Original article

A systematic review of unintended pregnancy in cross-cultural settings: Does it have adverse consequences for children?

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Abstract

Introduction: Although there has been a great deal of concern about the consequences of unintended pregnancies on child health, there has been little documented evidence across specific outcomes to inform programs and policies. This paper highlights the association between unintended pregnancy, and its health and developmental consequences to children.

Methods: Published and grey evidence available adverse effects of unintended pregnancy on children were extracted electronically using search engines: PubMed, EMBASE and Google Scholar for the period January 1981 through January 2017. The PRISMA checklist was used and qualities of eligible studies were assessed for method validity and result interpretation. Effect-size odds ratioswere calculated from extracted data.

Results: Of the 107 studies identified after removal of duplications, 29 studies with a quality score ranging from 3 to 6 (Mean = 5.65; SD±0.65) were included. Pattern of child rearing, development and health were found to differ for children classified to be breads of an unintended pregnancy. However, many of the available studies appear to have methodological limitations such as recall bias and brief period of follow-ups limiting causal inferences and to determine a temporal sequence. The findings were found to be inconsistent across studies.

Conclusion: Studies provide evidence relating to adverse health outcomes for children of unintended births. The existing knowledge is limited by weak research methodologies and a paucity of studies addressing subsequent health and developmental effects beyond the early childhood period. There is a need for more multi-wave longitudinal studies to assess child health and developmental trajectories associated with unintended pregnancies. [*Ethiop. J. Health Dev.* 2017;31 (3):138-154]

Key words: Unplanned pregnancy, unwanted pregnancy, child development, child health consequence

Introduction

Despite a concerted universal commitment to combat childhood adversities, a number of factors may impede the health and development of children. Globally, nearly forty percent of children are born as a consequence of an unintended pregnancy (UIP) (1) with the potential implication that that their health, development and child rearing pattern may have been influenced as a result. These children may be subjected to inappropriate child care and be at risk of childhood adversities such as maltreatment (2, 3).Consequently, children from UIPs may be more liable to poorer peri-natal outcomes (4, 5),infrequent breastfeeding (6-9), be less frequently vaccinated (10-12), and experience childhood ill-health (13, 14), behavioural problems (15) with disproportional use of foster care, contact with juvenile courts and other social services (16). These children may be at greater risk of infant and child mortality (17).

Patterns of UIP are a function of socio-demographic and psycho-social factors, which also have detrimental health effects on children. For example, single and teenage motherhood (6, 18, 19), and differences in age profiles between partners (20) have been associated with an increased likelihood of UIP. Moreover, the rate of UIP is higher for those women with lower literacy and income levels (21-24). In addition, social discrimination (25) and racial/ethnic disparities have also been associated with higher rates of UIP (26, 27). It has been consistently reported that non-white women are at greater risk than their white counterparts (19, 24, 28, 29). In some instances, traditional or unspecified beliefs may also affect the rate of UIP (30, 31). Some familial relationship dynamics including not living with partner (32), insecure relationship (33), differences in fertility preference and family size (31, 34, 35), family dissolution (36), lower level of parental involvement in contraception decision-making (32, 37) and intimate partner violence (38)are associated with significantly increased rates of UIP. This may reflect inter-partner power disparities (39) and contraceptive sabotage (6, 40, 41).

Although a fairly substantial number of studies have assessed the health problems of children from UIPs, there have been no systematic reviews of the outcomes of UIP. The available studies might not explicitly reflect the health impacts of children from UIPs, mainly due to less rigorous study designs. Typically, these studies lack control for other health-related behaviours (42), use relatively weak study designs (43) and may have limited information about the relevant temporal sequence, thus limiting the capacity to make

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causal inferences (44). In addition, there have been few prospective studies that have documented the cumulative health effects on children of UIP. As a result, there is little known about the long-term health and developmental outcomes for these children (4, 45-48). Even findings with robust designs tend to lack appropriate comparison groups further limiting the evidence base.

There is a need to comprehensively and systematically document what is known about the child health impacts of UIP. The current review intends to comprehensively evaluate the association between UIP and its impact on the health and development of the child. It also reviews the neonatal and child mortality consequences of UIP. The review is intended to inform clinical services ranging from screening for unintendedness and the development of appropriate services for children who are at risk. It will also help to inform policy concerned with improving and expanding maternal health services in general and family planning technologies in particular. Finally, the demographic, psycho-social and economic implications for children of an UIPwill be discussed.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (49) was used to summarize the review. Eligible studies were: (1) quantitative studies that addressed at least one child health outcome (2) for which potential confounders were controlled using robust statistical procedures (i.e., multivariable analyses); and (3) that obtained ethical clearances from wherein respective institutions. Descriptive studies which met the above criteria were included in the review. Interestingly, all included quantitative studies involved both descriptive and regression analyses, and thus, descriptive findings were part of the synthesis. Although the study examined some qualitative studies, none explored the context of UIP, particularly measuring the attitude and perception of mothers towards UIP. Hence, no qualitative studies met the criteria for inclusion in this review. References of eligible studies were cross-checked to retrieve and include all relevant studies in the review. Those studies for which data were collected before 1981 (3) were excluded. Given the paucity of literature on the current topic of interest, we included studies both from developed and developing countries published over the last three decades. Both published and grey literature available in English on the health effects of being an unintended child for the period from January 1981 through January 2017 were retrieved using electronic search engines.

PubMed and EMBASE were used as the primary databases for searching the available literature. Google Scholar was also used for supplementary manual searches of eligible articles. Search terms that would likely relate to the main theme of the review, i.e., adverse child health and developmental effects of UIPs, were used. The terms used for searching literature were: "unplanned pregnancy; pregnancy and unplanned or mistimed or unintended; unintended pregnancy and risk factors; child health and unintended pregnancy; unintended pregnancy and outcomes; unplanned or unintended and newborn or infant or child* or children or preschool or adolescent; pregnancy intention and health consequences"

Titles and abstracts of all studies were screened for initial eligibility. All included studies were thoroughly assessed for quality and further synthesis. An eight-point checklist (50), whose total score ranged from zero to eight, was used to assess the quality of each eligible study, based on study features including methodological validity and reliability. The items included: (1) quality of study design and sampling method (0/1), (2) quality of sampling frame (0/1), (3) adequacy of sample size (0/1), (4) quality of measurement (0/1), (5) unbiased measurement (0/1), (6) adequacy of response rate and description of non-response rate (0/1), (7) presence of CIs for estimates and sub-group analyses (if appropriate) (0/1) and (8) description of study participants and settings (0/1). One author (AAA) and JCM (non-author contributor) assessed the quality of included articles. Kappa statistic was used to examine interrater reliability for a quality score. The overall agreement for quality assessment was 81%. Any disagreements were resolved by discussions and mutual consensus between the two assessors. A kappa value of > .75 is considered to represent an excellent interrater agreement (51).

The screened articles from the primary review were then used to extract study designs, participant characteristics, exposure and outcome variables and their measurements. Moreover, key findings, adjustment factors (including those statistically significant) were extracted, and strengths and limitations of each study were critically appraised. Using numerator and denominator data extracted from the papers, we calculated samples with and without outcome(s) of interest and respective chi-square estimates using 2x2 frequency tables. From the 2x2 frequency tables, effect-size odds ratios (OR) with 95% confidence intervals (95%CI) were calculated using Campbell Collaboration Effect Size Calculator(52).The effect was considered to be significant if OR did not cross 1. For studies examining multiple outcomes, effect-size was calculated for each outcome. The effect-size odds ratio was reported as OR throughout the document.

Data extraction focused on overall health, developmental outcomes, parent-child attachment, rearing and/or parenting patterns for an unintended child. Finally, eligible studies were appraised, synthesised and summarised (Tables 1 and 2). Two authors (AAA and JMN) identified potential articles based on *a priori* criteria, as well as extracted the data and synthesised the review.SK critically reviewed the drafted manuscript. The terms 'unplanned and/or unwanted pregnancy' have been used interchangeably with 'unintended pregnancy' to consistently present the findings throughout the document.The PRISMA flow

diagram (49) was used to present the screening and eligibility of studies for the review (Figure 1).

Pregnancy intention was measured with standard questionnaires–National Survey for Family Growth (NSFG) (55), Pregnancy Risk Assessment Monitoring System (PRAMS) (56) and Demographic and Health Survey (DHS) (34). The common survey questions used were: 'At the time you became pregnant, did you want to become pregnant then, did you want to wait until later, or did not you want to have any (more) children at all'? Women were also asked whether the pregnancy was planned or not, intended or not and wanted or not wanted. The questions: "Are you trying to get pregnant now or in future?" and "How important is avoiding a pregnancy to you?" are used in prospective studies while retrospective studies asked women if the pregnancy was intended or not. Pregnancy intention could be categorized as intended vs. unintended (57) or as intended/wanted, mistimed (i.e., too short or too long timing (time failure)) and unwanted (6).

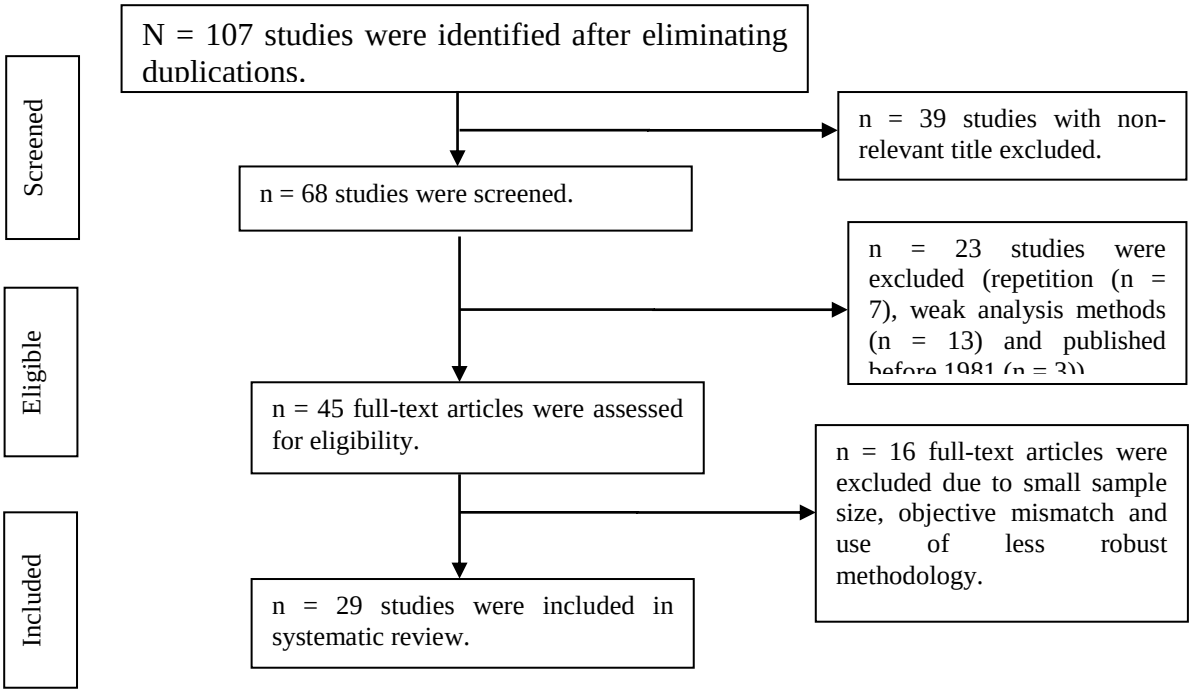

Figure 1**: Schematic representation of studies included in the systematic review**.

Results

A total of 107 studies were identified consisting of 100 full-text published articles and 7 unpublished ones. Seventy eight of these studies did not meet the set of a priori criteria and were excluded leaving 29 full-text eligible articles focusing on child health outcomes of UIP for this review. Table 1 provides a synthesis of 29 included studies for which details of some pertinent variables of interest were available. Most, 51.9% (n=15), of the studies employed cross-sectional designs followed by 41.3% (n=12) longitudinal and 6.8% (n=2) case-control studies. The majority (n=16, 55.17%) were conducted in the USA. Sample sizes ranged from 140 (53) to 87,087 (54) live singleton births. All indicated results were obtained from studies that adjusted findings for some characteristics of mothers and the index child regardless of study designs. Quality scores ranged from 3 to 7 with mean score of 5.65 (SD±0.65). Relatively higher quality studies consistently had greater effect-size OR (Annex: Table 1).

This review presents current evidence on health and developmental consequences for a child who is an outcome of an UIP. Early life birth outcomes including preterm birth and low birth weight were traced. Use of preventive services including adherence to recommended vaccination and evidence of stunting of growth was reviewed as well. Possible variations in rates of morbidity and mortality were considered. Mental health and childhood development (cognitive, skill and social domains) were also included in this review. Evidence concerning parenting patterns for children from unintended births has also been reviewed.

Children Health Consequences of Unintended Pregnancy: Children from UIPs have been found to have a range of adverse health outcomes. This review summarises health, developmental and parenting effects on children of unintended births. The themes included: adverse perinatal outcomes, malnutrition, lower rate of vaccination, poor development and mental health, as well as higher rates of childhood morbidity and mortality. The following sections provide thematic reviews of these outcomes.

Preterm Birth and Low Birth Weight: Poor birth outcomes including preterm or low birth weight (LBW) have been identified as a possible correlate or consequence of UIP. We have located 1 review, 6 cross-sectional, 2 longitudinal and 1 systematic review

dealing with the association of UIP and preterm birth (PTB). A research review found that mistimed pregnancy has been associated with a high risk of having a preterm child (46). Data from four of the six cross-sectional studies consistently suggested positive associations between UIP and PT B.A significant association has been observed between UIP and PTB [(OR = 1.32; (95%CI: 1.22-1.43)) (54) and (OR = 2.75; (95%CI: 2.16-3.50)) (55)]. Mutual intention of parents towards a pregnancy was found to have positive association with better birth outcomes. For instance, the concordance of not intending a pregnancy by/between partners was associated with an increased likelihood of PTB (58). Disparities in social status including ethnicity may be associated with different birth outcomes, with rates of PTB being relatively higher (OR = 1.30; (95%CI: 1.09-1.55)) among Black women rather than their White counter parts regardless of their pregnancy status (45). However, two of the remaining cross-sectional studies showed no difference (17, 59) in PTB despite unintended status of the respective pregnancies. This may be explained by differences in measurement and other possible underlying factors contributing to PTB other than pregnancy intention status.

Data from two longitudinal studies revealed consistent findings. One longitudinal study revealed an insignificant association for PTB from UIP (OR = 1.29; (95%CI: 0.77-2.16)) (60).Another prospective study, using a worldwide sample of women at 16 and 32 weeks of gestation and after delivery showed no difference in rates of PTB(61) for both intended and unintended births. However, a systematic review has documented an increased risk of PTB for births from UIP (62).

Six cross-sectional, 1case-control and 4 longitudinal studies, and 1 systematic review have examined the association between UIP and child birth weight. Data from four of the eight cross-sectional studies consistently showed a positive and significant association between UIP and LBW: [(OR = 2.24; (95%CI: 2.0-2.51))(6), (OR = 3.67; (95%CI: 2.67-5.03)) (55), (OR = 1.46; (95%CI: 1.32-1.62)) (54) and (OR = 2.66; (95%CI: 1.54-4.58)) (63)]. Some associations have shown disparities in sub-population analysis; for instance, the risk of LBW was found to be greater for UIPs for participants who identified as Blacks than for their White peers (64). However, two cross-sectional findings suggested (59) there is no significant association between UIP and LBW (OR = 1.09; (95%CI: 0.92-1.30)) (65). One high quality case-control study found that there was insignificant association between UIP and LBW (OR = 1.11; (95%CI: 0.95-1.29) (66).

Data from a longitudinal study has documented a positive association between UIP and LBW (OR=2.0; (95%CI: 1.19-3.36)) (67). Similarly, another large-scale prospective cohort study which examined characteristics of children at risk of maltreatment has revealed a significant association of UIP and LBW (3). Neither of the other two longitudinal studies however showed significant effect (58, 68). Another systematic review has reported a positive association between unintended births and LBW (62). These different findings reflect differences among the studies and study population characteristics that might have influenced measurement of exposure or outcomes. For example, preterm (69) and LWB (70) have been associated with uterine malnutrition, perinatal maternal body mass index (69), adverse socio-demographic characteristics, medical risk factors (e.g., infection) (69, 70), previous preterm birth (69) and lifestyles (70). In contrast, many of the included studies rarely controlled for these variables. Further study that controls these factors may help to understand the real impact of UIP on these outcomes.

Stunting of Growth: Children of UIP are treated differently regarding access to services. Four studies, one of which was longitudinal, have examined the nutritional status of children from unintended pregnancy. Data from 3126 lastborn live children younger than 36 months from Bolivian DHS revealed nearly a threefold higher rate of growth stunting for children from UIPs (OR = 2.54; (95%CI: 2.24-2.88) (71). Similarly, two population-based studies using data from developing countries documented an increased risk of stunting for children of unwanted pregnancies, [(OR = 1.12; (95%CI: 1.08-1.16)) (17) and (OR = 1.88; (1.40-2.52)) (72)], during their early childhood (<36 months). A Romanian experimental study using cross-sectional data at birth to estimate the effects of unintended fertility on nutritional status showed increased risk of stunting for an unanticipated (or mistimed) twin siblings (73). This latter finding may be attributed to an increase in family size due to the twins placing greater constraints on household resources. Chronic failure to thrive in these children may reflect persistent neglect (2, 3). Overall, the findings suggest differential nutritional conditions for children associated with UIP.

Vaccination: According to the cross-sectional assessment, despite the advantages of vaccination in preventing diseases, children from unintended (59), mistimed (10, 11) and unwanted (10-12) pregnancies were found to be less likely to be fully vaccinated at 12 months of age. Similarly, a 5 to 6-year follow-up survey documented three times the rate of incomplete vaccination for children from UIP (OR = 3.06; (95%CI: 2.56-3.66)) (12). Although the findings show that children from UIPs are less liable to be vaccinated, further studies are needed to better estimate the degree to which this is a problem.

Child Mental Health: Children from UIP might be expected to experience poor mental health which may be a consequence of antecedents that led to UIP and/or non-optimal mother-to-child interactions resulting from neglect after birth. One cross-sectional and four longitudinal studies examining mental health of these children were identified. The cross-sectional survey controlling for unmeasured confounders suggested

possible negative effects of UIP on childhood mental health (74).

A four-year follow-up study of 6640 children from UIP assessing their wellbeing and developmental outcomes has documented higher odds of hyperactivity (75). Moreover, poor child behavioural outcomes including aggression, externalizing, internalizing, dysregulation and socio-emotional competence problems were documented over the first three years of life (unpublished data)for these children from first-time mothers (15). A 14-year study using mother-child pairs from the Mater-University of Queensland Study of Pregnancy, an Australian longitudinal pre-birth cohort study, to explore child mental health (47) and early alcohol initiation was examined (76). Data from 4765 mother-children pairs documented a positive association between UIP and child aggression, externalizing, total problems and alcohol drinking (47). One of these studies revealed early adolescence alcohol initiation for unwanted children (OR = 1.48; (95%CI: 1.19-1.83)) (76). There are a handful of studies that demonstrate the association between UIP and child mental health (i.e., across various domains) and future longitudinal studies are required to elaborate a likely causal link and temporal sequence. There is a need for better control of possible confounders.

Child Development: Unintended pregnancies could be associated with a multitude of factors that could have a negative effect on child development (77-80). It has been reported that UIP may increase a range of undesired developmental outcomes (16). One of the five cross-sectional findings for children aged less than 2 years, using data from National Longitudinal Survey of Youth, documented significantly lower scores of skill development, fearfulness and positive affect (81) for children from UIP. Moreover, these children scored lower on receptive vocabulary (74, 81) and attained fewer years of schooling (unpublished data) (82). However, three of these cross-sectional surveys revealed non-significant associations on other domains of development (4, 74, 75, 83).

A four-year longitudinal study from the USA explored the overall development of children from UIP using Denver Development Screening (DDS) scale. It found a significant increase in poor developmental outcomes including activity level and Denver Development score capturing personal-social, fine-motor, language and gross-motor skills for mistimed children (5). However, one study that assessed the effect of pregnancy planning on cognitive development of children at ages of 3 and 5 years showed no difference for both children from unintended and intended pregnancies (4). There remains a significant lack of longitudinal studies examining child development outcomes of pregnancy intention controlling for maternal, child and other unmeasured confounders. Further long-term follow-up studies on the effect of UIP on different domains of development are also needed.

Child-parent Relationship and Parental Rearing Pattern: Unintended pregnancy may be negatively associated with parenting attitudes, behaviours and styles which could in turn influence child development. There have been 4 cross-sectional and two longitudinal studies reporting the effects of UIP on child-parent relationships and parenting styles. It has been suggested that the perceived risk and actual burden of parenting for the forthcoming child is high (53, 84). High parenting stress was reported for parents of children from UIP (OR = 1.14; (95%CI: 1.03-1.26)) (83). Inter-parent discussion (85), participation (53, 85) and non-authoritarian parenting (85) were reported to be significantly low for parents with a history of UIP. These parents have also been identified for a high likelihood of child abuse and neglect (2, 3).

Longitudinal studies have documented possible risks of child abuse and neglected for children from UIP (3), a two-fold association with poor child-mother attachment (OR = 2.25; (95%CI: 1.07-4.72)) (15) and poor quality child-parent relationship (84). There is scarcity of population-based studieson whether UIP affects the parenting patterns for those children from early childhood to adolescence. This may help provide some insights for parenting intervention for at risk families.

Child Morbidity and Mortality: Pregnancy intention can be coupled with other concurrent risk factors which increase the risk of child illness. Evidence from six cross-sectional and one longitudinal study documented consistent findings. In children resulting from UIP, the rate of illness at birth, not receiving treatment for the illness (13, 14) and infant mortality were claimed to be high (12, 16, 17, 81). Admission of children to an intensive care unit (ICU) was significantly high (OR = 2.17; (95%CI: 1.18-4.10)) (63), with elevated burdens of neonatal, post neonatal and early childhood mortality for mistimed and unwanted pregnancies (17). However, no association was reported for admission to ICU by a study undertaken by the Institute of Medicine for these children (16). This could be explained by differences in population characteristics such as socio-economic status and access to healthcare services.

Data extracted from a large-scale prospective study revealed nearly a three-fold increase in neonatal mortality for children who were the result of an UIP and neonatal mortality (OR = 3.29; (2.71-3.98)) (12). This may suggest increased disadvantages of these children at different levels of their lives.

Summary: Our review revealed disadvantaged health and developmental outcomes for children from UIPs. They have been consistently experienced birth-related adverse outcomes such as small for gestational age (86), preterm birth (45, 46, 54, 58, 62, 87) and LBW (6, 48, 54, 61, 62, 64, 88). Mothers with UIPs are less liable to practice risk reduction behaviours. This, in turn, may increase proneness for unhealthy exposures and subsequent susceptibilities and would purportedly affect the health, development and child-parent relationship. Furthermore, these children may be less likely to receive preventive services such as vaccination (58, 71, 72), breastfeeding (6-8) and are more likely to be malnourished (17, 71, 72). As a

result, high morbidity and mortality rates were suggested (12, 13, 16, 17, 81, 89). High burden of morbidity and mortality may presumably depend on pre-pregnancy, intra-partum and postpartum health status of the mother. Postpartum child conditions may moderate or mediate ongoing wellbeing as well. However, evidence on long-term cumulative health, developmental and child rearing patterns is scarce (4, 45-48). There is a need for further study in this area.

Discussion

Although the public health importance of UIP is indisputable, there remain substantial inconsistencies on the health, developmental and parenting-related impacts on children from UIPs across studies to guide evidence-based interventions (44, 83). This review, therefore, seeks to fill the knowledge gap in regard to the undesired health consequences of these children.

Children from UIP were disproportionately found to experience a wide range of health and developmental problems for a number of reasons. Firstly, UIPs have been associated with a less healthy maternal pre- or peri-natal lifestyle including cigarette smoking(90), alcohol and drug(24, 60, 90, 91) use, although such risk factors may precede or co-occur with UIP. Ostensibly, maternal exposure to such teratogens may have poor child health outcomes (92-95). Moreover, breastfeeding (6-8) and early child-to-mother interaction/attachment (53, 84, 85, 96) may be less common for an unintended child. Secondly, mothers with an UIP have been found to attend less than the recommended number of times for prenatal care (11, 31, 55, 88, 97-102), with fewer or no opportunities for early detection and prevention of pregnancy-related complications (54, 62, 87). Consequently, health and development may be affected with a possibility of progression into late childhood and adolescence. This may mean fewer opportunities for early detection and prevention of pregnancy-related complications (54, 62, 87). Thirdly, children who are consequence of UIP may be subjected to different rearing or parenting (53, 85) malpractices, including childhood maltreatment (2, 3).For example, child-to-mother interaction/attachment (53, 84, 85, 96) may be suboptimal with differing parenting (53, 85) practices, including childhood maltreatment and abuse (2, 3). This may extend beyond early childhood with subsequent poor physical and mental health outcomes. Fourthly, there may be differences in the social and economic characteristics of children who were not intended and it may be that these differences explain some of the observed differences in health outcomes.

Generally, it has been believed that the rate and pattern of UIP is decreasing due to women's access to effective family planning services. This suggests that subsequent health outcomes may differ for children from different country backgrounds based on their ability to access available healthcare and social services despite the status of parental pregnancy intention. However, given the included studies were looking at different outcomes and mainly from developed nations, it was not possible to fully compare developed and developing countries. Nonetheless, we scrutinized the effect size of each health outcome based on statistical significance. Only 15% (n=3 out of 20) of the studies from developed countries showed insignificant associations for PTB (68, 87) and LBW (66) whereas the remaining studies reporting positive and significant associations of UIP and child health consequences. The respective figure for developing countries that show positive but statistically insignificant associations for LBW (63) and child rearing (53)in 2 out of the 9 included studies. Moreover, as only 3 of 9 studies were from developing countries, their findings might not fully represent any differences between developed vs. developing countries. Nonetheless, the findings consistently tend to reveal similar effects of UIP regardless of whether one is examining developed or developing countries. This may mean that those socio-economically and psychosocially disadvantaged groups of women are at higher risk of UIP across the globe (1) and relatively at equal risk of negative outcomes (103). There is a need to consider whether targeted intervention would reduce the magnitude of UIP and subsequent adverse child health effects in both developed and developing settings.

Overall, these findings may have implication for designing multi-faceted interventions that addresses the socio-demographic and psychosocial aspects of UIP. This may also involve improving the socio-economic status of women at risk of UIP. Furthermore, the societal (104, 105) and political (106) implications of UIP are immense. For example, lower rates of UIPare associated with lower crime rates (107) and lower healthcare costs (108, 109).

Given the emphasis on the fertility issue and the due attention on its health effects since the early 1980s, we included studies characterised by robust methodologies from 1981 through to 2016. This would reduce exclusion of relevant literature and provide an opportunity to track contemporary situations into child health and developmental outcomes. Furthermore, it might provide a baseline for insight into the problems and enhance recommendations for future research directions and implications for evidence-based child health interventions. Standard guidelines were used for quality score and inclusion of reporting items. It included available data both from developed and developing countries.

Heretofore, a handful of studies have focused on long-term health impacts, developmental pathways and parenting patterns of children of UIPs. There is a need for rigorous longitudinal cohort studies involving mother-child pairs with appropriate comparison groups (i.e., matched cohort of children from intended pregnancy) controlling for a wide range of possible confounders to ascertain the temporal sequences and explore causal associations of the health and developmental trajectories for these children. Such prospective studies (44, 110) that focus on health,

developmental and parenting trajectories beyond early childhood are needed to improve policy and practice.

Conclusion and recommendation:
The findings of this review provide substantial evidence of negative health and developmental outcomes experienced by children from UIPs. A relatively large number of studies have found a strong association between UIP and a wide variety of later poor child health outcomes. These findings implicitly suggest improving family education, better child bearing practices and enhancing overall child health for children from UIP. Further prospective studies examining developmental, health and parenting trajectories beyond the early childhood period for children from UIPs are needed. Since the underlying factors may not be similar for all women with UIPs, analysis of each homogenous population subgroup (e.g., by age group, lifestyle, etc.) is needed to provide conclusive evidence for individual groups to enhance maternal and child health. Such studies would be of benefit in filling the gaps of knowledge and tailoring contextualized maternal and child health interventions.

Limitations: Though existing literature provides some evidence about the poor health consequences of children from UIP, there is evidence of substantial weaknesses limiting the capacity to make causal inferences. These drawbacks reflect the cross-sectional study designs used so far. Design limitations are characterised by an inability to disentangle the temporal sequence of exposures and outcomes. Many findings have been prone to recall bias (17, 45, 54, 55, 85, 111) and rationalization (5, 75). The current evidence is limited by a scarcity of longitudinal studies (44, 110) and non-reliability of findings due to weak study designs (53) and brief period of follow-up (12). Furthermore, existing studies have suggested mixed effects. The majority of the data were cross-sectional with a chance of bias, ex post rationalization and lack of conclusive strength. The vast majority of literature was from the USA and findings may not be representative of all countries. Selection bias was an inevitable limitation of this synthesis since our review targeted only available literatures published in English. Child health outcomes may vary based on study settings (e.g., developed vs. developing countries) due to disparities in access to healthcare services and cultural norms in regard to contraception, sexual relationships, marriage, family values, etc. Finally, a meta-analysis that pools effect sizes into one outcome of interest is needed but not possible because of the heterogeneity and the limited number of included studies with different outcomes in each thematic area.

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Competing interests
The authors report no conflict of interest.

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Appendix

Table 1: Study characteristics of included 29 full-text articles

Authors	Study country	Study design	Number and characteristics of study participants	Key findings	Confounders adjusted in multivariable analyses	Significant confounders
Kost, et al., 2015 (55)	USA	CS	4297 women aged 15-44 years were drawn from NSFG of 2002 and 2006-2010 (with singleton live births of age >20 years).	No significant association between pregnancy intention and PT. Unwanted births were more LBW (0.07%).	Socio-demographics and birth order	Maternal age, education, marital status, race and birth order.
Saleem, et al., 2014 (112)	USA	Longitudinal follow-up from late infancy through kindergarten	1150 mothers and children, 2600 children and fathers, and 1150 couples and children from Early Childhood Longitudinal Study Birth Cohort	Unwantedness by mother, mistiming by father, and discordance of parental pregnancy wantedness (when the mother wanted but the father did not) predicted lower social-emotional development scores.	Socio-demographics	Income and education
Singh, et al., 2013 (12)	India	Prospective 5-6 years follow-up of National Family Health Survey	2108 births for which pregnancy intention was assessed prospectively	-Unwanted births were (AOR=1.38) more likely to receive inadequate vaccinations. Mistimed/unwanted births had 83% higher risk of neonatal mortality.	Socio-demographics, women's autonomy, media exposure and sex of child	Education, autonomy, media exposure, household standard of living
Dibaba, et al., 2013 (88)	Ethiopia	Community-based prospective cohort from pregnancy (2nd and 3rd TM) to delivery	537 newborns	Incidence of LBW was 17.9% (95%CI: 14.6, 21.1). Unwanted children were at higher risk of LBW (RR=2.08; (1.02–4.23)).	Maternal socio-demographics, parity, prenatal care, history of stillbirth and sex of the newborn.	wealth status, prenatal care use and maternal middle upper arm circumference size
McCrory, et al., 2013 (83)	Ireland	CS	10,567 children were assessed at 9 months	40.7% had UIP and associated with birthing complications (RR=1.08) and parenting stress score (AOR=1.27). LBW, PT and fussy difficult score were non-significant outcomes.	Maternal demographics	-
Singh, et al., 2012 (17)	India	CS, National Family Health Survey from 2005-06.	51, 855 women aged 15-49 years	-Mistimed children less likely received all recommended vaccinations (AOR=1.4) and die during neonatal (AOR=1.8) and post neonatal (AOR=2.6). -Unwanted children received less vaccination (AOR=2.2), stunted (AOR=1.3) and, die neonatally (AOR=2.2), postneonatally (AOR=3.6) and during early childhood (AOR=5.9).	Maternal socio-demographics, mother autonomy, media exposure, sex, age, birth order and interval of the index child	Wealth index, religion, caste, education, mother autonomy, mother age, media exposure, sex, birth order and interval, child age, residence and region
Nelson, et al., 2012 (96)	USA	Longitudinal from approximately 1 month postpartum to 15 years	373 first-born children and their families and 472 later-born children and their families from National Institutes of Child Health and Human Development Study of Early Child Care and Youth Development (SECCYD)	Pregnancy planning, Negative Parent–Adolescent Relationship Quality Via Depressive Symptoms at Various Levels of Parenting Stress were associated.	Maternal socio-demographics, proportion of time the mother was partnered	Proportion partnered, income-to-needs ratio and parenting stress
Inas Mohamed Abdallah, et al., 2011 (63)	Egypt	Prospective with 7 months follow-up	253 pregnant women were recruited during 3rd TM	UIP was not associated with LBW (AOR=1.76, 95%CI:0.77-3.99) and admission to ICU (AOR=1.64 (95%CI: 0.69- 3.91).	Socio-demographics, parity and previous UIP	Maternal education, economic levels, parity and previous UIPs

Carson, et al., 2011 (4)	UK	Prospective cohort of children born in 2000-02 recruited at 9 months and followed at 3 and 5 years from UK Millennium cohort study	11,790 singletons at age 3 and 12,136 at age 5	Mean verbal ability score was −0.3 (−1.3 to 0.7)—equivalent to no delay.	A priori confounders or mediators (model 1)—Sex of child, age (in days), language spoken at home; Socio-demographic, health, and health related behaviours in pregnancy (model 2); and Early life course (model 3) and Later early life course (model 4).	-
Marston, et al., 2010 (72)	Bolivia, Egypt, Kenya, Peru, and the Philippines	CS, 5 DHS (from 5 countries)	45, 121 women of reproductive age participating in major DHS.	Not having received fully vaccinated was associated with: mistimed (AOR=1.4-Egypt); unwanted (AOR=1.6-Kenya) and (AOR=1.24-Peru). Stunting was associated with unwanted (AOR=1.15-Peru)	Socio-demographics and birth order	Education, wealth index (except in Kenya), type of residence and birth order.
Hayatbakhsh, et al., 2010 (47)	Australia	Prospective longitudinal 14-year	4765 mother- children cohort of Mater University Study of Pregnancy	Increased odds of child aggression, externalizing, total problems and alcohol drinking for those unintended children at 14-years	Maternal socio-demographics; Maternal DSSI mental health at the first clinic visit; maternal smoking and drinking at entry to study. Mediators: mothers' attitude towards caring for the baby at 6 months and mother-child communication at 14-year.	Mother's age, marital status, anxiety, depression and smoking during pregnancy both for UIP and child outcomes; **Mediators:** Mother's attitude towards baby at 6 months was associated for both exposure and outcome variables.
Hohmann-Marriott, et al 2009 (58)	USA	CS	5,788 both father and mother from Early Childhood Longitudinal Study—Birth Cohort (ECLS-B) interviewed when children were 9 months old.	When the mother only, the father only, or neither partner intended the pregnancy, odds of prematurity were 1.3–1.4 times higher than when both the mother and father intended the pregnancy. Risk of LBW by contrast, was not associated with intentions but was associated with the father not having discussed the pregnancy with the mother.	Socio-demographics and pregnancy characteristics (smoking during pregnancy and multiple/twin birth)	Age, SES, race; birth order, twin/multiple birth and mother smoking

Hutchinson, et al., 2008 (76)	Australia	Prospective longitudinal study	4258 mother-child pairs from Mater University Study of Pregnancy	34.9% of adolescents reported having consumed alcohol by age 14. Alcohol initiation at 14 was higher (AOR=1.40) for adolescents from mothers with negative attitude towards the pregnancy attitude and for adolescents from UIPs (AOR=1.22).	Demographics, maternal alcohol and tobacco use, maternal mental health, obstetric factors and early temperament	Attitude to teaching the baby
Allen, et al., 2008 (111)	USA	CS	13,446 women from 1998 to 2005 PRAMS	The prevalence of preterm delivery was 9.4%; insignificant association was observed between UIP and PT delivery.	Maternal socio-demographics, parity and medical risk factors	Pre-pregnancy BMI, smoking during pregnancy, medical risk factors and receipt of prenatal care
Afable-Munsuz, et al.,2008 (45)	USA	CS	15,331 women with LB	Preterm birth was associated with unsure (AOR=1.49) pregnancy status.	Maternal socio-demographics	Education
Mohllajee, et al., 2007 (54)	USA	CS	87,087 women who gave birth between 1996 and 1999 in 18 states.	The prevalence of LBW, preterm birth and small for gestational age in infants were: 5.9%, 8.7% and 8.2%, respectively. An increased likelihood of PT delivery (AOR=1.16) and premature rupture of membrane AOR=1.37) were high for unwanted pregnancies. Ambivalent pregnancies had increased odds of LBW infant (AOR=1.15); mistimed pregnancies had a lower likelihood (AOR= 0.92), however.	Maternal socio-demographics, cigarette smoking and alcohol use during pregnancy and, previous LBW and PT birth	-
Goto, et al., 2006 (53)	Japan	Prospective cohort from pregnancy through 6 weeks postpartum	140 pregnant women were followed from 2003-04.	Outcomes against unintended were: -MAI-JV: (AOR=4.3); having confidence in child rearing (AOR=3.1), -Feel I am abusing my child (AOR=7.6) and have time to interact with child in a relaxed mood (AOR=4.8). -Discussion about child rearing was not significant. Think the child's father is cooperative (AOR=4.9).	Maternal and paternal socio-demographics, BW and cohabiting with grandparent.	-

Messer, et al., 2005 (113)	USA	Prospective cohort from 26-29th week of gestation to prior delivery	1908 > 16 yr 24-29 weeks Pregnancy, Infection and Nutrition (PIN) study, a prospective cohort examining risk factors for preterm birth	Reporting not intending the pregnancy was not associated with increased risk of PT birth (Risk Ratio [RR] = 1.0, 95% CI: 0.8, 1.1), but reporting the highest quartile of perceived stress (RR = 1.6, 95% CI: 1.1, 2.3) and the highest quartile of distancing coping style (compared with lowest quartile) was associated with PT birth (RR = 1.4, 95% CI: 1.1, 1.9).	Maternal socio-demographics	-
Goto, et al., 2005 (85)	Japan	CS	197 mothers of children aged 3 to 18 months	Not denying feeling of abusing a child (OR =5.2); not discussing child rearing with husband (OR=3.1) or family (OR=3.3), and husband's infrequent participation in child rearing (OR=1.9) were significantly findings.	Socio-demographics of mother, father and child	Discussion about child rearing
Crissey, et al., 2005 (75)	USA	4 years follow-up from National Maternal and Infant Health Survey to assess child wellbeing and development	6640 live birth from NMIHS	**Health:** -Mistimed: higher odds of being classified as in less than excellent health and (OR=1.17) higher odds, but marginally significant (OR=1.25) **Activity**: Unwanted birth (OR=1.46). **Development:** -No association for both mistimed and unwanted birth.	Maternal socio-demographics; child demographics (age (except for DDS) and sex); biomedical (BW, GA and parity)	Race, marital status, income; BW, parity and sex.
Shapiro-Mendoza, et al., 2004 (71)	Bolivia	CS, DHS	3126 lastborn singleton live children younger than 36 months	22% children were stunted (3% severe); the odds of stunting were 1.33 and 1.28 for mistimed and unwanted children of 12-35 month age, respectively.	Child demographics, maternal demographics and reproductive history	Maternal age, education, birth order, health service use, total facility, residence and region
D'Angelo, et al., 2004 (6)	**USA**	CS	25,027 women with recent live birth from PRAMS	Unadjusted relative risk of LBW was 1.21 (95%CI: 1.11–1.32) for unwanted and 1.10 (95%CI: 1.05–1.16) mistimed births	Socio-demographics, parity and infant birth weight	Age, education, marital status, race, parity and Medicaid reception

Hummer, 2004 (5)	USA	Panel/LF data for 4 years	8,285 mothers with LB	-Health status was insignificant; -Less desirable outcome in terms of activity for unwanted children (AOR=1.45); -Bottom 20% DDS scores for mistimed children (AOR=1.22)	Child demographics, child biological characteristics and maternal socio-demographics	Race, education, marital status and child sex (boy-with activity),
Eggleston, 2001 (65)	Ecuador	CS, DHS	2490 women	-Infants from unwanted pregnancies were more likely than from planned to have LBW (odds ratio=1.64). -Mistimed pregnancy was not associated with LBW.	Pregnancy and delivery characteristics (site of delivery, prenatal care, anaemia, blood pressure, cigarette smoking, alcohol consumption) and socio-demographics (age group, sex of infant, birth order, urban/rural residence, and maternal education).	Maternal age birth order, and education, blood pressure and use of alcohol during pregnancy and sex
Sable, et al., 2000 (48)	USA	Case-control	2,378 singleton infants (779 cases with very low birth weight, 799 controls with moderately low birth weight and 800 controls with normal birth weight) from Missouri Maternal and Infant Health Survey	Pregnancy denial-VLBW (AOR=1.41); having a mistimed pregnancy appear to have reduced the odds of moderate low birth weight (AOR=0.79).	Maternal socio-demographics, health during pregnancy, adequacy of ANC, prior live birth and smoking during pregnancy.	Marital status, taking loan, poor health during pregnancy, Medicaid reception and smoking during pregnancy.
Orr, et al., 2000 (87)	USA	Prospective cohort from first prenatal visit to birth	**922 >/= 18 year** pregnant low income women (1994-95)	The incidence of PT was 13.7%; the relative risk for preterm was high (RR=1.82) for UIP.	Maternal socio-demographics, behavioural and medical/pregnancy related characteristics.	Clinic attendance, income and race; bleeding, hospitalization during pregnancy, poor weight gain, pre-eclampsia and previous poor pregnancy outcomes
Kost, et al., 1998 (68)	USA	CS	11670 live births from National Maternal and Infant Health Survey and NSFG	Non-significant association between birth outcome (premature delivery, LBW or small for gestational age) and early well-baby care, and pregnancy intention.	Socioeconomics, physical health-related variables, prenatal behaviour and experience.	Age, race, education, marital status, previous LB, negative pregnancy experience, BMI and pregnancy behaviour.
Sable, et al., 1997 (66)	USA	Case-control	2, 828 mothers from Missouri Maternal and Infant Health Survey	The prevalence of LBW and moderately LBW in UIP was 58 and 59%, respectively. Very LBW mothers significantly report unhappiness towards a pregnancy (AOR=1.53) and pregnancy	Maternal Socio-demographics	Race and Medicaid reception.

				denial (1.54).		
Baydar, et al., 1995 (81)	USA	CS panel data	1,327 children younger than 2 years from National Longitudinal Sur- vey of Youth cohort for whom intention was assessed before birth for 61% and postpartum for 25%.	Mistimed and unwanted children were rated significantly higher than wanted children on the fearfulness scale and mistimed children were rated significantly lower on the positive affect scale. However, PPVT-R scores, measuring receptive vocabulary, are significantly lower among mistimed and unwanted children than among those who were wanted.	Socio-demographics of children and mothers	Race, employment, income, presence of biological and father at birth maternal AFQT

ANC-antenatal care; BMI-body mass index; CI-confidence interval; CS-cross-sectional; ES-OR-effect size odds ratio; DHS-Demographic and Health Survey; DSSI-Delusion-States-Symptoms-Inventory; DSS-Denver Development Score; GA-gestation age; ICU-intensive care unit; LB-birth weight; LBW-low birth weight; NSFG-National Survey of Family Growth; PI-pregnancy intention; PT-preterm; PRAMS-Pregnancy Risk Assessment Monitoring System; SES-socio-economic status; TM-trimester; VLBW-very low birth weight.