

SYSTEMATIC REVIEW

ANTECEDENTS AND MATERNAL HEALTH OUTCOMES OF UNINTENDED PREGNANCY: A SYSTEMATIC REVIEW

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ABSTRACT

Background: While concerns about adverse health outcomes of unintended pregnancies for the mother have been expressed, there has only been limited research on the outcomes of unintended pregnancies. This review provides an overview of antecedents and maternal health outcomes of unintended pregnancies (UIPs) carried to term live birth.

Methods: The authors extracted published and unpublished data on current evidence of UIP using the search engines MEDLINE, PubMed and EMBASE and presented the findings in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Results: The systematic review included 64 studies with a mean quality score of 4.94 (SD ± 0.72). It involved 671,046 reproductive age women who had given birth to a single child. Socio-demographic and reproductive characteristics were antecedents for and/or consequences of UIPs. Unintended pregnancies were associated with reduced use of prenatal healthcare services, illicit drug use, intimate partner violence, and adverse maternal mental and physical health.

Conclusions: Antecedents of an UIP may include socio-demographic and reproductive characteristics of women, as well as family and socio-cultural characteristics of a society. Findings on adverse outcomes of UIPs were mixed, but are generally suggestive of negative outcomes. Longitudinal multi-wave studies with appropriate comparison groups are needed to fill the gaps and identify research and policy alternatives.

Key words: antecedents, maternal health outcomes, unintended pregnancy, systematic review

INTRODUCTION

Globally, over 40% of all pregnancies are unintended, of which 38% are carried to term (1). Unintended and/or unplanned pregnancies are common in both developed and developing economies. For instance, consistently over 50% of pregnancies are unintended in the USA (2-5), 26%-42.8% in Europe (6,7), 46.7% and 5%-60% in Australia and developing regions, respectively (8, 9).

Despite possible adverse consequences, UIP has received less attention than other public health problems (10) and there has only been limited research on its antecedents and maternal health outcomes. The reliability and validity of available evidence is limited by methodological weaknesses. A better understanding of potential risk factors and long-term adverse health outcomes (11-13) has been suggested. However, there is a consistent lack of evidence on antecedents and adverse health outcomes beyond the postpartum period. Even findings with robust study designs are inconsistent and tend to lack appropriate comparison groups limiting the evidence base. This review aims to synthesise the overall contexts of UIP carried to live birth with a particular emphasis on antecedents and maternal health outcomes.

Definition, classification and measurement of unintended pregnancy:

To have a better understanding of UIP, the authors briefly reviewed the concept, underlying definition, taxonomy and measurement.

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Definition and classification:

An UIP can have varying meanings and evolutions, and is a general term for mistimed, unwanted (14) and/or undecided pregnancy (15, 16). This classification does not reflect all aspects of UIP (17-20) and studies often measure the degree of pregnancy intention as intended versus unintended (3, 21-27). However, this classification has been criticised since health outcomes may vary with sub-classes (i.e., mistimed vs. unwanted) (28). Furthermore, there are pregnancies which are ambivalent with regard to intentionality. In the latter instances, there is a degree of uncertainty regarding the intention of conception of the pregnancy (14). Pregnancy intention is a complex phenomenon (28-30) with some at extreme ends of a continuum (29, 31-34) and others ambivalent (35). In some instances, the concept of an UIP is attitudinal (36, 37) involving affective, cognitive, psychological, socio-cultural and conceptual contexts (15, 30) and reproductive norms (38).

Furthermore, the recurrence of varying levels of intention (39), ambivalence (40) and two party involvement in decision-making may affect the designation of pregnancy intention (30, 33). Pregnancies that occur despite contraceptive use are classified as unwanted (i.e., not wanted at all) (15) though the use of less effective contraception may reflect some ambivalence (30, 41). However, not all contraceptive failure may result in an UIP (35, 36).

Measurement:

To date, there is no standardized measurement of UIP (14). Different international and national studies have used different survey tools with varying categories. The National Survey for Family Growth (NSFG) (42) and Pregnancy Risk Assessment Monitoring System (PRAMS) (24, 43) are the two predominant survey instruments used to assess UIP in the USA. The NSFG incorporates measures of contraceptive use and the extent of timing (44) and the health outcomes may vary based on the timing of UIP (45). Although retrospective survey methods at a population-level may involve recall bias (38), they are widely used in many settings (46) to assess UIP. For instance, conventional questions about pregnancy intention and timing (i.e., Demographic Health Survey (DHS)) (16, 23) are widely used in developing countries.

The actual assessment of pregnancy intention may be compromised by measurement errors, contraceptive failure, sub-fecundity and change of intention over time (38). The reliability of measurements also vary over time (14, 38, 47), across social groups (14) and study designs. For example, prospectively determined unwanted pregnancy may become a wanted or mistimed pregnancy retrospectively due to subsequent acceptance, rationalization (46), changing circumstances (48) and live child (15) with better than anticipated outcomes (49). The issue of termination of a pregnancy is another example. Available measurements tend to assume most pregnancy terminations result from UIPs (15) though women choosing to terminate a pregnancy may have different life circumstances (50) than those choosing to continue to term. All terminated pregnancies (31, 51, 52) were excluded from the following analyses presuming that they were unwanted pregnancies (15, 53-55) and may have also underestimated the true rate of unwanted pregnancies.

METHODS

The term ‘unplanned pregnancy’ has been used interchangeably with ‘unintended pregnancy’ to maintain consistency throughout the document. Given the scarcity of literature, the review includes studies from both developed and developing countries. For this review, both published and grey literature available in English on maternal health effects of UIP since January 1981 through January 2015 using electronic search engines such as MEDLINE, PubMed and EMBASE as primary databases and Google Scholar have been used. Two selected sub-themes of search terms of the review include: (1) antecedents or risk factors; and (2) maternal health outcomes of UIP. Search strategies included “antecedents OR risk factors of unplanned pregnancy OR unintended pregnancy OR mistimed pregnancy OR unwanted pregnancy; unplanned pregnancy OR unintended pregnancy OR mistimed pregnancy OR unwanted pregnancy AND maternal health; unplanned pregnancy OR unintended pregnancy OR mistimed pregnancy OR unwanted pregnancy AND outcomes; and pregnancy intention AND health maternal consequences”.

Eligible studies included: (1) quantitative population-based studies addressing at least one maternal health outcome; (2) for which potential confounders were controlled using robust statistical procedures (i.e., multivariable analyses); and (3) that report having obtained ethical clearances from respective institutions. The literature search was cross-checked against references from eligible studies to retrieve and include all relevant studies. Descriptive and qualitative studies pertinent to epidemiological estimates, measurement and characterization of UIP were included. However, studies on outcome measures from (1) qualitative, (2) descriptive only and (3) for which data were collected before 1981 were excluded.

The author (AAA) reviewed abstracts and full-texts of all included studies and examined them for further synthesis. This author then screened articles from primary reviews, extracted and synthesised data on study designs, participant characteristics, exposure and outcome measurement, key findings, adjustment factors (including those which were statistically significant), appraisals of strengths and limitations. Quality assessment was based on an 8-point checklist (56) to evaluate quality of each included study for method validity, outcome(s) measurement and sub-group-analysis. Three co-authors (RA, SK and JMN) cross-checked the reliability and assessed overall synthesis process. Quality scores were for this review purpose and did not necessarily represent the original thread of each included research article. Using numerator and denominator data, the authors calculated samples with and without outcome(s) of interest and respective chi-square estimates, as well as estimated odds ratios (OR) with 95% confidence interval (95%CI) using Campbell Collaboration Effect Size Calculator (57). The authors used a statistically significant predictor with the largest effect-size from primary analysis (i.e., original research article) to estimate effect-sizes for prevalence studies examining multiple concurrent factors. The review involved both qualitative (Table 1) and quantitative (Table 2) syntheses. The authors narratively and/or qualitatively synthesised and summarised data on definitions, classifications, measurements, epidemiology and antecedents whilst quantitative synthesis focused on maternal lifestyle, prenatal healthcare service utilization and health outcomes. The authors used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (58) to screen and select eligible studies, and to summarize the systematic review.

RESULTS

Description of studies:

The review identified a total of 371 studies, 255 of which were full-text published articles, 6 were categorised as grey literature and there were 3 dissertations. Some 64 (25.1%) full-text studies fulfilled the inclusion criteria and 188 (74.1%) including dissertations were excluded for the reasons outlined in the PRISMA flow diagram (Figure 1). The majority of studies, 42 (65.6%), were cross-sectional followed by 15 (23.4%) longitudinal, 5 (7.8%) case-control and 2 (3.2%) randomized clinical trial designs. In randomised studies, the participants were primarily randomised for other study purposes rather than to assess pregnancy intention status (22, 59). Most of the included studies, 27 (41%), were from the USA. A total of 671,046 reproductive age women ranging from 119 (6) to 143,303 (60) who had given birth to a singleton child were included in this review. Quality scores ranged from 3 to 7 (mean = 4.94; SD \pm 0.72) and higher quality studies relatively had greater effect-sizes. Tables 1 and 2 present the summary reports of pertinent study characteristics. Unless otherwise stated, all quantitatively synthesised results were from adjusted findings for selected confounders.

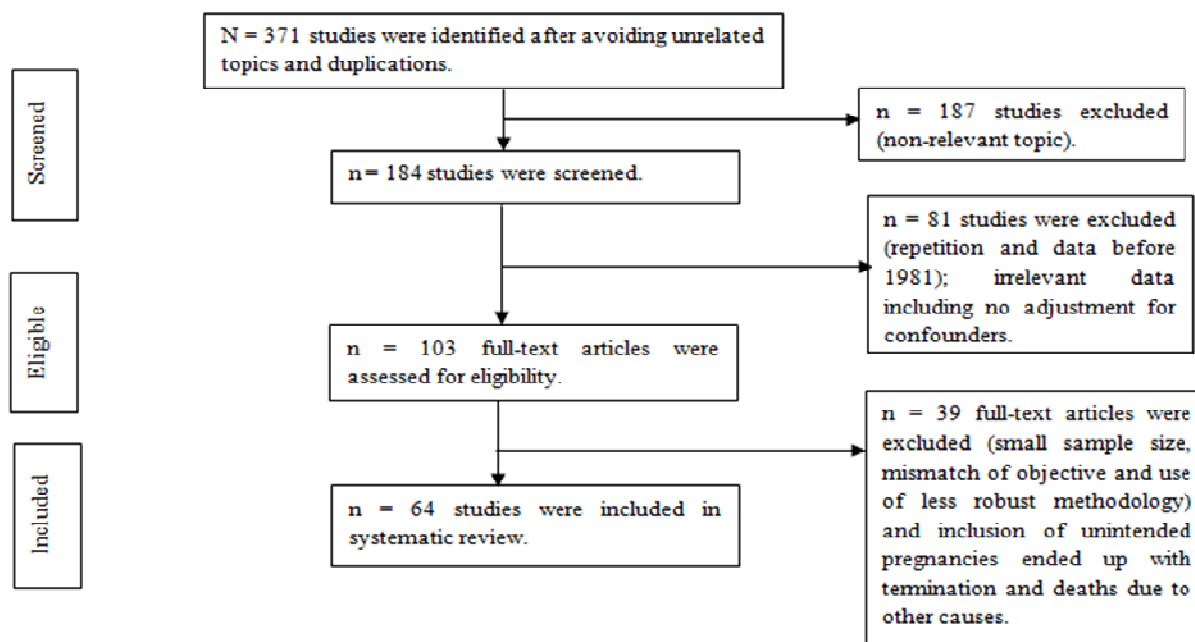


Figure 1: Schematic representation of studies included in the systematic review using PRISMA checklist and flow-diagram.

Authors and year	Participant characteristics and objectives	Measurement of pregnancy intention	Classification of pregnancy intention	Remarks/comments
Guzzo, et al., 2014 (3)	1,463 women 18-24 years for wave III and 25-32 years for wave IV from National Longitudinal Study of Adolescent Health -To assess the stability of <i>pregnancy intention</i> - women asked about the same live birth at different times	“Please think back to the time just before you became pregnant. Did you want to have a child then?” (Wave III) and “Thinking back to the time just before this pregnancy with [partner], did you want to have a child then?” (Wave IV). Responses were categorized as no (unintended), yes (intended), or refused/don’t know/missing.	Intended Unintended	-Explores stability of <i>pregnancy intention</i> over time for the same birth using a nationally representative school-based sample; -Initially <i>intended</i> pregnancies likely re-categorized as <i>unintended</i> and vice-versa; -Race and employment predict the likelihood of switching; -The dichotomy of <i>intended</i> vs. <i>unintended</i> may underestimate the effects of <i>mistimed</i> pregnancy; i.e., retrospective or prospective measurements may underestimate or overestimate the effects of UIP if associated with the outcome of interest; -Prone to selection bias; -Does not measure partner’s <i>pregnancy intention</i> .
Rebecca, et al., 2012 (61)	725 married <50 years non-sterilized women with live birth were drawn from Bangladesh Microcredit and Health Study -To assess forward and backward measures of pregnancy intention: from wanted pregnancy prospectively to <i>unwanted</i> retrospectively.	DHS questionnaire	Wanted Wanted later/ Not wanted Unsure	- Longitudinal design with better comparison of prospective and retrospective reports of pregnancy intention; -Prospective estimates would be higher if pregnancy is not intended in the near future; -Retrospective measures underestimate <i>unintended</i> pregnancy; -Explores the degree of post birth rationalization; -Unable to measure mistimed pregnancy prospectively; -Could not disentangle the effects of mistimed and unwanted may in turn would affect health outcomes of interest; -Prone to selection bias; -Does not measure partner’s intention about pregnancy.
Lifflander, et al., 2007 (20)	39 18-49 years women participated on focus-group discussion -To explore the reasons for the high rate of UIP in low-income women.	Audiotaped and transcribed verbatim. Theory of Planned Behaviour decision tree was also used.	Planning or decision to have a child Taking specific behaviours to increase likelihood of conception Making plans to care for a child	-Pregnancy planning status depends on women’s perception of advantages and disadvantages whether to plan a pregnancy or not; -Highlights the situations of child bearing and rearing viz. timing; -Explores differences between definitions and values of planning; -Explores in-depth women’s own experience of pregnancy intention; -Underestimates the rate of abortion; -Not generalizable measuring pregnancy intention for all women or couples; -Could not disentangle the effects of mistimed and unwanted pregnancy-unwanted supposedly carrying heavy risks; -Does not measure partner’s <i>pregnancy intention</i> .

Table 1: Summary of measurement and classification of pregnancy intention\

To be continued ...

Koenig, et al., 2006 (46)	2,387 non-pregnant women with two most recent live births -To determine differences in proportion of retrospectively and prospectively reported pregnancy intention and correlates of switching	Retrospective: standard DHS retrospective questionnaire on pregnancy intention	Unwanted pregnancy Mistimed pregnancy Wanted-timing unsure (for 1 st subsequent pregnancy)	-Maternal age at birth and number of children at baseline affect the shift of pregnancy intention between retrospective and prospective measurements; -Provides longitudinal data for better estimates; -Underestimates the actual level of undesired child bearing; -Susceptible for recall and selection bias; -Does not measure partner's pregnancy intention.
Barrett, et al., 2004 (18)	47 women for qualitative study (to delineate pregnancy construct); 390 and 651 women for field-tests (psychometric test for means of measurement) those who were with continuing pregnancy and opting for abortion, post-abortion and post-natal care.	Six items with excellent reliability ($\alpha > .80$) and high face, content and construct validity ($\alpha = 0.92$) were used.	Expressed intentions Desire for motherhood Contraceptive use Pre-conceptual preparations Personal circumstances/timing and Partner influences	-Develops a valid, reliable and appropriate measure of pregnancy intention in context of contemporary demographic trends and social mores; -Establishes population estimates of unplanned pregnancy based on lay views; -Considers context, instance and behaviour of the women/couples; -Has a high internal consistency, high stability (standard and longer term) and excellent face, content and construct validity; -Suitable for use with any pregnancy regardless of outcome; -Provides a complex and realistic portrayal of human fertility behaviour; -Does not provide any information for pregnancies ending in abortion; -Could not disentangle the effects of mistimed and unwanted pregnancy-unwanted pregnancies carry heavy risks; -Does not measure partner's pregnancy intention.
Earle, 2004 (29)	-19 primigravidae women aged 16-30 years interviewed with qualitative in-depth interview and then followed at 3 specific stages of pregnancy and after birth. -To classify and understand conception by deconstructing planned vs. unplanned dichotomy of pregnancy intention	Audio tape-recorded in depth interview to generate women's experiences of conception and analysed by open coding.	Planned: planned or trying to have a baby; Laissez-faire: stopped contraception but with a relaxed approach to pregnancy planning (i.e., confused); Recalcitrant: want to be pregnant but sought planning pregnancy would not be acceptable socially; Accidental: pregnancies that could be unexpected and due to contraceptive failure.	-Used prospective design with possibility of understanding the dynamics of intention during and after pregnancy; -Displayed unusual classifications with difficulty of comparison; -Could not be handled by rigorous quantitative approaches as its focus is on subjective experiences of women towards their pregnancy; -Would be theoretically rigorous but not statistically generalizable; -Would be used solely for subjective understanding of conception; -Sole inclusion of primigravidae might hide the experiences of multigravidae would not reflect feelings across all reproductive age women; -Would not work similarly for male partners as male partners influence is crucial in how women define their pregnancy; -Could not disentangle the effects of mistimed and unwanted pregnancy-unwanted pregnancies carry heavy risks; -Does not measure partner's pregnancy intention.

To be continued ...

D'Angelo, et al., 2004 (28)	25,027 women with recent live birth from PRAMS dataset - To analyse demographic and behavioural risk factors attributable for mistimed and unwanted pregnancies.	PRAMS questionnaire. -It measured intention before pregnancy but interview was retrospective for recent live birth.	Intended Mistimed Unwanted	-Three groups of pregnancy intention differed on each variable; -Such a clear classification provides a clue for severity of outcomes and target groups to tailor interventions (facilitates sub-group analysis); -More likely to report as unwanted rather than mistimed if behavioural risk factors co-exist with an UIP; -Underrepresentation of pregnancy outcomes other than live births such as pregnancies ending in abortion; -Could not explore complex emotional and psychological dynamics underlying attitudes related to pregnancy; -Prone to recall and selection bias; -Does not measure partner's pregnancy intention.
Pulley, et al., 2002 (45)	Number (in '000) from NSFG -To explore outcomes of pregnancy unintendedness based on extent of mistiming.	NSFG questionnaire	Intended pregnancy Moderately mistimed (24 or fewer months) pregnancy Seriously mistimed (mistimed more than 24 months) pregnancy Unwanted pregnancy	-Explores extent of variation in mistiming based on SES, race, stage of life; -Explores severity of outcome based on the extent of mistiming; -Assesses feelings at the time of conception but not at the time of birth (but feelings can change over time); -Included dimensions of contraception use and timing; -It does not measure partner's pregnancy intention.
Marjorie, et al., 2000 (37)	311 women aged ≥ 18 years seeking a pregnancy test with possible UIP -To examines the relationship among pregnancy intention and attitudes, inconsistent contraceptive use and plans for potential pregnancy	Pregnancy intention was measured using traditional classifications of mistimed and unwanted pregnancies. - Attitudes toward a pregnancy: "If you are pregnant now, how would you feel about it?" (5-point Likert-type scale: "very happy to be pregnant" to "rarely," or "never.")	Mistimed and happy Mistimed and neutral Mistimed and unhappy Unwanted and happy Unwanted and neutral Unwanted and unhappy	-Mistimed and pregnancies for which women are unhappy are potential candidates for adoption and abortion; -Future fates of mistimed and unhappy pregnancies are unpredictable by mothers; -Intention and happiness could be combined for better outcomes of family planning services; -Does not risk for recall bias; -Uncertain about the actual status of the possible pregnancy unless confirmed pregnancy test; -Could not represent women who undertake pregnancy test in other places rather than health facilities, e.g., home pregnancy test.
Bankole, et al., 1998 (38)	1664 married women -To look at the consistency and validity of reproductive intention and planning status	DHS questionnaire	1. Want more 2. Uncertain 3. No more	-Consistently measures pregnancy intention; -Reliability is affected —unwanted reclassified as wanted over time; -Subject to measurement errors; -Postfactum rationalization (i.e., ex post rationalization) through time; -Underestimates levels of UIP; -Could not disentangle the effects of mistimed and unwanted pregnancy -Does not measure partner's pregnancy intention.

DHS-Demographic and Health Survey; PRAMS-Pregnancy Risk Assessment Monitoring System; NSFG-National Survey of Family Growth; UIP-unintended pregnancy.

Main results:**Part I: Antecedents of unintended pregnancy:**

Given varying contexts of women's personal and cultural situations (or realities), antecedents were grouped into socio-demographics, relationship dynamics, knowledge for and use of family planning methods and reproductive characteristics.

Socio-demographic characteristics :

Women's age was found to be the key factor in the epidemiology of UIPs (27, 43, 62-64), with teenagers having had substantially higher rates of UIPs (4, 24, 27, 51, 65-76). Age-specific patterns were also observed in different types of UIP-mistimed being common in younger age groups (4, 28, 45), whilst unwanted pregnancies were more common in older women (28, 31, 38). Younger age at first birth (62), having a first sexual experience before the age of 16 years (77), an increase in age (78) and similarity (27) or difference in age profiles (64) between partners were associated with increased likelihood of UIPs (27).

The literacy level of women was found to be associated with pregnancy intention (63, 72, 79, 80). More educated women were more likely to have a wanted pregnancy (21, 23, 24, 27, 65, 77, 78, 81, 82). Mistimed pregnancies were higher while women were undergoing education/training (31). In contrast, data from one study reported higher rates of unwanted pregnancy in highly educated women (53). This may be explained by women with a higher academic profile tending to postpone child bearing, resulting in an increased age at first pregnancy and/or unwanted pregnancy.

Low income (43, 53, 63, 76, 78, 81, 83) and those women who were on public assistance (23, 24) experienced strikingly higher rates of UIP. Conversely, earning high income and having private insurance for antenatal care was found to be protective (21). Nonetheless, the findings that high-income women had a higher rate of UIP (22, 23, 84) may be attributable to some specific personal and social factors (38, 48). Marital status (31, 45, 53, 67, 69, 78-80), duration of marriage (38), teenage marriage (64, 81, 85) and different modes of cohabitation (24, 62, 72, 81, 84) have also been associated with UIP.

Social discrimination (86) and disparities in race/ethnicity have also been associated with higher rates of UIP (66, 69) with black or non-white women consistently reported as being at greater risk than their white counterparts (23, 24, 45, 72). This finding was, however, not consistent with results from a multicentre randomized controlled trial where racial status (being black) was not associated with UIP (22). This may be due to differences in methodology. Women with traditional or unspecified beliefs may be less likely to experience mistimed pregnancies (43, 62) and Muslim women reported lower levels of unwanted pregnancy (67) than those with other religion affiliations.

Family relationship dynamics:

Familial insecurity coupled with underlying factors which may be proxies for low socio-economic status may hasten the incidence and negative effects of experiencing UIP. For example, family structure and living arrangements (80) such as growing up in a single-family (23, 69, 79), not living with partner (87) and insecure relationship (53) were found to be factors associated with UIP. Differences in fertility preference and family size (43, 88, 89), family dissolution (90) and lower level of parental involvement in contraception decision-making significantly increased the rates of UIP (73, 87) whereas relationship security (53), partner support and awareness of ongoing pregnancy may reduce the rates of UIP (73).

Family planning knowledge and use:

Despite advances in reproductive technology, most UIPs may happen because of insufficient knowledge (91) and limited access to effective contraception (91, 92) which leads to subsequent higher rates of contraceptive failure (17). The risk is lower where family planning knowledge and use is sufficient (23, 64, 93, 94). For instance, awareness of traditional methods of family planning prevented UIP (67). However, contraceptive types may determine effectiveness; e.g., hormonal contraceptives are characterised by higher failure rates (22, 94). The lack of contraceptive education (66) in socio-economically disadvantaged women (14), child sex preference (24), time constraint, perceived difficulty and embarrassment (27) were found to increase vulnerability to UIPs. These findings may provide some insight into the joint effect of education and life skills training to promote effective and efficient contraceptive use.

Reproductive health behaviours and outcomes:

The reproductive health characteristics of women play a central role in the rates of UIP. For instance, awareness of timing of ovulation may decrease the risk of UIP by 45% (93) whereas lack of motivation to avoid unprotected sex

(62) may increase susceptibility to UIP (95). Early debut for sex (25, 62, 79, 85), non-consensual first intercourse, having multiple sexual partners (25, 62), occasional/non-use of contraceptives (82) were associated with increased rates of UIPs. Not surprisingly, those women who did not use contraceptive consistently experienced higher rates of unwanted or mistimed pregnancies (53, 63, 96, 97) whereas partner's willingness to use contraceptive was less likely to be associated with UIP (22). This finding has some preventive implications such as health education on consistent use and partner involvement in family planning. However, one randomized prospective study revealed no association of UIP with contraceptive utilization (59).

Parity status has consistently been reported to affect both the magnitude and frequency of UIPs. Having higher birth orders (23, 24, 63, 67, 72-75, 78, 88, 90, 93, 98) appeared to increase the risk of unwanted (28, 38, 53, 87) rather than mistimed (4, 28) pregnancy. This may suggest that reproductive history could play a role when coupled with such background characteristics. Moreover, prior exposure for adverse pregnancy outcomes including previous UIP (22, 78, 99), abortion (22, 94), child loss (42) and pregnancy scare were found to be associated with UIPs. However, an unwanted pregnancy may occur regardless of prior history of adverse outcomes (62, 81).

Overall, women from disadvantaged socio-economic backgrounds are highly vulnerable to experience an UIP and its subsequent consequences (100, 144). Relationship patterns, reproductive characteristics, knowledge and use of family planning can play an important role in mediating a shift in reproductive intention (61) from unintended to intended pregnancy and vice-versa.

Part II: Maternal outcomes:

Maternal healthcare services utilization:

Pregnant women are usually encouraged to adopt a set of healthy behaviours to use prenatal and perinatal health-care services. These services have had proven effects for better maternal and child health outcomes. However, pregnancy intention may relate to sub-optimal use of these services. This section focuses on antenatal care, vitamin intake and breastfeeding in regard to UIP.

Antenatal care and skilled birth:

Women's use of antenatal services may prevent UIP, identify and manage pregnancy-related complications, improve maternal wellbeing and reduce maternal mortality (97). However, 19 cross-sectional studies showed late (42, 60, 101), delayed initiation (7, 43, 102-108) and inadequate number of obstetrical visits (21, 83, 104, 109-112) as common characteristics of women with UIP. Nine of these studies aggregated healthcare services utilization by types of pregnancy intention, with unwanted pregnancy associated with delayed (28, 42, 43, 102) and non-skilled birth attendance (12, 110) rather than mistimed or unsure pregnancies (79). Unintended pregnancy was associated with late recognition of being pregnant (42, 60, 79, 103), less prenatal care (42) and inadequate frequency of attendance to prenatal care services (103). Nonetheless, a non-significant association was observed between mistimed and prenatal (83, 103) and late initiation of care (21). One case-control study reported the association of inadequate prenatal care and UIP (81). Similarly, a longitudinal study (105) and a systematic review (104) showed delayed initiation of prenatal health services for women with UIP. Unintended pregnancy was often found to be associated with reduced uptake of antenatal care.

Vitamin intake during pregnancy:

Vitamin supplements during pregnancy may enhance normal foetal development and the wellbeing of women (113). Five cross-sectional and one case-control study documented the influence of pregnancy intention on multi-vitamin use. One of the five cross-sectional studies (114) reported that pre-pregnancy intention was associated with an increased likelihood of multivitamins use. As expected, unintended (43, 81, 83, 115) and mistimed (43) pregnancies were associated with inadequate intake and a less likely reduction in the consumption of intra-partum caffeinated beverages (115). Surprisingly, one cross-sectional study reported less adherence of women who had a wanted pregnancy with a proper vitamin intake (101). A case-control study reported a positive association between UIP and vitamin intake (81). These inconsistent findings may reflect differences in study samples and/or study designs.

Breastfeeding:

Given its proven health benefits, breastfeeding is universally recommended for all lactating women and found to reduce the risks of maternal breast cancer, type-2 diabetes mellitus, postpartum haemorrhage, postpartum depression (116, 117), cardiovascular diseases (116) and pregnancy weight (117).

Consistently, 8 of the 9 cross-sectional studies reported a tendency for mothers with intended pregnancies to exclusively breastfeed and initiate breastfeeding in the postpartum period(118). Unintended pregnancy (46) was associated with late initiation (119), shorter duration (9, 42, 119-121) and reduced breastfeeding (28, 42, 119). In contrast, data from 18 multi-country (9) and 2 cross-sectional studies (28) suggested a non-significant association between pregnancy intention and breastfeeding (43).

Maternal lifestyle

Cigarette smoking:

Smoking before, during and after pregnancy may lead to adverse pregnancy outcomes(122). Nine cross-sectional studies showed mixed outcomes, however. Unintended pregnancy was associated with increased (81, 115) pre-pregnancy and pregnancy smoking (28, 76, 116), and exposure to a secondary smoker (43, 115). Two of these studies (28, 79) reported more exposure of women with UIP to smoking than their intended pregnancy counterparts (28, 79). Interestingly, pre-pregnancy smokers with an intended pregnancy were more likely to quit smoking at intra-partum (21, 101). Nonetheless, a large population-based longitudinal study reported a minimal rate of quitting for women having an unwanted pregnancy (123) and another with a one-year follow-up reported no association between preconception smoking and pregnancy intention (114). Studies on maternal smoking are inconsistent and inconclusive as to whether pre-pregnancy smoking leads to UIP or vice-versa. Further research may be needed to determine the causal direction of the association between smoking and UIP.

Alcohol use:

Alcohol use in pregnancy may be more prevalent amongst women with UIP (72,76). Interestingly, 6 cross-sectional studies suggest consistent findings-pregnancies for which women showed intent were less likely associated with the use of alcohol in pregnancy (21, 101). Preconception binge drinking (72) and intra-partum alcohol consumption (79) were related to UIPs (72,76). However, a one-year longitudinal study showed no difference in pregnancy intention and preconception heavy drinking (114) and a multi-centre randomized trial study reported a negative association (22). This could be explained by differences in study participants' characteristics including homogeneity with similar lifestyles.

Illicit drug use:

Two cross-sectional (76, 124) and a case-control (81) studies reported the associations between UIP and illicit drug use. A longitudinal study suggested a positive link between UIP and drug use particularly in those with disadvantaged backgrounds and prior history of adverse birth outcomes (125). A prospective longitudinal (126) and randomized trial (22) study determined that women with substance use disorders were less likely to experience UIPs. This suggests there are multiple determinants of UIP other than drug use. However, these studies were less likely to have controlled for pre-pregnancy lifestyles including alcohol and drug use disorders leading to UIP, or to test whether drug use was an outcome of UIP. Thus, further multilevel prospective studies controlling for pre-pregnancy lifestyles are needed.

Intimate partner violence:

The quality of inter-partner relationship may influence the use of contraceptives and hence pregnancy intention. Fourteen cross-sectional studies and one randomized trial documented mixed outcomes, however. Unintended pregnancy had an effect on intimate partner violence (84). This may partially reflect inter-partner power disparities affecting negotiation (127) and contraceptive sabotage (13, 28, 128). Reciprocally, intimate partner violence (129-132) including physical violence (14, 89, 131, 133-135) has been consistently associated with UIP (136), although the causal direction of this association is unclear. However, data from one randomized trial (22) showed a negative association of UIP with physical abuse. Longitudinal studies are required to examine the directionality of the association between pregnancy intention and intimate partner violence.

Mental health outcomes:

Poor maternal mental health has been suggested as a factor contributing to UIPs. Eighteen studies have examined maternal mental health as related to UIP-8of which were cross-sectional, 9were longitudinal and one was a randomized trial. Some of these studies used either UIP or mental health variables as predictors, outcomes or controls. All have focused on depression although one longitudinal study examined both anxiety and depression (144). Unintended pregnancy was found to affect maternal mental health in cross-sectional studies. Mothers with UIPs were more likely to become psychiatric in-patients (69) and those experiencing varying degrees of prenatal (137, 138)and postpartum (43)depression (69, 139, 142) had twice the rates of UIPs(140) than their non-depressed counterparts. Despite this, 2 studies reported non-significant associations between pregnancy intention and intra-partum depression (141, 142).

In longitudinal studies, reciprocal effects of depression on UIP were observed (86, 126, 143). Data from a randomized clinical trial also reported increased depression following an UIP (153). However, 4 prospective studies documented statistically non-significant association between pregnancy intention and depression (62, 140, 144, 145).

Stress was suggested to increase the risk (62) of UIP by reducing coping skills (22). However, a finding from a randomized clinical trial revealed a non-significant association between pregnancy intention and stress (22). Mental health problems are suggested as causes or consequences of UIP. Available data has shown inconsistent results on this latter issue.

Physical health outcomes

Unintended pregnancy is suggested to have an association with some medical problems. Six cross-sectional studies have pointed to the associations between UIP and poor physical health outcomes (146) including weight gain (101) and obesity (147, 148). However, non-significant associations were documented for diabetes mellitus (149) and hypertensive disorders of pregnancy (78). Inconsistent evidence from a handful of studies suggests more studies that disentangle the link between UIP and maternal physical health consequences are needed.

Table 2: Summary of characteristics of 64 full-text articles with critical appraisal, quality scores and effect-size odds ratios with 95% confidence intervals (ES-OR (95%CI))

Authors and year	Study country	Study design	Number and characteristics of participants	Exposure (s) and/or measurement	Outcome (s) and/or measurement	Key findings	Possible biases/ limitations	Quality score	OR (95% CI)
Ayoola, et al., 2015 (60)	USA	CS: 5 years panel data	143,303 women of child bearing age from PRAMS dataset	**PI	Early (0-6 weeks) and late pregnancy recognition ≥ 7 weeks).	-UIP takes longer time to be recognized.	-Prone to recall bias; -Could not assign cause-effect relationships.	5	2.30; (2.25-2.35)
Hall, et al., 2015 (86)	USA	2.5-year population-based cohort study (2008-09)	794, 18-20 years, socio-economically diverse adolescent women	- Discrimination (Everyday Discrimination Scale) -Stress (Perceived Stress Scale) -Depression (CES-D) -Reproductive outcomes.	PI	-Social discrimination was high among stressed and depressed women.	-Less external validity across reproductive age groups; -Unable to investigate the effects of changing mental health and discrimination status or account for temporal ordering effects; -Did not include biological indicators to model the interactive biosocial trajectories of health and UIP; -Micro-dynamics of PI were not considered.	5	4.43; (2.70-7.02)
Martinde-las-Heras, et al., 2015 (84)	Spain	CS	779 women (mean age = 29.9 (+/- 5.6) year) at the hospital obstetric departments	Self-report physical IPV measured by a 30-item Index of Spouse Abuse	PI	15.1% UIPs occurred in women with a history of IPV.	-May underestimate number of UIP attributable to mothers' perception based on child outcomes; -Subjected to recall bias; -Did not identify temporal sequence of causation.	5	1.89; (1.16-3.06)

To be continued ...

Beguy, et al., 2014 (80)	Kenya	3-year prospective study	849, 15-22 years young women from Transitions to Adulthood Project	Pregnancy	UIP	41% UIPs (26% mistimed and 15% unwanted) had occurred.	-Not representative across reproductive age groups; -Subjected to recall bias or "ex post-facto rationalization".	5	1.28; (0.81-2.02)
Exavery, et al., 2014 (87)	Tanzania	CS	2199, gravid 15-49 years women	Pregnancy	PI	32.5% and 13.4% pregnancies were <i>mistimed</i> and <i>unwanted</i> , respectively.	-Subjected to recall bias; -Unable to establish causation.	6	-
Gatny, et al., 2014 (26)	USA	2.5-year prospective study	901 young adolescent women aged 18-19 years	Pregnancy scare	PI	40% UIPs occurred following pregnancy scare.	-Non-generalizability (less external validity); -Did not fully capture emotions surrounding pregnancy; -Use of a broad classification, unintended pregnancy, might hide the actual association.	5	5.96; (4.78-7.43)
Sebastian, et al., 2014 (67)	Ghana	CS	1914 pregnant women	Pregnancy	PI	70% of the pregnancies were unintended.	-Subjected to recall bias; -No evidence of causality.	6	4.92; (3.97-6.08)
Palamuleni, et al., 2014 (88)	Malawi	CS	2144, 15-49 years pregnant women	Pregnancy	*Perceived desire of current pregnancy (wanted, mistimed and not wanted)	43% women reported unintended pregnancy.	-Subjected to recall bias; -Could not establish cause-effect relationship.	5	3.17; (2.83-3.55)
Sriprasert, et al., 2014 (27)	Thailand	CS	250, 15-24 years at prenatal clinic	Pregnancy	PI	65.2% pregnancies were <i>unintended</i> .	-Underestimated women seeking abortion for <i>unintended</i> pregnancy (underestimate); -Could not differentiate the extent of an UIP.	4	2.91; (1.62-5.04)
Laurie, et al., 2014 (143)	USA	Longitudinal survey	3,939 aged 18-24 years from National Longitudinal Study of Adolescent Health	CES-D depression-	PI	13.5% pregnancies were <i>unintended</i> .	-Subjected to recall bias; -Could not establish temporality.	6	2.18 (1.74-2.74)

To be continued ...

Tebekaw, et al., 2014 (94)	Ethiopia	*CS	7759 women of reproductive age (15-49 years)	Pregnancy	PI	32% pregnancies were <i>unintended</i> : 11% unwanted and 21% <i>mis-timed</i> .	-Subjected to recall bias; -Could not establish cause-effect relationship.	5	1.54; (1.40-1.71)
Teshome, et al., 2014 (89)	Ethiopia	CS	616 women aged 15-49 years	Pregnancy	PI—unintended, unwanted and mis-timed.	The prevalence of unintended pregnancy was 36.5%.	-Pocket study with less representation; -Could not establish causality; -Subjected to recall and possible residual biases.	4	1.36; (0.97-1.91)
Azevêdo, et al., 2013 (137)	Brazil	CS	1,054 women 18-49 years	IPV	PI	-Association between IPV and UIP diminished by contraception use	-Prone to recall bias and ex post rationalization	5	5.13; (3.92-6.71)
Habte, et al., 2013 (93)	Ethiopia	CS	1267, 15-49 years pregnant women	Pregnancy	*PI (intended and unwanted)	-Unintended pregnancy was 24%.	-Prone for recall bias; -Aon-comparable classification of UIP restricting replication; -Could not identify cause-effect relationship.	4	2.72; (1.86-3.97)
Ikamari, et al., 2013 (69)	Kenya	CS	1272 aged 15-49 from slum and non-slum areas	Pregnancy	PI	-24% women experienced <i>unintended</i> pregnancy.	-Could not establish causal link; -Not generalizable for general community.	5	6.57; (4.93-8.75)
Nelson, et al., 2013 (150)	USA	CS	1494 14-40 years pregnant women presenting to urban emergency department	IPV	PI	-High stress and depressive symptoms were associated with UIP.	-Could not capture some dimensions of PI; -Restrictive definition might underestimate outcome; -Subject to selection and recall bias.	4	1.14; (0.92-1.41)
Dixit, et al., 2012 (24)	India	Matched case-control	4187 women with UWP and 3711 women controls from NFHS	Pregnancy	**PI (wanted and unwanted)	About 22% women reported unintended pregnancy.	-Prone for selection and information bias; -Could not identify cause-effect relationship.	4	1.14; (0.96-1.36)

Pallitto, et al., 2012 (130)	Multi-country study (10 countries)	CS	17,518 ever-partnered women from WHO multi-country study on women's Health and Domestic Violence	Physical violence	PI	History of IPV was associated with <i>unintended</i> pregnancy and abortion	-Underreport IPV and UIP; -Could not establish causality.	5	-
Raihana, et al., 2012 (129)	Bangladesh	CS	4925, 10-49 years ever married women	IPV	*PI	-Exposure to any form of IPV increases the risk of UIP by 34.5%.	-Did not consider the different forms of an UIPs; -Prone to recall bias; -Could not identify cause-effect relationship.	4	1.81; (1.60-2.06)
Adhikari, et al., 2009 (23)	Nepal	CS	713 15-49 years, married pregnant women	Pregnancy	*PI	41% pregnancies were unintended.	-Used non-comparable classification of UIP; -Could not establish causal link.	4	1.89; (1.39-2.56)
Stephenson, et al., 2009 (13)	India	CS	3734 women aged 15-49 years	Physical violence	*PI	-Prospectively measured unwanted pregnancy identified a higher prevalence of unwanted than do retrospective measures.	-Might underestimate domestic violence due to its sensitive nature; -Did not address other forms of domestic violence with high tendency of co-occurrence and significant reproductive consequences.	5	3.79; (3.40-4.23)
Tenkku, et al., 2009 (126)	USA	Prospective cohort study	737 15-44 years pregnant women from Women Infants and Children (WIC) study participants	Psychiatric disorder measured by Diagnostic Interview Schedule, Version IV	**PI	30.9% reported at least one psychiatric disorder of whom 67.3% were with an UIP.	-Prone for recall bias; -Could not establish temporal sequences.	5	2.51; (1.81-3.47)

To be continued ...

Kuroki, et al., 2008 (22)	USA	Multicenter randomized Clinical Trial to encourage use of dual contraceptive method for STIs and UIP prevention.	542 women 13-35 years desiring to avoid pregnancy and experienced STIs within 24 months. Women enrolled for Project PROTECT: from primary care, gynaecology, and family planning Clinics (1999-2003).	History of unplanned pregnancy	Subsequent unplanned pregnancy incident and predictors	22.5% of the enrolled women were exposed for prior <i>unintended</i> pregnancy resulted in subsequent <i>unintended</i> pregnancy.	-Exclusion of non-English-speaking women may limit external validity; -Information on depression or number of previous UIP may be constrained by secondary analysis; -Underpowered to detect associations between reproductive history and UIP due to small sample size; -Did not classify UIP into <i>mistimed</i> and <i>unwanted</i> .	5	4.53; (3.37-6.09)
Ma, et al., 2008 (25)	China	CS	848 sexually active female students from sexual behaviour survey	Pregnancy	PI (Yes/No)	11.6% female university students had UIP.	-Subjected to reporting bias (information on sexual behaviour was excluded for sexually active students who did not respond to the question about a history of pregnancy); -Could not establish cause-effect relationship; -Non-representative to other segment of the population with differing sexual behaviour orientation.	4	1.13; (0.60-2.13)
Chuang, et al., et al., 2011 (114)	USA	CS	35,351 18-44 years non-pregnant women	PI	Preconception behaviours-smoking, drinking and FA; future PI	Women intending pregnancy within 12 months were more likely to use FA, but PI was not associated with preconception smoking or heavy drinking.	-Unable to evaluate how pregnancy intention changed over time and whether preconception behaviours change accordingly; -Social desirability; -Could not establish causal link.	5	1.05; (1.01-1.10)

Orr, et al., 2008 (79)	USA	Prospective (panel) study	913, >18 year pregnant women at 1 st prenatal clinic visit	Cigarette smoking, alcohol and illicit drug use, and 3 rd TM prenatal care initiation	**/**PI	34% and 11% pregnancies <i>unwanted</i> and <i>mistimed</i> , respectively. UIPs were at risk of alcohol, illicit drug use and late initiation of ANC.	-Non-generalizable for early adolescent females; -Prone to recall bias.	5	2.93; (2.19-3.91)
Wanzhen, et al., 2008 (133)	New Zealand	CS	1088 mothers cohabiting in marriage or de-facto partnerships	Physical IPV	PI (yes or no).	58.3% pregnancies were unplanned. Victims of physical IPV more likely report an unplanned pregnancy.	-Misclassification of IPV and pregnancy intention could not be ruled out due to recall bias -Could not ascertain causality; -Findings might not be reliable.	5	1.14; (0.91-1.42)
Mazharul, et al., 2004 (63)	Bangladesh	*CS, DHS	6926 women 10-49 years	Pregnancy	*PI (planned, mistimed and unwanted)	19 and 13% pregnancies were <i>mistimed</i> and <i>unwanted</i> , respectively.	-Prone to recall bias; -Could not establish causal link.	6	1.22 (1.01-1.49)
Crosby, et al., 2003 (73)	USA	CS	170, 14-20 years pregnant unmarried adolescent at their first ANC visit	Pregnancy	PI	51.2% adolescent pregnancies were <i>unplanned</i> and <i>unwanted</i> .	-Reliance on retrospective reports of pregnancy intent and <i>wantedness</i> ; -Non-generalizable.	4	-
Parvin, et al., 2013 (98)	Iran	Case-control	181 married women with unintended pregnancy and 391 married women with planned pregnancy	PI	Predictors of UIP	Among the cases, 55.8 and 30.4% were <i>mistimed</i> and <i>unwanted</i> pregnancies respectively.	-Used non-representative samples; -Prone for selection and information bias (case-control study).	3	4.51; (2.27-8.95)

To be continued ...

Hall, et al., 2013 (62)	USA	Longitudinal (panel) study	940, 18-20 years women with a strong desire to avoid a pregnancy.	CES-D depression symptoms; Perceived Stress Scale (PSS-4)	Contraceptive use and PI change over one year time.	10% not intending pregnancy initially become pregnant. Stress, co-occurring stress and depression symptoms were associated with UIP.	-Non-representation of across reproductive age groups; -Unable to determine prior mental health symptoms; -Unable to assess potential time-varying effects of both predictors and outcomes.	5	1.75; (0.95-3.21)
Singh, et al., 2013 (105)	India	Prospective Survey	2108 women with live births for which pregnancy intention assessed prospectively	PI—wanted, mistimed, unwanted and wanted-timing unsure	WHO recommended prenatal care utilization (WHO, 2006)	Mothers reporting unwanted births received inadequate prenatal care (20.6% mistimed vs. 5.9% unwanted)	-Brief period of follow-up might hinder establishing causality; -Prenatal care visits were prone to recall bias.	7	4.60; (2.82-7.48)
Hohmann-Marriott, et al., 2009 (112)	USA	CS	5,788 father and mother from Early Childhood Longitudinal Study—Birth Cohort (ECLS-B) interviewed when children were 9 months	PI	Mother's self-report of receiving prenatal care in the 1 st TM.	Pregnancy intention by father only, neither and non-marital conception was associated with delayed prenatal care.	-Liable to recall and selection bias.	5	-
Marston, et al., 2003 (109)	Bolivia, Egypt, Kenya, Peru, and the Philippines	CS	45,121 women of reproductive age participating in major DHS.	*PI	Predictors of UIP	-ANC reception was low and unattended pregnancy was greater for unwanted pregnancy; -There was inter-country difference.	-Difficulty of disentangling effects of birth order from those of pregnancy intention; --Subjected to recall bias; -Could not identify cause-effect relationship.	5	-

To be continued ...

Eggleston, 2000 (103)	Ecuador	CS	3988, 15-49 years women	*PI	Use of prenatal care	Women with unintended pregnancy delayed initiation of prenatal care in 1 st TM and reception of inadequate number of prenatal care.	-Liable to recall bias; -Could not identify cause-effect relationship.	6	Delayed ANC (1.22; (1.05-1.42)); inadequate care (1.25; (1.06-1.49))
Magadi, et al., 2000 (110)	Kenya	CS	5104 live births for whom mothers received prenatal care in 1993	*PI	Frequency and timing of antenatal visits	Use of prenatal care is infrequent for <i>unwanted</i> and <i>mistimed</i> pregnancies	-Prone for recall bias; -Could not identify causal link.	5	
Altfeld, et al., 1997 (21)	USA	CS	378 postpartum women from Beautiful Babies project in 1990	PI: wanted and other	Prenatal visit in 1 st TM, self-reported cigarette smoking (Yes/No) and alcohol use (Yes/No)	-Women who wanted their pregnancies were less likely to have smoked cigarettes or drink alcohol during pregnancy, but were not more likely to have initiated prenatal care in the 1 st TM.	-Prone for recall and residual bias; -Could not establish causal link;	5	
Delgado Rodríguez, et al., 1997 (7)	Spain	CS	409 women delivering in hospital setting	Pregnancy planning (planned vs. unplanned).	Frequency and timing of prenatal care (Kessner index)	-Unplanned pregnancy was a risk factor for inadequate use of prenatal care and a delayed first prenatal care visit (and reduced number of visits.	-Liable to selection bias; -Subjected to detection bias (planned pregnancies might be detected earlier than unplanned); -Could not establish causality.	6	Inadequate ANC (2.34; (1.26-4.33)); delayed ANC (1.80; (1.18-2.74))

To be continued ...

Sable, et al., 1990(111)	USA	CC	1484 low-income women	PI	Inadequate prenatal care	Not knowing pregnancy status in the first 4 months of pregnancy predicted inadequate prenatal care (10%) in women.	-Recall bias with possible misclassification of the outcomes; -Could not establish causality.	4	3.58; (2.33-5.51)
Singh, et al., 2012 (12)	India	CS	51, 855 women aged 15-49 years	*PI	Skilled birth attendant	Mistimed pregnancies were delivered without a skilled attendant at birth.	-Subjected to recall bias or ex post revision; -Could not establish causal relationship between pregnancy intention and the covariates.	5	1.13; (1.10-1.17)
Joyce, et al., 2000 (16)	USA	Prospective	240 women	***Pregnancy intention and stability	Prenatal care initiation, cigarette smoking during pregnancy and breastfeeding	-Effects of UIP on the timing of initiation of prenatal care, smoking during pregnancy and breastfeeding after delivery were less than during pregnancy.	-Had limited power to test the differences in terms of timing; -Less external validity.	5	-
Hellerstedt, et al., 1998 (115)	USA	CS	7174 pregnant women	PI-intended, mistimed and unwanted.	Self-reported health behaviours, intake of vitamins and caffeinated drinks	-women with UIPs were at risk of smoking and less likely use of vitamins and decrease in use of caffeinated beverages.	-Could not establish causality; -Subjected to ex post rationalization.	4	
Cheng, et al., 2000 (43)	USA	**CS	9048 women with live born infants	**PI	Use of multi-vitamin, 3 rd TM and postpartum smoking, alcohol use at 3 rd TM, time of initiation and duration of BF, and PP contraceptive use.	-Women with UIPs smoke prenatally and postpartum, suffer from PPD and less likely consume preconception FA, initiate ANC in 1 st TM and BF for 8 weeks. Inadequate FA consumption, delayed prenatal care and PPD higher for an <i>unwanted</i> than mistimed.	-Not assessed whether mother/father was pleased with the pregnancy nor did ambivalent feelings about the pregnancy; -Subjected to recall (retrospective report) and social desirability (sensitive behaviours) biases; -Could not establish cause-effect relationship.	5	5.29; (4.23 - 6.61)

To be continued ...

Chine- buah, 2001 (120)	Ghana	CS	1101 primipa- rous women	*PI	Prolonged BF considered as breastfed 13-36 months.	-Women with planned preg- nancy had greater me- dian duration of breastfeed- ing; no differ- ence in breast- feeding dura- tion among multiparous women.	-Did not represent multiparous women; -Liable to recall bias; -Could not establish causal link.	5	-
Dye, et al., 1997 (152)	USA	Case- control	33,735 PP women	**PI (wanted , mis- timed and un- wanted)	Breastfeeding: exclusive, planned both breast and bottle feeding, or planned on breastfeeding of any kind.	Women with UIP less likely breast- feed (for any BF and 66.3% EBF).	-Actual breastfeeding behav- iour might vary after discharge from the hospital; -Could not establish causality.	5	
Hromi- Fiedler, et al., 2006 (9)	Multi- coun- try (18 coun- tries) study	CS	41,353 women between 13 and 36 months PP	*PI (planne d, mis- timed or un- wanted	Breastfeeding for 13-36 months of child age	-Significant association existed be- tween UIP and less likeli- hood of pro- longed breast- feeding.	-Subjected to recall bias; -Could not establish causal link.	5	1.08; (0.98- 1.20)
Dott, et al., 2009 (81)	USA	Case- control	4094 women	PI	Maternal be- haviours (exposure to smoke at home, smok- ing, occupa- tional expo- sure, hot tub/ sauna, illicit drugs, >300mg caf- feine/day, inadequate prenatal care and no folic acid or multi- vitamin 1 month before conception)	-Maternal smoking, exposure to smoking at home, illicit drugs, inade- quate prena- tal care and no FA be- fore 1 month before con- ception in ambivalent, mistimed and UIP are common in respective orders.	-Missed some variables per- taining to <i>unintendedness</i> as data were collected for an- other purpose; -Possibility of misclassifica- tion of the exposure due to longer time between expo- sure and interview; -Social desirability bias; -Residual confounding might exist due to multiple variables included in the analyses.	4	Smoking (1.57; (1.34- 1.84)); illicit drug (2.91; (1.99- 4.27)); ANC (11.93; (4.06- 34.99)); FA (1.45; (1.27- 1.64)).

To be continued ...

Chisolm, et al., 2014 (123)	USA	CS	49,510 females	**PI	Perinatal cigarette smoking	Women with unwanted pregnancy less likely to quit smoking.	-Merging of mistimed and intended pregnancy might hide outcomes in light of specific categories; -Subjected to recall bias;	5	1.06; (1.02-1.11)
Blake, et al., 2007 (124)	Columbia	CS	1044 black women enrolled at prenatal clinic 2001-03.	**/**PI	Psychosocial and behavioural risk factors: cigarette smoking, depression (Hopkins Symptom Checklist-Depression Scale), IPV (CTS), smoking or exposure to environmental smoke (SFQ) and alcohol or illicit drug use.	Women with UIP had higher odds of smoking (15 and 28%), alcohol use (23 and 23%), illicit drugs (12 and 14%), depression (47 and 46%) and IPV (32 and 35%).	-Subjected to recall bias and ex post rationalization; -Might not indicate causality.	5	Smoking (1.23; (0.78-1.94)); illicit drugs (1.28; (0.75-2.20)); depression (1.12; (0.87-1.43)); IPV (1.13; (0.86-1.50)).
Timothy, 2003 (71)	USA	Case-control	72,907 women	**PI-unintended vs. intended	Peri-pregnancy binge drinking	- Preconception binge drinking was associated with UIP.	-Liable for recall bias;	5	1.03; (0.97-1.08)
Goodwin, et al., 2000 (135)	USA	CS	34,835 women	**PI	Physical abuse during 12 months before pregnancy	Women who had <i>mistimed</i> or <i>unwanted</i> pregnancies reported significantly higher levels of physical abuse (8.8%).	-Prone to recall bias; -Could not establish causal association.	6	3.57; (3.25-3.93)
Gazmararian, et al., 1994 (142)	USA	CS	12,612 mothers (3-6 months postpartum)	**PI	Physical violence	-Women with unwanted or mistimed pregnancies had high odds of experiencing physical violence.	-Liable to recall bias; - No evidence of causality.	5	

To be continued ...

Lau, et al., 2007 (141)	China	CS	2178 pregnant women visiting 5 hospitals	PI	Antenatal depression—Edinburgh Postnatal Depression Scale	25.9% pregnancies were unintended, of which 40.7% mothers had severe depression.	-Liable to recall bias; -Could not establish temporal relationship.	6	1.12 (0.92-1.36)
Fellenzer, et al., 2014 (137)	USA	CS	18,059 women	**PI	Self-reported prenatal depression symptoms	- <i>Mistimed</i> pregnancy is a risk for moderate to severe prenatal depression. Moderate to severe prenatal depression was associated with UIP.	-Recall bias for prenatal depression during and after delivery/ birth outcomes may matter; -Prone to social desirability bias; -Inability to distinguish chronic depressive symptoms and those originating in the prenatal period; -Measurement of predictive factors and prenatal depression symptoms may have precluded assessment of the temporal sequence.	5	-
Mercier, et al., 2013 (145)	USA	Multi-phase prospective cohort study	688 women at 3 months and 550 women at 12 months evaluated for postpartum depression.	**PI	Postpartum depression at 3 and 12 months—Edinburgh Postpartum Depression Scale	-No statistically significant association was found between pregnancy intention and postpartum depression.	-Lacked control of pre-pregnancy depression; -Subjected to recall and social desirability bias.	5	2.11; (0.76-5.89)
McCrary, et al., 2013 (139)	Ireland	CS	10,567 mothers of children at 9 months	PI (intended vs. unintended).	PP depression—CES-D	-Risk of maternal depression was high among women with UIP.	-Short time (9 months) horizon to look at the effects; -Ex post rationalization; -Subjected to selection bias.	5	2.22; (1.94-2.53)
Yanikerem, et al., 2013 (142)	Turkey	CS	550 pregnant women attending prenatal care	PI	Beck Depression Inventory	27.1% were unplanned pregnancies.	-Could not establish temporality.	5	1.18 (0.76-1.84)
Christensen, et al., 2011 (152)	USA	RCT-secondary analyses from Mood and Health Project	215 low-income women	PI-intended, mistimed, and unwanted.	Depressive symptoms by Beck Depression Inventory-II (BDI-II)	-UIP was associated with a marginally significant nearly fourfold increase in risk of the “Postpartum High” pattern in depressive symptoms.	-External validity may be affected due to inclusion of specific group of women with relatively small sample size.	5	9.37; (4.60-19.10)

To be continued ...

Grussu, et al., (2005) (6)	Italy	Prospective	119 primiparous women	Unplanned pregnancy	Profile of Mood States (POMS) and Parental Attitude Research Instrument (PARI).	-UIP moderately affects mood disturbances.	-Could not rule out pre-existing mood disorders and maternal attitudes; -Brief period of follow-up may limit the strength of causation.	4	1.57; (1.11-2.23)
Lynne, et al., 2005 (140)	USA	Prospective	1908 women aged >16 year at 24-29 weeks of GA to delivery	PI	Maternal mental health: 20-item CES-D.	Not intending pregnancy was associated with stress and depression.	-Prone to selection bias; -May not be representative.	5	1.31; (0.93-1.83)
Iranfar, et al., 2005 (138)	Iran	Prospective	163 pregnant women (58 with unintended pregnancy and 105 intended)	PI	PPD measured using Beck Depression Inventory	-The relative risk of depression was high in UIP at 37 weeks of GA and 10 days postpartum.	-Brief period of follow-up and small sample size might affect validity and reliability.	4	2.75; (1.45-5.20)
Najman, et al., 1991 (144)	Australia	Prospective pre-birth cohort	277 postpartum women	Pregnancy planning (wanted and unwanted)	Delusion-States-Symptoms Inventory (DSSI) anxiety and depression scale	-Women with unwanted children had slightly higher rates of anxiety and depression.	-Could not rule out prior mental health problems; -Used very restrictive definition which might underestimate the true magnitude of <i>unintended</i> pregnancy.	5	Anxiety (1.04; (0.43-2.49)); depression (1.07; (0.22-5.14))
Inas Mohamed Abdallah, et al., 2011 (78)	Egypt	Prospective	253 pregnant women recruited during 3rd. TM	PI	GDM, HDP and hospitalization	-UIPs were reported and found to increase the risk of GDM, HDP and hospitalization during pregnancy.	-Reliability and validity were limited by small sample size and non-standardised measurement tools; -Could not establish causation due to a brief period of follow-up.	3	2.51; (0.44-14.22)
Garbers, et al., 2013 (96)	USA	CS	4161 15-44 years women with recent live birth	PI	BMI as indexed by National Heart, Lung, and Blood Institute	-Women with unwanted pregnancies had nearly three times higher odds of class-III obesity.	-Prone to recall bias; -Could not establish temporal sequence.	6	5.01; (4.37-5.97)

ANC—antenatal care; BMI—body mass index; CES-D—Centre for Epidemiological Studies Depression Scale; CI—confidence interval; CTS—Conflict Tactics Scale; CS—cross-sectional; DHS—Demographic and Health Survey; FA—folic acid; FP—family planning; GA—gestation age; GDM—gestational diabetes mellitus; ICU—intensive care unit; IPV—intimate partner violence; HDP—hypertensive disorders of pregnancy; NSFG—National Survey of Family Growth; OR—effect size odds ratio; PPD—postpartum depression; PI—pregnancy intention; PRAMS—Pregnancy Risk Assessment Monitoring System; RH—reproductive health; SES—socio-economic status; SFFQ—Smoke Free Families Questionnaire; STI—sexually transmitted; TM—trimester; UIP—unintended pregnancy.

*DHS and equivalent studies.

**PRAMS studies.

***NSFG studies.

DISCUSSION

The aim of this review was to document the antecedents and maternal health outcomes of UIP carried to term (live birth child), as well as to identify gaps in available evidence. This review presents a comprehensive and contemporary evidence of antecedents and adverse maternal health outcomes of an UIP by extracting data from a variety of settings for over three decades. Though slight variations exist in methods of classification and operationalization of pregnancy intention, most studies share common survey questionnaires; namely, DHS, NSFG and PRAMS.

Unintended pregnancy has received a high level of scrutiny in recent decades (14). Despite our burgeoning knowledge on socio-demographic and reproductive characteristics as antecedents of UIP, studies have poorly addressed the causal pathways and temporal sequences of UIP and subsequent health outcomes (11, 13, 153). An ecological model may best depict the overall factors that influence UIP from micro-to-macro perspectives (90) and provide some insights for biological, social and policy level determinants. The best available evidence has been from two broad cross-sectional studies in the US-NSFG and PRAMS. The PRAMS explores maternal characteristics using mixed-mode data collection techniques before, during and after pregnancy (154). The DHS remains the main source of data in developing countries. All three surveys use retrospective assessment of UIP. Most studies so far were cross-sectional and could not establish temporal sequence of causation. Although a handful of prospective studies exist, findings were limited by the inability to disentangle pre-existing health problems (62, 144), restrictive definition (144), less reliability and validity (16, 26, 62, 86) from limited sample size (78, 138) and brief period of follow-ups (6, 78, 79, 105, 138, 140) making it difficult to disentangle the antecedents of UIPs from potential outcomes (4). Most of these studies were also limited by narrow scopes covering only one or some aspects of predictors and health consequences. Methodologies used to examine UIP and subsequent adverse consequences have frequently been criticised for inconsistencies in measurement, recall, selection and social desirability bias (3, 37, 46, 60, 61, 139). Despite these limitations, findings from a number of robust studies provide some clues about maternal health outcomes of UIP.

Generally, little is known about long-term maternal health outcomes of UIP. Women may not be prepared psychologically to cope with stresses associated with UIP. Adverse maternal health effects (42) may be coupled with pre-existing socio-demographic, economic and lifestyle contexts. Stress induced by unexpected pregnancy may compound with underlying problems. The dilemma of whether to continue or terminate, or future parenting issues may trigger disturbances in normal functioning. Mothers with prior poor health may have UIP, as well as engage in unhealthy behaviours which may all contribute to increased rates of adverse outcomes. Moreover, family violence (129-132) may further contribute to both adverse outcomes (127) and decision about the use of contraceptive methods. These may be coupled with pre-existing and/or co-occurring factors that would hinder adherence to proper recommendations. This process may turn into a cycle and continue throughout pregnancy and postpartum, with detrimental behaviours that perhaps affect health long-term with cumulative effect. Ascertaining directions of causality requires repeated measurements of both pregnancy intention and maternal health outcomes. Prospective longitudinal studies that measure intention close to pregnancy commencement and examine and measure outcomes by sub-population characteristics could reduce recall bias and may determine causal direction to future adverse mental and physical health outcomes.

The systematic review has a number of strengths. We included robust published studies over the last three decades. This reduces the chance of exclusion of relevant literature. It has also included all women within the reproductive age and available data both from developed and developing countries. Standard guidelines were used for quality scoring and inclusion of reporting items. This is a comprehensive quantitative review which addresses many as-

pects of UIP with regard to antecedents and maternal health outcomes. Weaknesses of the review include that the majority of the results were from cross-sectional data with greater chance of bias, ex post rationalization and lack of research strength. The great majority of this literature was from the USA. Thus, findings may not be representative of all countries. Selection bias is a concern since this synthesis has been restricted to the available literature published in English. Moreover, studies in this field have been challenged by unreliable definitions and measurements of both UIP (3, 18, 20, 28, 29, 37, 38, 45, 46, 61, 111) and related health outcomes. Exclusion of UIPs ending with elective abortion may underestimate the magnitude and outcomes of UIP. Finally, the underlying risk factors for UIP may not be similar across women of different reproductive age groups or for those who exhibit various lifestyles, limiting the generalizability of this synthesis.

Implications for practice and/or policy:

An UIP may carry severe consequences (14) and have economic (108, 155, 156), political (70) and societal (108, 157) implications. For instance, a decrease in the rates of UIP may reduce the crime rate, welfare reception (160) and healthcare costs (157). The findings may help tailor evidence-based interventions to prevent the public health, social and economic consequences of UIP. Unintended pregnancies and subsequent maternal health outcomes are important issues for public health practitioners, clinicians, researchers and policy makers. Comprehensive and ongoing knowledge would provide an important avenue for health screening, counselling and referral linkage, particularly for women in the reproductive age group. This would enable for evidence-based interventions such as scaling up family planning services, and the designing and implementation of health promotion programs.

Conclusions: Antecedents of an UIP may span socio-demographic and reproductive characteristics of women, as well as family dynamics. Findings of adverse outcomes of UIPs were mixed, but are generally suggestive of negative outcomes. We strongly recommend prospective multi-wave longitudinal studies with appropriate comparison groups (e.g., women who accessed or were denied abortion services) to explore the long-term adverse maternal health trajectories.

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