also reported that although globally the infant mortality rate has decreased from an estimated rate of 65 deaths per 1000 live births in 1990 to 29 deaths per 1000 live births in 2017, still every year, 4.1 million babies die during the first year of their life³. In 2006, the March of Dimes reported that “every year an estimated 7.9 million children – 6% of total births worldwide - are born with a serious birth defect of genetic or partially genetic origin. Additional hundreds of thousands more are born with serious birth defects of post-conception origin, including maternal exposure to environmental agents (teratogens) such as alcohol, rubella, syphilis and iodine deficiency that can harm a developing fetus”⁴.

The focus on PNC reflects an emphasis on observing and monitoring a woman’s health during pregnancy and intervening when and if needed (health promotion, risk assessment and intervention). However, improving the coverage, content, and use of PNC was a necessary, but not sufficient step in improving pregnancy outcomes. For example, in the United States, in 2016, 93.8% of pregnant women initiated PNC before the third trimester (77.1% initiated care during the first trimester and 16.7% initiated care during the second trimester)⁵.

The United States has also succeeded in reducing infant mortality rates from 12.6 deaths per 1,000 live births in 1980 to 5.9 in 2015⁶. However, despite these improvements, the maternal and infant mortality rates, and the rates of complications of pregnancy and adverse pregnancy outcomes, including congenital anomalies, low birthweight and preterm delivery, continue to be higher than desired: the proportion of babies born low birthweight and the proportion of babies born preterm continue to be high (8.1% and 9.9% respectively), and maternal mortality and morbidity rates are increasing⁶. In fact, in 2012, 35 of the 38 “Very High Human Development Countries” reported preterm delivery rates that were lower than that of the USA, and 29 developed countries reported lower infant mortality rates than the US^{6,7}. In 2015, the WHO reported that 53 countries had lower maternal mortality rates than the USA².

Over the past few years, and because of the slow progress in improving pregnancy outcomes, there has been a great emphasis on preconception care (PCC) as an alternative and additional approach to counter the persistent adverse pregnancy outcomes around the world. The goal of PCC is to promote the health of women of reproductive age before conception and thereby improve maternal and infant pregnancy outcomes. Today, there is ample scientific evidence that in many cases, improving a woman’s health before pregnancy (preconception health and health care) will improve pregnancy outcomes for both mothers and infants. However, despite the scientific evidence and the broad interest in PCC, there has been only modest progress in implementing these concepts into clinical practice and developing research studies to advance practice and PCC has proven to be difficult to implement into clinical practice. Most women and physicians realize the importance of optimizing their health before pregnancy, however, time constraints and the wide range of activities that constitute preconception care are primary barriers to widespread implementation⁸.

HISTORY

PCC is not a new concept –it has been believed for ages that the health of a woman before she gets pregnant

as well as her behavioral and her environmental exposures have an impact on the outcome of her pregnancy for her and for her infant. In fact, references to the importance of a mother's health in improving pregnancy outcomes are found in documents hundreds of years old. In 1825, William Potts Dewees in the first pediatric textbook in the United States stated that "physical treatment of children should begin as far as may be practicable, with the earliest formation of the embryo; it will, therefore, necessarily involve the conduct of the mother, even before her marriage, as well as during her pregnancy"⁹. In recent years, PCC was first described by Chamberlain in 1980 as a specialty service for women who had a previous poor reproductive outcome¹⁰. It was then described in the United States by the United States Public Health Service in the landmark publication "Preventing Low Birth Weight"¹¹. The concept was adopted by the United States Public Health Service's Expert Panel on the Content of Prenatal Care, who defined its components and emphasized that it is most effectively delivered as part of primary care services¹².

More recently, in 2004, the United States Centers for Disease Control and Prevention (CDC) convened experts who developed and published "Recommendations to Improve Preconception Health and Health Care"¹³. Following the publication of the recommendations, state and local health departments within the United States initiated programs to implement the Recommendations. Many countries such as Canada, Belgium and the Netherlands have also started to implement PCC programs¹⁴⁻¹⁶. In February 2012, the WHO convened a meeting of researchers and partner organizations "to achieve a global consensus on the place of PCC as part of an overall strategy to prevent maternal and childhood mortality and morbidity". Deliberations and conclusions from the meeting are summarized in a WHO Policy Brief titled "Preconception Care: Maximizing the Gains for Maternal and Child Health" and a report titled "Meeting to Develop a Global Consensus on Preconception Care to Reduce Maternal and Childhood Mortality and Morbidity"¹⁷⁻¹⁸. These reports include an in-depth discussion of the rationale behind PCC as well as definitions, components of PCC, delivery mechanisms, and proposed action steps for countries. The report concludes that PCC has a positive impact on maternal and child health outcomes. The report also provides a foundation for implementing a package of promotive, preventive and curative health interventions shown to have been effective in improving maternal and child health. The report recommends that a wide range of sectors and stakeholders needs to be engaged to ensure universal access to PCC and guides non-health sectors, foundations and civil society organizations to collaborate with, and support, public health policy-makers to maximize gains for maternal and child health through PCC¹⁸.

■ DEFINITION

The group of scientists convened by CDC in 2004 defined PCC as "interventions that aim to identify and modify biomedical, behavioral, and social risks to a woman's health or pregnancy outcome through prevention and management, emphasizing those factors which must

be acted on before conception or early in pregnancy to have maximal impact. Thus, it is more than a single visit and less than all well-woman care. It includes care before a first pregnancy or between pregnancies (commonly known as interconception care)"¹³.

Scientists convened by WHO in February 2012 defined PCC as "the provision of biomedical, behavioral and social health interventions to women and couples before conception occurs. It aims at improving their health status and reducing behaviors and individual and environmental factors that contribute to poor maternal and child health outcomes. Its ultimate aim is to improve maternal and child health, in both the short and long term"¹⁸.

The published literature lists a very wide range of interventions that are proposed to be included in PCC. Some of these interventions are based on scientific evidence and have existing clinical practice guidelines whereas others are based on common sense and current standard practice. It is clear from the above definitions that PCC is not limited to clinical care but addresses all factors that may contribute to the outcomes of pregnancy: family history, medical conditions, exposures to teratogens including prescription medications, environmental exposures, and risky behaviors such as smoking and drinking.

Participants at the WHO meeting defined the components of PCC to include 13 conditions as follows: nutritional conditions, tobacco use, genetic conditions, environmental health, infertility/ subfertility, interpersonal violence, too early/unwanted and rapid successive pregnancies, sexually transmitted infections, HIV, mental health, psychoactive substance use, vaccine preventable diseases, and female genital mutilation¹⁸.

■ DOES PRECONCEPTION CARE WORK?

Over the past 50 years, there have been many publications advocating the use of PCC. Most discussed evidence for one or a few interventions and most discussed PCC for specific populations such as women with chronic health conditions and couples with infertility. The most comprehensive discussion of the evidence in support of PCC came from the CDC published in a supplement of the American Journal of Obstetrics and Gynecology¹⁹.

In June 2006, CDC established five PCC implementation workgroups (clinical, public health, consumer, policy and finance, and research and surveillance) to discuss opportunities and to develop strategies for implementing PCC. The clinical workgroup worked together for over 2 years to define the clinical components of PCC, summarize the existing evidence for inclusion of each component in clinical activities, and define the health promotion package to be delivered as part of PCC.

To identify PCC recommended interventions and better understand the scientific evidence in support of these interventions, the 29 members of the clinical workgroup along with 30 expert consultants reviewed over 700 papers and used specific criteria to make their assessment. The workgroup reviewed in depth topics currently proposed to be included in PCC. Topics were selected based on the effect of PCC on the health of the mother and/or infant, its prevalence, and detectability, as follows²⁰:

- There is a good chance that the health of the mother or the infant will be improved if the condition is identified and addressed before pregnancy;
- The burden of suffering and prevalence of the condition are sufficient to justify screening and treatment;
- The condition is detectable in clinical care, in either primary or specialty settings;
- If screening is employed, the screening methods available to detect the condition are sufficiently predictive to justify screening; or
- Clinical practice guidelines already exist suggesting that preconception interventions be implemented.

The group concluded that there were 83 components that were recommended to be included in a PCC package. The group then researched these topics to determine the quality of the scientific evidence in support of including these topics in a PCC package and the strength of recommendation based on that evidence. For each topic the workgroup assigned a score for the strength of the evidence supporting its inclusion in PCC and assigned a strength of the recommendation, using criteria adapted from those used in the report by the US Preventive Services Task Force Guide to Clinical Preventive Services^{19,22}. The following criteria were used to determine the quality of the evidence²⁰:

- (I-a) Evidence was obtained from at least 1 properly conducted randomized controlled trial that was done before pregnancy.
- (I-b) Evidence was obtained from at least 1 properly conducted randomized controlled trial that was done not necessarily before pregnancy.
- (II-1) Evidence was obtained from well-designed controlled trials without randomization.
- (II-2) Evidence was obtained from well-designed cohort or case-control analytic studies, preferably from 1 center or research group.
- (II-3) Evidence was obtained from multiple-time series with or without the intervention. Dramatic results in uncontrolled experiments could also be regarded as this type of evidence.
- (III) Opinions were gathered from respected authorities, based on clinical experience, descriptive studies and case reports, or reports of expert committees

The following criteria were used to determine the strength of the recommendation²⁰:

- (A) There is good evidence to support the recommendation that the condition be considered specifically in a PCC evaluation.
- (B) There is fair evidence to support the recommendation that the condition be considered specifically in a PCC evaluation.
- (C) There is insufficient evidence to recommend

for or against the inclusion of the condition in a PCC evaluation, but recommendation to include or exclude may be made on other grounds.

(D) There is fair evidence to support the recommendation that the condition be excluded in a PCC evaluation.

(E) There is good evidence to support the recommendation that the condition be excluded in a PCC evaluation.

Results of this activity were published in a special supplement of the American Journal of Obstetrics and Gynecology¹⁹ and summarized in an article titled “The Clinical Content of Preconception Care: An Overview”²⁰. The clinical workgroup concluded that for 30 of the conditions reviewed there was good evidence to support the recommendation that the condition be specifically considered in a PCC evaluation. These conditions include: having a reproductive life plan / family planning, nutritional adequacy, folate supplements, immunization status, Sexually Transmitted Infections (STIs), Hepatitis B, Rubella, HIV, Chlamydia, diabetes, hypothyroidism, Phenylketonuria, seizure disorders, hypertension, rheumatoid arthritis, tobacco use, alcohol use, excess vitamin A, vitamin D deficiency, calcium intake, BMI ≤ 18.5 kg/m², BMI ≥ 25 kg/m², household exposures, teratogenic medications, over-the-counter medication, dietary supplements, preterm birth/Low birthweight infant, cesarean section, history of miscarriage, and cancer survivors²⁰.

The number of interventions recommended to be included in a PCC package by various groups, countries and programs is much larger than the 30 listed above. In general, recommended PCC interventions may be grouped into three main categories: Assessment (including family and personal history and medical assessment), Counseling and Education, and Prevention and Management. Based on our review of the literature, we have summarized the recommended interventions for each category along with the quality of evidence and the strength of recommendation for each intervention.

1. Assessment: assessment aims to identify potential risks to the mother and baby and to rule out any potential complications of pregnancy. Providers should review the woman’s family history, past obstetrical and gynecological history, past medical and drug history, chronic illnesses, psychosocial history, behaviors, and exposures to potential teratogens. All women in need of PCC should also undergo a thorough physical examination and have specific laboratory tests done to identify potential risks to their pregnancy outcomes. If risk factors are identified during these assessments, the risks should be managed, or patients should be referred to specialized services if needed. Table 1 describes some of the interventions recommended to be included under the assessment category along with the quality of evidence and strength of recommendations described in the literature^{14-16,18,19,22}.

Table 1: Components of Preconception Care: Assessment

Component	Intervention	Quality of Evidence	Strength of Recommendation
History	Personal history/demography: age, education, occupation, consanguinity	III	As and Bs
	Family history: diabetes, hypertension, congenital anomalies, other chronic diseases including disability, mental disorders	II-3	B
	Personal medical, surgical and obstetrics/gynecology history: seizure disorders, diabetes, hypertension, mental disorders, vaccination status (tetanus, diphtheria, rubella), hepatitis C, STIs, thyroid, history of poor perinatal outcomes, history of genetic conditions	I-a	As
	Behavior: smoking, medical prescription, self-medication (over the counter), folic acid intake, contraception, unprotected sex	I-a	As
	Domestic violence	III	C
	Environmental exposures: second-hand smoking, insecticides, pesticides, cleaning products	III	As, Bs, and Cs
	Physical exercise	II-2	C
Medical Assessment	Physical examination: general exam, body mass index, vital signs	III	A These interventions were not assessed; a score was assigned based on relevance
	Mental health status: depression	These interventions were not assessed; a score was assigned based on relevance	
	Complete blood count		
	Screening and testing if indicated: sickle cell disease and beta thalassemia, other genetic conditions		
	ABO blood grouping and Rhesus		
Blood sugar: fasting sugar and HbA1c (if available) if there is family history of diabetes	I		A
	Other screenings if indicated: hepatitis B/C, HIV, Sexually Transmitted Infections, bleeding/clotting disorders, periodontal disease, pap smear, mammogram, etc	Variable	As, Bs, Cs

2. Counseling and Education: There is evidence that counseling and education during the preconception period results in changes in risk behaviors leading to improved maternal and neonatal outcomes. Based on history and medical assessment, if a health condition or a risk is identified, women and couples will

have the opportunity to receive treatment or sit with a specialist to receive counselling on the best course of action. Table 2 describes some of the interventions included under the health promotion category along with the quality of evidence and strength of recommendations described in the literature^{14-16,18,19,22}.

Table 2: Components of Preconception Care: Counseling and Education

Intervention	Quality of Evidence	Strength of Recommendation
Counselling on healthy lifestyles	Various	Various
Counselling on healthy reproductive life planning	III	A
Counselling on the importance of early entry into prenatal care	Not Assessed	A
Counselling on Folic acid intake	I-a	A
Counselling on healthy diet	II-a	A

Continuation - Table 2: Components of Preconception Care: Counseling and Education

Intervention	Quality of Evidence	Strength of Recommendation
Counselling and education on avoiding tobacco	II-a	A
Counselling and education on avoiding alcohol and harmful substances	III	A
Counselling and education about avoiding medications contraindicated in pregnancy	II-2 (prescription) and III (over the counter)	A
Counselling on risks of congenital anomalies	Not assessed	A
Infertility counselling	Not assessed	A
Counselling on STI/HIV	III (STI) I-b (HIV)	A

3. Prevention and management: many women of childbearing age suffer from various chronic conditions and are exposed to (or consume) substances that can have an adverse effect on pregnancy outcomes, leading to pregnancy loss, infant death, birth defects, or other complications for mothers and infants. Conditions like asthma, overweight or obesity, cardiac disease, hypertension, diabetes, thyroid disorder, dental caries and other oral diseases have been found to be associated with complications for mothers and infants. It is essential that these conditions be identified and addressed in the

preconception period. Managing chronic conditions during pregnancy is not feasible and often by the time a woman presents for prenatal care, all the fetal organs had been formed and it is too late to prevent maternal and fetal complications related to these conditions. In addition to having chronic diseases, a substantial proportion of women who become pregnant engage in high-risk behaviors that contribute to adverse pregnancy outcomes. These behaviors must be addressed during a PCC encounter^{14-16,18,19,22}.

Table 3: Components of Preconception Care: Prevention and Management

Component	Intervention	Quality of Evidence	Strength of Recommendation
Prevention	Folic acid supplements	I-a	A
	Family planning services	III	A
	Safe sex	Not Assessed	A
	Iron supplements if indicated	I-b	A
	Vaccination against rubella (MMR) (if indicated)	II-3	A
	Vaccination against tetanus and diphtheria (if indicated)	III	B
	Vaccination against hepatitis B (if indicated)	III	A
	Vaccination against influenza HPV vaccine	III II-2	C A
Management	Diabetes Mellitus	I	A
	Obesity	II-2	B
	Thyroid Disease	II-1	A
	Phenylketonuria	II-1	A
	Seizure disorder	II-2	A
	Hypertension	II-2	A
	Rheumatoid Arthritis	III	A
	Cancer	III	A
	Alcohol use	III	A
	Tobacco	II-a	A
Illicit drugs	III	C	

CONCLUSION

Effective preconception care is delivered through a wide range of clinical and community settings and cuts across many sectors, including health, education and social. Many clinical interventions have been identified which could be offered to women prior to conception to help avoid adverse outcomes. Most of these interventions have scientific evidence to support their role in improving

pregnancy outcomes. Clinical care providers play a very important role in providing these interventions during the preconception period. Therefore, it is recommended that clinical care providers incorporate evidence-based preconception services into their daily care of women of reproductive age in an effort to further improve the health of women before and during pregnancy as well as to improve the outcomes of pregnancy for women and their children.

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Resumo

Introdução: As Nas últimas décadas, foram observadas melhorias no cuidado à gravidez e no desenvolvimento infantil em todo o mundo. No entanto, os problemas de gravidez continuam altos na maioria dos países. Houve uma concentração de cuidados no período pré-natal como a principal abordagem para melhorar os resultados da gravidez. Atualmente, a atenção aos cuidados de mulheres grávidas, mulheres que deram à luz recentemente e recém-nascidos está focada no cuidado de concepção para melhorar os resultados da gravidez e os resultados do crescimento e desenvolvimento infantil.

Objetivo: Descrever as evidências para os cuidado concepção (PCC) e informações para o profissional da saúde, bem como descrever instrumentos para apresentar aos profissionais de saúde o PCC, sua definição, seus componentes, intervenções recomendadas e a base científica para recomendações.

Método: Houve uma pesquisa de literatura publicada relacionada a evidências científicas para a eficácia do PCC na melhoria dos resultados da gravidez. A pesquisa foi realizada com base no Pubmed e utilizando técnicas de raspagem de dados, no material disponível na internet e divulgado por organizações internacionais, como a Organização Mundial da Saúde e relatórios de órgãos governamentais.

Resultados: Relata-se que a literatura sobre a base científica do PCC é fragmentada e a maioria das publicações discute evidências de uma ou poucas intervenções, com a maioria dos relatórios considerando o PCC para populações específicas, como mulheres com problemas crônicos de saúde e casais com infertilidade. No entanto, essas publicações não oferecem uma visão realista das intervenções propostas do PCC, com as evidências científicas que as apoiam. Os aspectos gerais da literatura existente e as intervenções preconcebidas recomendadas são descritas, juntamente com a qualidade das evidências científicas e a força das recomendações por trás de cada uma dessas intervenções.

Conclusão: Muitas intervenções clínicas foram identificadas que poderiam ser oferecidas às mulheres antes da concepção para ajudar a evitar resultados adversos. A maioria dessas intervenções possui evidências científicas para apoiar seu papel na melhoria dos resultados da gravidez. Portanto, recomenda-se que os prestadores de cuidados clínicos incorporem serviços de concepção baseados em evidências em seus cuidados diários a mulheres em idade reprodutiva, em um esforço para melhorar a saúde das mulheres antes e depois da gravidez. durante a gravidez, bem como melhorar os resultados da gravidez para mulheres e filhos.

Palavras-chave: cuidados concepção, saúde concepção, saúde da mulher, saúde materna, saúde infantil.

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