



Maternal Nutrition in the First Thousand Days: Translating Cohort Findings Into Antenatal Practice

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Abstract

Cohort evidence on nutrition in the first thousand days is extensive, and the obstacle to acting on it is the timing of the clinical encounter rather than the strength of the findings. In 328 women attending a first antenatal appointment at a mean gestational age of 12.4 weeks, 96.5 per cent were taking folic acid, 57.9 per cent met the recommended dose and 30.2 per cent had started before conception. Among the 78 women with obesity, for whom a higher dose is recommended, 89.1 per cent did not meet it. National maternity data show just over a quarter taking folic acid before pregnancy, lowest in the most deprived areas and among minority ethnic groups. In a Bangladeshi cohort of 2,572 women, 80 per cent consumed supplements in some quantity while adherence-adjusted effective coverage was 6 per cent. Evidence for interventions to raise uptake is graded very low.

Keywords: First thousand days; Maternal nutrition; Folic acid; Antenatal care; Implementation

Introduction

Maternal nutrition in early pregnancy contributes to nutritional programming and to the foundations of a child's life-course health, and the period from conception to a child's second birthday is widely described as the first thousand days [1,2]. Antenatal iron and folic acid and multiple micronutrient supplements are identified as priority nutrition interventions for that window [3].

Neural tube defects are potentially preventable by periconceptional folic acid, and women of childbearing age are recommended to take 400 micrograms daily from at least two to three months before conception, with a higher dose of 5 mg for those at raised risk including women with obesity [4,5].

This review examines the gap between that evidence and what is achieved in practice, and separates the several distinct failures that the phrase poor compliance runs together.

Objective

This review sets out to establish four things from the published literature. First, what proportion of women take periconceptional supplements, and whether taking, dosing and timing succeed at similar rates. Second, whether the groups at greatest risk are the best or least well covered. Third, how effective coverage compares with reported coverage where both have been measured. And fourth, what interventions to improve uptake have achieved.

Literature Review

Three things measured as one: A prospective observational study recruited 328 women at 18 weeks' gestation or less attending a first antenatal appointment, with a mean gestational age of 12.4 plus or minus 1.4 weeks and mean body mass index of 26.7 plus or minus 5.2. Of these, 96.5 per cent were taking folic acid and 95.7 per cent supplemented daily; 57.9 per cent met the recommended dose; and 30.2 per cent had commenced supplementation 12 weeks before conception (Figure 1) [4]. Sixty-one per cent reported starting when they found out they were pregnant [4].

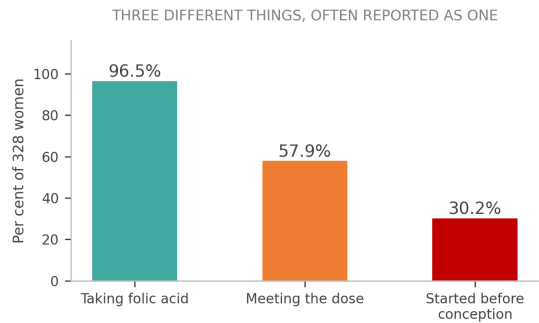


Figure 1: Three different things, often reported as one [4]

The group at greatest risk: Women with obesity, defined at 30.0 kg/m2 or 27.5 kg/m2 adjusting for ethnicity, comprised 23.8 per cent of the cohort, or 78 women. Of those, 89.1 per cent, that is 55 women, did not meet the higher folic acid dose recommended for them, and women with obesity were significantly less likely to meet the higher dose requirement ($p < 0.001$) (Figure 2) [4,27]. The investigators concluded that supplementation practices in the cohort were suboptimal for preventing neural tube defect risk [4].



Figure 2: The group needing the higher dose [4]

When the window closes: The recommended period begins two to three months before conception, while the mean gestational age at first antenatal appointment in this cohort was 12.4 weeks (Figure 4) [4,5]. The interval during which the supplement is most consequential has therefore passed before the first clinical contact for most women, which is a structural feature of the care pathway rather than a failure of advice given within it. Prevalence and predictors of periconceptional uptake have been studied prospectively in comparable obstetric populations with similar findings [11,12], and uptake measured in a nationally representative sample of mothers [14] (Table 1).

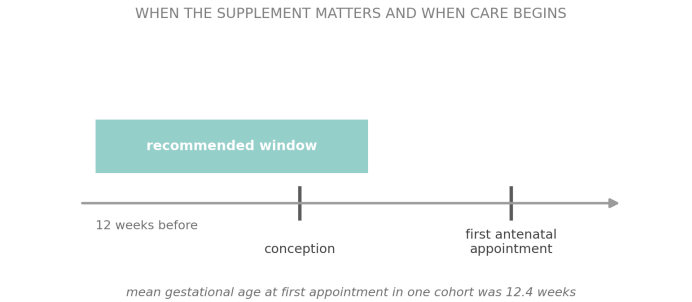


Figure 4: When the supplement matters and when antenatal care begins [4,5]

Table 1: Supplementation practice in 328 women at first antenatal appointment [4]

Measure	Proportion	Number
Taking folic acid	96.5%	315 of 328
Supplementing daily	95.7%	314
Meeting the dose requirement	57.9%	190
Commenced before conception	30.2%	99
Obesity, not meeting higher dose	89.1%	55 of 78

Uptake before pregnancy at national level: Analysis of national maternity services data for 2018 and 2019 found that just over a quarter of people take folic acid before pregnancy, with the lowest uptake among people living in the most deprived areas and those of minority ethnic background (Figure 5) [6]. Guideline authors note that compliance with existing recommendations is recognised as poor [6].

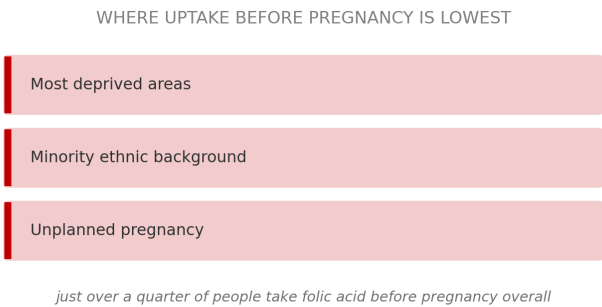


Figure 5: Where uptake before pregnancy is lowest [6]

Reported coverage against effective coverage: A baseline assessment interviewed 2,572 women in two rural districts who had given birth in the preceding six months. Approximately 80 per cent had consumed iron and folic acid supplements in any quantity and about 76 per cent had received antenatal care at least once, but only 8 per cent had received at least 180 tablets and 6 per cent met the user adherence-adjusted definition of effective coverage (Figure 3) [3]. Multivariable analysis showed a linear relationship between the number of antenatal visits and the number of supplements consumed, modified by the timing of the first visit [3].

Table 2: Coverage as reported against coverage as delivered

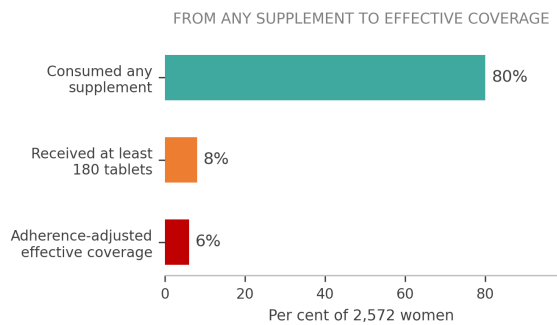


Figure 3: From any supplement to effective coverage [3]

Adherence within pregnancy compared with before it: A first-trimester birth cohort assessing dietary intake, micronutrient status and supplement adherence in women at 8 to 12 weeks' gestation, with a mean maternal age of 29 years, reported high adherence to supplementation during pregnancy compared with preconception [1]. The pattern is consistent across the studies reviewed: behaviour within pregnancy is considerably better than behaviour before it [1,4].

What has been tried to improve it: A guideline evidence review examined interventions to increase uptake of folic acid supplementation before and during the first 12 weeks of pregnancy, comparing information and education provision against usual practice, and graded the quality of the evidence as very low (Figure 6) [6]. The review notes that randomised trials were not pooled with cohort and uncontrolled studies, so the body of evidence is heterogeneous as well as weak [6] (Table 2).

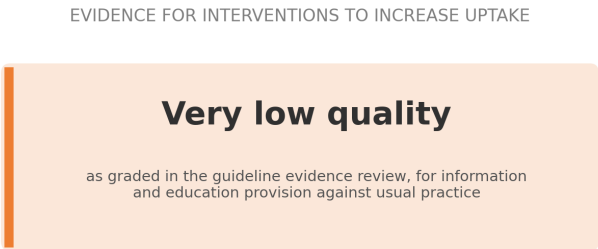


Figure 6: Evidence for interventions to increase uptake [6]

Setting	Reported coverage	Effective coverage
European antenatal cohort	96.5% taking any	30.2% timed correctly [4]
National maternity data	—	Just over a quarter pre-pregnancy [6]
Rural district cohort	80% consumed any	6% adherence-adjusted [3]

The efficacy the practice rests on: Periconceptional folate supplementation for preventing birth defects has been assessed by Cochrane review [8], following the randomised evidence that established the effect [9,10]. Global folate status in women of reproductive age has been reviewed with attention to methodological issues [30], and three decades of opportunity and controversy in folic acid and birth defect prevention have been

summarised [31]. Birth prevalence of spina bifida by fortification status has been compared across countries by systematic review and meta-analysis [32], which is the population-level alternative to individual supplementation [31,32].

Why obesity raises the requirement: Maternal obesity is associated with increased risk of neural tube defects on meta-analysis [26], which is the basis for the higher recommended dose [4,5]. Preconceptional and maternal obesity have been reviewed for their epidemiology and health consequences [25], and maternal obesity trends documented in the same health system as the antenatal cohort described here [27]. Influence of maternal obesity on long-term offspring health [24] and the association with child obesity [28] extend the consequences beyond the periconceptional window.

The wider preconception argument: A series of reviews has argued that the preconception period matters for future health and that intervention strategies must reach women before conception [15,16,17]. Professional bodies have issued recommendations spanning adolescent, preconception and maternal nutrition [18], and recommendations for nutrition during pregnancy, lactation and early childhood have been set out with their implications for long-term child health [29]. The developmental origins framework provides the rationale [23].

What else is supplemented in this window: Multiple micronutrient supplementation during pregnancy has been assessed by Cochrane review [19] and in low- and middle-income settings specifically [34], as has daily oral iron [20]. Evidence-based interventions for maternal and child nutrition have been costed [21], and the burden of maternal and child undernutrition and overweight described across low- and middle-income countries [2,22]. Adherence to iron and folic acid has been measured in other health systems with markedly different results [33] (Table 3).

Table 3: What is and is not established about periconceptional supplementation practice

Question	What the evidence supports
Do women take a supplement?	96.5% in one antenatal cohort [4]
At the right dose?	57.9%, and 10.9% of those with obesity [4]
At the right time?	30.2%; a quarter nationally [4,6]
Is coverage evenly distributed?	No; lowest where deprivation is highest [6]
Does advice raise uptake?	Evidence graded very low [6]

Method

Search strategy: PubMed and the archives of the major obstetric, public health nutrition and maternal and child health journals were searched for studies of periconceptional and antenatal nutrition practice. Search terms combined first thousand days and maternal nutrition with folic acid, adherence, effective coverage, antenatal care and implementation. Reference lists of the guideline evidence review [6] and the antenatal observational study [4] were screened by hand for primary sources.

Eligibility: Studies were included if they reported supplementation practice, coverage or adherence in defined antenatal or periconceptional populations, or evaluated interventions to improve them. Guideline and evidence review documents are cited for their content and their own grading of evidence and are identified as such.

Data extraction and handling: Population, setting, gestational age at assessment, the definition of adherence applied and the reported proportion were extracted as published. Whether a figure describes taking a supplement, taking the correct dose, or starting at the correct time is stated in every case, because those three differ by more than threefold within a single cohort and are frequently reported under the single heading of compliance. This review reports published findings and does not constitute supplementation, dietary or antenatal guidance for any individual, which are matters for the treating clinician and midwifery team. No pooling or re-analysis was performed. Figures 1 to 6 and Tables 1 to 3 reproduce published values only. This is a narrative synthesis of published literature and was not registered as a systematic review.

Concluding Remarks

Compliance is not one measurement and treating it as one produces a misleadingly reassuring picture. In a single cohort, 96.5 per cent were taking folic acid, 57.9 per cent were taking the right dose, and 30.2 per cent had started at the right time [4]. A service reporting the first figure could describe near-universal coverage while two thirds of women had missed the period that matters most.

The timing failure is the one least amenable to anything done in antenatal clinic. The recommended window opens two to three months before conception and the mean gestational age at first appointment in this cohort was 12.4 weeks [4,5]. Sixty-one per cent started when they found out they were pregnant, which by then is not early [4]. Advice delivered at booking addresses a decision that has already been made or missed.

The obesity finding inverts the expected pattern and deserves particular attention. Women with obesity require a higher dose because their risk is higher, and 89.1 per cent of them did not receive it, significantly worse than other women [4]. The group with most to gain from the intervention was the group least likely to be adequately covered, and unlike the timing problem

this one is visible and correctable at a clinical encounter, since body mass index is measured at booking.

The distinction between reported and effective coverage makes the same point at scale. Eighty per cent of women in one cohort consumed supplements in some quantity while 6 per cent met the adherence-adjusted definition of effective coverage [3]. A programme reporting the first number would look successful. The second is the one that corresponds to the exposure the trial evidence is based on.

Where uptake fails, it fails unevenly. National data show lowest pre-pregnancy uptake in the most deprived areas and among minority ethnic groups [6], a pattern set out in detail in a national preconception health report card [7], and the linear relationship between antenatal visit number and supplements consumed, modified by timing of the first visit, points the same way: coverage tracks engagement with services [3]. That makes supplementation a marker of access as much as of individual behaviour.

On what to do, the evidence is genuinely thin and should be described that way. The guideline evidence review graded interventions using information and education provision as very low quality [6]. That is not an argument against advising women; it is an argument against expecting advice alone to close a gap that is substantially about when and whether people reach services at all [3,6].

Three limitations belong with these conclusions. The antenatal cohort assesses supplementation by questionnaire at a single visit, and self-reported supplement use has been questioned for accuracy in this population [4,13]. Maternal health behaviours during pregnancy have been related to socio-demographic and infant characteristics in the same setting [12]. The studies span very different health systems, with supplementation policy, food fortification and antenatal access differing markedly between them, so the figures are not directly comparable [3,4,6]. And none of the cohorts reviewed here links supplementation practice to neural tube defect outcomes directly, so the clinical consequence of the shortfall is inferred from established efficacy rather than measured [4,5].

A service-level implication follows that does not depend on resolving the evidence gap. Body mass index is measured at booking, and the higher dose is indicated by it, so the 89.1 per cent shortfall among women with obesity is detectable at a contact that already happens [4,26]. Unlike the timing problem, that one requires no earlier engagement and no behaviour change before conception.

The population alternative deserves mention because it addresses the timing problem directly. Comparison of spina bifida birth prevalence by fortification status indicates what a supply-side measure achieves without requiring anyone to plan a pregnancy [32], and reviews of three decades of folic acid policy set out the arguments on both sides [31]. Where the binding

constraint is that the window closes before contact, an intervention that does not depend on contact is structurally better matched to it [6,32].

Finally, what these figures do not show. None of the cohorts reviewed links supplementation practice to neural tube defect incidence in the same population, so the harm attributable to the shortfall is inferred from established efficacy [8,9,10] rather than observed. That inference is well founded, but the size of the preventable burden in any given service is not something these studies measure [4,32].

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Conflict of Interest

The authors declare no competing interests.

Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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