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Does depression experienced by mothers leads to a decline in marital quality: a 21-year longitudinal study

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Abstract

Purpose Marital conflict and/or marital breakdown are known pathways to the onset of depression. Few studies however have examined the possibility that depression can lead to a decrease in marital quality and an increase in marital breakdown. Depression may be an important pathway to a decline in martial quality.

Methods A birth cohort study with women (mothers) recruited early in pregnancy and followed for 21 years. Using repeated measures analysis for four waves of data collection we use GEE to examine the extent to which symptoms of depression predict subsequent poor martial quality in women and poor marital quality predicts subsequent depression.

Results A bidirectional association between poor marital quality and depression is observed. After removing those who had pre-existing poor marital quality we note that depression predicts subsequent poor martial quality. Similarly, we note that poor marital quality predicts subsequent depression. These associations are all statistically significant and of a similar magnitude.

Conclusion Over the maternal reproductive life course there is a long-term trajectory of reduced marital quality and increased depression. Maternal depression is as likely to lead to a decline in marital quality as poor martial quality is likely to lead to increased levels of depression. There may be a need to develop intervention programmes to reduce this long-term pattern of change.

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Introduction

Marital quality has consistently been associated with a number of indicators of mental health, including depression [1]. There is now considerable support for the finding that a decline in marital quality is associated with increased depression [1–4].

Despite this substantial literature there remain doubts about whether poor marital quality leads to, as suggested, depression and importantly the magnitude of this "causal" association. Three study types have provided estimates of the strength of the association between marital quality and depression. Most commonly there are estimates based upon cross-sectional survey data. For these types of estimates there are generally moderate to strong associations based on the assumption that poor marital quality precedes the onset of depression [1, 5]. A second type of estimate is derived from a limited number of prospective studies almost invariably testing the possibility that poor marital quality at one point in time predicts subsequent onset of depression. These studies suggest a moderate (but statistically significant) association between the decline in marital quality and the onset of depression. Almost all of these latter studies are limited to a consideration of two time points [5, 6]. This evidence would be more convincing if it involved multiple waves of data collection. A third type of study addresses the possibility that depression may predict the onset of poor marital quality. There are few studies which explicitly test this possibility using prospectively collected data. Based upon evidence and analyses suggesting that depression has an impact on (disrupts)

interpersonal interactions and relationships it is suggested that depression is often associated with a significant level of functional impairment; for example at work [7] and in recreation, personal and social life [8]. From this perspective depression may lead to changes in a number of life domains with a decline in martial quality as one of the outcomes.

Changes in marital quality following the birth of a child

There is now consistent evidence that the quality of a marital relationship declines following the birth of a child [9–13]. This decline is not simply a function of the duration of marriage. Studies which examine marital quality and match by duration of marriage suggest the decline in marital quality is greater for those couples that have children [12, 14]. Put simply, parenthood appears to lead to a decline in marital quality [11]. This decline is progressive over the life course and does not seem to be related to the life course stage through which the family (child) is progressing [15]. Marital quality appears to improve once the children leave the parental home [10]. While explanations of these changes in marital quality are somewhat speculative, it is likely that children place a stress on the marital relationship because of the time, financial and other resource constraints they impose on the marital relationship. Arguably children could be considered a continuing source of stress on the martial relationship, with this stress only somewhat mitigated by the extent to which the couple involved planned and wanted the child [11].

Poor marital quality predicting increased depression

A good deal has been written about the association between marital quality (primarily marital conflict and marital breakdown) and depression. Despite this extensive literature the causal direction of this association remains uncertain. The majority of available studies are based on the assumption that marital problems predict the onset of the depression [5, 6, 16–22]. Even when the analyses are limited to panel studies with pre-existing depression taken into consideration, the onset of marital problems has been found to predict subsequent depression, whether measured using self-report scales [6, 17, 23–26] or clinical criteria [19–21]. In studies which examine whether this association might be attributed to a range of confounders (e.g. poverty, young maternal age), the finding of an association between marital problems and subsequent depression tends to be confirmed. However, little is known about the extent to which the association between marital quality and depression might vary by the stage of the life course at which

poor marital quality is experienced. The presence of children, for example, may modify the association between marital quality and depression.

Depression predicting decreased marital quality

The evidence suggesting that depression may lead to a decline in marital quality rests on two types of evidence. The first is the finding that the age of onset of the most common mental disorders precedes the age at which most couples marry. The second is that depression has been found to lead to a wide range of interpersonal and social problems and to the consequent generation of life stresses.

Most of the more common mental disorders like anxiety and depression begin in adolescence or early adulthood. In the National Co-morbidity Study Replication, Kessler and colleagues [31] found that most of the high-prevalence disorders, specifically anxiety disorders such as phobias and separation anxiety disorder, first occur with median age of onset in the range of 7–14 years [27–31] or in the adolescent period [28, 29, 32, 33]. In population samples the age of onset (AOO) for unipolar major depression has been found to peak at 15–19 years for females and 25–29 for males. Kessler and colleagues [34] found that the highest relative hazard of first onset was found in the age range of 10–14 years with the National Co-morbidity Survey Replication-Adolescent Supplement (NCS-A) reporting the median AOO for mood disorders as 13 years. According to Kessler et al. [33] the AOO for mood disorder distributions have a consistently low prevalence until the early teenage years with a linear increase through to late middle age followed by a decline. As a general rule the age of first onset for most of those persons who experience a common mental disorder is some years before the age at which they first marry. The current median age of marriage in Australia is 31.4 and 29.2 years, respectively, for males and females [35]. Arguably, for many, a pre-existing mental health problem precedes marriage and is likely to influence the selection criteria in a desired partner. There is evidence to support this suggestion that marital partner selection may involve concordance for mental illness [36].

Further support for a causal sequence involving depression preceding the onset of poor marital quality comes from both theoretical considerations and some limited research findings. Social learning theory would suggest that, in general terms, limiting the causal sequence to a single direction is unlikely to reflect the reality of the association between marital quality and depression. Bandura's [37] aphorism that "Personal and environmental factors do not function as independent determinants; rather they determine each other" argues for the interaction of structural/institutional factors and those that are individual

and interpersonal. From a social learning perspective the association between marital quality and depression is likely to include interactions which are bidirectional, with depression having an impact on marital interactions and vice versa. Depressed persons have been found to have interactions which have a negative impact on their friends, partners and children. People who are depressed typically have a lack of interest in social life, exhibit fatigue and passivity and manifest a range of other symptoms including sadness and feelings of hopelessness that often attract negative responses from those with whom they interact [39]. Depressed people may make those with whom they interact feel guilty [38] and hostile [39, 40]. For those in their social world, interacting with a depressed person can be perceived as a burden which may lead to avoidance behaviour. The family members interacting with and/or caring for a partner who is severely depressed often become depressed themselves [39].

Taking this argument further it has also been suggested that depression could be thought of as involving a depressogenic environment, [41] that is living in a context where a wide range of interactions and circumstance are affected by the depression, regardless of whether the depression is manifest at that point in time [39–41]. Once there have been repeated episodes of depression, there are likely to be consequences for social interactions and family life that persist even when the person who was depressed is not currently depressed.

Hammen [8, 42, 43] has found that the experience of depression may have a wide range of lifestyle consequences. In the stress generation hypothesis Hammen emphasises the likely impact of depression on a wide range of social interactions in which the depressed person is involved. These impacts are likely to be experienced by those with whom the depressed person has the most intensive level of interaction, that is their partner and children. Such interactions are found to generate additional stresses for the person who is depressed. Thus depressed persons engage in more conflict, have more marital and relationship problems, are likely to elicit rejection from those around them and exhibit a range of impaired social skills and problem solving behaviours [44]. Depressed persons are believed to create their own stresses partly as a consequence of their negative interpretations of their world and depressed persons are disproportionately likely to be involved in dysfunctional interpersonal relationships [43, 45]. For example, young, depressed females (aged 15) were more likely to have a child by 20 years, with this early parenthood interpreted as leading to a range of additional stresses for the young girl with a history of depression. We have previously noted that depression can lead to the onset of marital problems [46] and that this association is not a consequence of confounding. Hammen and her colleagues

[8] are suggesting the existence of an ongoing cycle of depression and life problems, including marital conflict and child rearing concerns, with depression playing an important role in initiating this cycle.

Methodological considerations

Describing the association between marital quality and depression in terms of discrete onsets and consequent outcomes may not reflect reality. Certainly, formal marriage is a discrete event with a specific date of onset; however, informal marriage (cohabiting) is increasingly common and includes many of the elements of a formal marriage. Further, poor marital quality is unlikely to have a discrete beginning and end point. The evidence suggests that the quality of a marital relationship changes over time [47]. Declines in marital quality may be gradual over months and possibly years. While the duration of exposure to poor marital quality is likely to predict depression, it is not clear whether a time lag of weeks, months or years best captures the nature of this association. There is little known about the duration of the experience of poor marital quality and only a little more is known about the duration of an episode of depression. From a research perspective, addressing cause–effect sequences which have no discrete beginning or end raises some practical problems.

Marital quality appears to decline gradually over the period following marriage, partly as a consequence of the birth of children (though interestingly the presence of children increases marital stability) [48] and partly as a consequence of such factors as poverty, age and the prevailing cultural norms [49]. The data also point to a U-shaped curve with marital quality improving in the longer term [47]. There is limited specific detail about the length of time poor marital quality is likely to persist and the specific duration between the initiation of a marital relationship and the time a decline in the marital quality begins.

More is known about the episodic nature of depression. There is considerable variability in the duration of a depressive episode with evidence suggesting a skewed distribution, with perhaps 10–15 % of depressed persons experiencing a depression which lasts only a few weeks and another 15 % who have depression which lasts a year or longer [50]. Further, "recovery" from depression may not involve a complete remission. Rather there is often a continuation of depressive symptoms but at a sub-clinical level [51]. Depression may be characterised as a chronic and recurrent condition with multiple episodes recurring over the adult life course [52]. Microsimulations, based upon population estimates, suggest a mean number of lifetime episodes of depression (for those ever depressed)

of 7–8 episodes over the life course [53]. To the best of our knowledge there have been no previous discussions of the association between cycles of depression and poor martial quality over the life course.

To determine the direction of the cause–effect sequence involving poor marital quality and depression, there is a need to remove from the causal group those who score positive for the outcome (respectively, either pre-existing depression or poor marital quality) at the time point the data are first collected (for example exclude all already depressed persons from the marital quality variable to determine whether poor marital quality predicts subsequent depression).

This paper aims to test and compare alternative causal sequences to assess the association between marital quality and depression. It uses four waves of data from a large-scale population survey collected prospectively over a 21-year period. At each wave data were obtained using the same measures of marital quality and depression. We compare cross-sectional analyses with prospective analyses controlling for a number of potential confounders.

The Mater-University of Queensland Study of Pregnancy (MUSP) and its outcomes is the data set used in this study.

Research questions:

a. Does the onset of depression independently predict a decline in marital quality and does the onset of poor marital quality independently predict subsequent depression?
b. To what extent do psychological and social factors account for the association between depression and marital quality?

Materials and methods

Study population

The data are derived from a longitudinal study, the Mater-University of Queensland Study of Pregnancy (MUSP). Some 8,556 pregnant women were recruited at their first obstetric clinic visit, at approximately 18 weeks' gestation. Their children were born between 1981 and 1984 at one of the two major public obstetric hospitals in Brisbane [54]. Some 8,548 subjects (of 8,556 women) agreed to participate in the study. The MUSP cohort comprises 7,223 (84 %) women who gave birth to a live singleton baby at the study hospital. These mothers and their offspring were interviewed at multiple time points–at first clinic visit (FCV), 3–5 days post-delivery, 6-months after birth (6-months FU), when the child was 5 years (5-year FU), 14 years (14-year FU) and 21 years (21-year FU) of age.

Full details of the MUSP study are described elsewhere (54). Loss to follow-up reduced the baseline sample of 7,223 women to approximately 4,000 women at the 21-year FU.

To assess the pattern of association between depression and dyadic adjustment over time we restricted the analysis to 2,971 women who had attended the first clinic visit (FCV) and all subsequent interviews at 5-, 14- and 21-year follow-ups.

Measures

Dyadic adjustment

At each phase of this study, dyadic adjustment for either married or cohabiting couples is assessed using eight items from the Spanier Dyadic Adjustment Scale (DAS) [55]. The commonly used DAS scale comprises four interrelated subscales. According to Spanier independent use of the subscales will not greatly alter the reliability and validity of this measure. In 1992, studies of the dimensionality of dyadic adjustment [56, 57] corroborated that satisfaction scale was a psychometrically solid subscale and can be used alone with little loss of information. The DAS has proven to be popular and has purportedly been used in more than 1,000 studies [58].

The eight items, each with five response options (all the time, most of the time, some of the time, rarely, or never), ranges from 1 to 5 assessing the extent to which a partner derives satisfaction from the relationship. The total score varies from 10 to 50. Summed average means of each item are calculated and multiplied by 10. A lower score reflects a poorer relationship. On the basis of this score, dyadic adjustment is categorised into three groups: poor adjustment, good adjustment and no partner. A total score ranging from 10 to 37.5 is defined as poor adjustment (in the bottom standard deviation, approximately of scores) and a score above 37.5 is classified as good adjustment. Selecting the bottom standard deviation of dyadic adjustment scores is somewhat arbitrary but reanalyses with other cut-offs produced essentially similar results. Women with no partner are identified as a third category. The Cronbach's alpha for the DAS ranges from 0.82 to 0.86, depending upon the stage of the life course when the DAS was administered.

Depression

Maternal depression is measured using the seven-item depression subscale from the delusions-symptoms-states inventory: state of anxiety and depression (DSSI/SAD). These seven items do not produce an equivalent to a clinical diagnosis of depression but identify symptoms of

psychopathology that limit a person's capacity to function and to maintain relationships. The internal reliability and validity of this scale is very high [59, 60]. Comparisons of the DSSI/SAD with the Edinburgh Postnatal Depression Scale (EPDS) and the Hospital Anxiety and Depression Scale (HADS) show that these measures share some common items and that these three measures correlate well with each other [61]. Correlation with Beck depression inventory (BDI) and DSSI/SAD (depression) is 0.76 when both of these instruments applied in a MUSP sub-sample of 774 women.

Each of the seven DSSI/depression items has 5-point response options (never, rarely, some of the time, most of the time, or all the time) scored from 1 to 5 which provides a total score range of 7–35. The higher the score, the more symptoms of depression the respondent experiences. The Cronbach's alpha for the scale ranged from 0.79 to 0.88. Women with a total score >1 pooled standard deviation (1SD) above the mean are considered to be depressed. The overall pooled standard deviation of depression is measured combining standard deviation of reported depression at each phase of the study.

The cut-offs used for our study produced levels of depression that are somewhat higher than those that would be obtained using clinical criteria. Assessments of other DSSI cut-offs produced similar results with the advantage that a larger cut-off produced more stable estimates.

Confounders

There are some potential confounding variables included in the multivariate analyses. Maternal education was recorded (self reported) at the first clinical (recruitment) visit. Mothers were asked at what level they completed their education, with levels (school to university) scored from low to high. Mothers were also asked whether they (or their partner) belonged to one of the following groups; Australian Aborigine, Maori Islander, Asian, White or other. These were recoded to Aboriginal/Islander, Asian or White. Maternal age was recorded (as date of birth) in the respondents' obstetrical history taken at the first clinic visit. Age is scored to the nearest year at the first obstetrical visit. Parity is recorded from the mother's medical history taken at the first clinic visit.

Statistical analysis

For the cohort in this study we have identical measurements of depression and dyadic adjustment at multiple points in time. The same measures administered over the life course are correlated. To take into account this correlation generalised estimating equations (GEE) have been used [62, 63]. More commonly used statistical methods

assume that measurements are independent of each other. GEE takes into consideration the fact that there are correlated repeated measures (of marital quality and depression). Multivariable generalised estimating equations with modified Poisson regressions estimate the adjusted relative risks (RR) and 95 % confidence interval (CI) for the prediction models both for dyadic adjustment and depression. When depression is the outcome, dyadic adjustment is the exposure, and when dyadic adjustment is outcome, depression is the exposure. In modified Poisson regression robust variance estimation is used to avoid overestimating standard errors of parameter estimates [63].

Prediction models both for dyadic adjustment and depression are controlled for other variables-woman's education, age, race and parity. All these socio-demographic confounders are measured at FCV and are included in the models to adjust the parameter estimates. Age at the first clinic visit is included as a dichotomous variable—below 30 years and above 30 years. Parity is categorised into three groups—no child, 1–2, and 3 or more children. Woman's education is recorded as did not complete secondary education, completed secondary education and completed higher education. Parental racial origin is categorised as White, Asian and Aboriginal-Islander.

We have conducted a series of analyses. First, there are descriptive analyses with measures of the proportion of those categorised as depressed or with poor dyadic adjustment over the four follow-up phases. We used simple Poisson regression to determine whether exposure to a predictor (either depression or poor dyadic adjustment) at an earlier phase of data collection predicts an outcome at current follow-up adjusting for socio-demographic factors: women's age, parity, women's education and race. For some analyses we combine the four-phase data sets and estimate the mean cross-sectional association between depression and dyadic adjustment using GEE with modified Poisson regression adjusted for the selected confounders. This mean cross-sectional association is measured both for depression and dyadic adjustment in several models considering one as an exposure and the other as an outcome and vice versa. In these models, both the depression and dyadic adjustment are reported at the same phase of the study. Finally, we conducted prediction analyses using GEE modified Poison with exposure at one time point used to predict the outcome at subsequent times. The prediction models are modified using left censoring (excluding women with pre-existing depression or dyadic adjustment status at the first phase of the study) from the outcome.

When poor dyadic adjustment is the outcome, women with no partner are excluded and good adjustment is defined as the reference category. Excluding no partner category involves treating dyadic adjustment as a

dichotomous variable and permits the use of Poisson regression analysis. Similarly, the poor dyadic adjustment category is excluded from the prediction model for no partner where good adjustment is a reference category.

Results

In Table 1 we examine levels of depression and poor dyadic adjustment at each phase of the study. After the birth of the child there is an increase in the percent of mothers with depression at each phase of the study until the 21-year follow-up. There is a similar trend for poor dyadic adjustment to become more common over time. Overall, 14.7 % of mothers have poor adjustment/no partner at the time they are recruited into the study, while 36.1 % of mothers are in these categories at the 21-year follow-up.

In Table 2 we examine the association between dyadic adjustment and depression on the basis that the four study phases are considered as cross-sectional survey data. In Table 2 we also examine dyadic adjustment as a predictor of depression and then depression as a predictor of dyadic adjustment. At all phases, women who report poor marital quality (poor dyadic adjustment) or who have no partner are found to have higher rates of depression. The reverse causal sequence, depression treated as a predictor of poor dyadic adjustment, suggests effects of a similar magnitude. From a data analysis perspective, when using cross-sectional data, dyadic adjustment strongly predicts depression and depression strongly predicts dyadic adjustment.

While the pattern of association in Table 2 is fairly consistent, there are variations from phase to phase of data collection suggesting that estimates of the strength of the associations vary by life course stage at the time the data were collected. Stronger associations are observed earlier in the reproductive life course.

In Table 3 we use time-lagged data to determine the extent to which categories of dyadic adjustment predict depression at subsequent points of data collection. Poor dyadic adjustment at the FCV strongly predicts maternal depression at the 5-year follow-up, with the women who report having no partner at the FCV having the highest rate of depression at the 5-year follow-up. Similar findings are apparent for dyadic adjustment at 5 and 14 years predicting depression at 14 and 21 years, respectively. The magnitude of these associations is substantially below the magnitude of the comparable cross-sectional associations.

Table 4 presents the prediction model for depression status at each phase of the study and subsequent dyadic adjustment. The women who reported they have no partner are excluded from Table 4. The first model shows the association between depression at one phase of data collection and dyadic adjustment at a subsequent phase of collection. In the second model women who had poor dyadic adjustment at the FCV are excluded. Depression at FCV, 5- and 14-year follow-up consistently predict poor dyadic adjustment at the subsequent phase of follow-up (depression at FCV does not). The associations in model 2 are slightly lower than those in model 1 and the association between depression at FCV and poor dyadic adjustment at the 5-year follow-up is no longer statistically significant.

In Table 5 we have details of the associations over the phases of the study between depression and subsequent "no partner" status. Depression at FCV predicts "no partner" marital status at the 5-year F/U as do depression at each subsequent phase of the study and "no partner" status at the following phase of the study. Depression at an earlier phase consistently predicts marital breakdown at each subsequent phase of the study. The strongest association was observed when women had a young family. However, the strength of the association (effect size) gradually appears to decline over time.

Discussion

Using four phases of data collection over a 21-year period, with repeated measures of marital quality and depression at each phase of data collection, we find that poor marital quality is as likely to predict subsequent depression, as depression is likely to predict subsequent poor marital quality. We also find that estimates of the strength of the association between depression and marital quality vary greatly depending upon the time lag involved and the stage of the life course. There is a compelling case for poor marital quality predicting depression but there is also a compelling case that depression many reduce marital quality. If poor marital quality and depression are chronic aspects of the lives of those affected, then one might

Table 1 Proportion (%) of women depressed and with varying levels of dyadic adjustment over time for the cohort (n = 2,917)

	Phases of data collection			
	FCV (%)	5 years (%)	14 years (%)	21 years (%)
Depression				
Not depressed	89.2	86.9	83.2	82.4
Depressed	10.8	13.1	16.8	17.6
Dyadic adjustment				
Good adjustment	85.3	75.2	68.6	63.9
Poor adjustment	12.0	16.7	19.8	17.4
No partner	2.7	8.1	11.6	18.7

Table 2 Comparison of unadjusted association with dyadic adjustment predicting depression and depression predicting dyadic adjustment

FCV				
Dyadic adjustment predicting depression	RR of depression	Depression predicting dyadic adjustment	RR of poor adjustment	RR of no partner
Good adjustment	1	Not depressed	1	1
Poor adjustment	4.70 (3.82, 5.77)	Depressed	4.34 (3.60, 5.23)	4.72 (2.98, 7.48)
No partner	4.01 (2.76, 5.83)			
5 years F/U				
Good adjustment	1	Not depressed	1	1
Poor adjustment	3.81 (3.12, 4.66)	Depressed	3.15 (2.69, 3.68)	4.06 (3.19, 5.17)
No partner	4.05 (3.18, 5.15)			
14 years F/U				
Good adjustment	1	Not depressed	1	1
Poor adjustment	3.51 (2.95, 4.18)	Depressed	2.91 (2.55, 3.33)	2.57 (2.09, 3.17)
No partner	2.68 (2.15, 3.34)			
21 years F/U				
Good adjustment	1	Not depressed	1	1
Poor adjustment	3.29 (2.74, 3.95)	Depressed	2.81 (2.43, 3.26)	2.39 (2.07, 2.77)
No partner	2.82 (2.33, 3.41)			

Table 3 Dyadic adjustment predicting depression with time lag

Life course stage	Prediction model 1	Prediction model 2 (excludes those depressed at FCV)
RR (95 % CI) of depression 5 years F/U		
Dyadic adjustment at FCV		
Good adjustment	1.00	1.00
Poor adjustment	2.04 (1.64, 2.55)	1.59 (1.16, 2.16)
No partner	2.60 (1.80, 3.77)	2.75 (1.73, 4.39)
	(n = 2,841)	(n = 2,536)
RR (95 % CI) of depression 14 years F/U		
Dyadic adjustment at 5 years F/U		
Good adjustment	1.00	1.00
Poor adjustment	2.26 (1.89, 2.71)	1.83 (1.41, 2.37)
No partner	2.15 (1.70, 2.73)	1.98 (1.42, 2.75)
	(n = 2,841)	(n = 2,471)
RR (95 % CI) of depression 21 years F/U		
Dyadic adjustment at 14 years F/U		
Good adjustment	1.00	1.00
Poor adjustment	2.17 (1.83, 2.58)	1.54 (1.17, 2.02)
No partner	1.71 (1.36, 2.16)	1.42 (1.01, 1.99)
	(n = 2,841)	(n = 2,370)

Model 1: prediction analysis *includes* women with depression at first clinic visit and adjusted for mother's education, race, age, and parity

Model 2: prediction analysis *excludes* women with depression at first clinic visit and adjusted for mother's education, race, age, and parity

interpret the multiple waves of data we have collected as involving the selection, somewhat arbitrarily, of particular points in a continuing process involving experiences of poor marital quality and/or depression. This is not to deny that increased levels of depression may lead to a decline in marital quality or that a decline in marital quality may lead to an increased level of depression. Rather it is to suggest that data collection may extract experiences of depression and poor marital quality from an ongoing process, and that

it is somewhat arbitrary to suggest that depression or marital quality "cause" the other. While the simultaneous measurement of marital quality and depression consequently involves an estimate of stronger association (from this perspective they affect each other and increase or decrease in similar time periods), the more correct assessment of their association is that it is part of an ongoing sequence of linked causes and outcomes over the life course. It is possible that many other studies would

Table 4 Depression predicting poor dyadic adjustment with time lag

Life course stage	Prediction model 1	Prediction model 2 (excludes those depressed at FCV)
RR (95 % CI) of poor dyadic adjustment at 5 years		
Depression at FCV		
Not depressed	1.00	1.00
Depressed	1.52 (1.12, 1.90)	1.19 (0.84, 1.68)
	(n = 2,670)	(n = 2,332)
RR (95 % CI) of poor dyadic adjustment at 14 years		
Depression at 5 years F/U		
Not depressed	1.00	1.00
Depressed	1.97 (1.68, 2.32)	1.81 (1.42, 2.32)
	(n = 2,512)	(n = 2,115)
RR (95 % CI) of poor dyadic adjustment at 21 years		
Depression at 14 years F/U		
Not depressed	1.00	1.00
Depressed	2.01 (1.70, 2.38)	1.66 (1.23, 2.23)
	(n = 2,307)	(n = 1,883)

Model 1: prediction analysis *includes* women with poor dyadic adjustment at first clinic visit and adjusted for mother's education, race, age, and parity

Model 2: prediction analysis *excludes* women with poor dyadic adjustment at first clinic visit and adjusted for mother's education, race, age, and parity. Excludes women whose poor dyadic adjustment first (to the study) precedes the onset of depression

Table 5 Depression predicting "no partner" status with time lag

Life course stage	Prediction model 1	Prediction model 2 (excludes those depressed at FCV)
RR (95 % CI) of "no partner" at 5 years		
Depression at FCV		
Not depressed	1.00	1.00
Depressed	2.56 (1.93, 3.38)	2.36 (1.71, 3.26)
	(n = 2,367)	(n = 2,296)
RR (95 % CI) of "no partner" at 14 years		
Depression at 5 years F/U		
Not depressed	1.00	1.00
Depressed	1.99 (1.56, 2.53)	2.05 (1.50, 2.80)
	(n = 2,274)	(n = 2,080)
RR (95 % CI) of "no partner" at 21 years		
Depression at 14 years F/U		
Not depressed	1.00	1.00
Depressed	1.86 (1.59, 2.19)	1.99 (1.59, 2.48)
	(n = 2,350)	(n = 2,038)

Model 1: prediction analysis *includes* women with "no partner" at lag time and adjusted for mother's education, race, age, and parity

Model 2: prediction analysis *excludes* women with "no partner" at lag time and adjusted for mother's education, race, age, and parity

discover this sequence of the more common mental illnesses and the exposures which are believed to precipitate their onset if such studies had, as do we, repeated measures over a long period of time.

This study of changes in levels of depression and marital quality, over the early marital life course, provides additional information about the more likely causal sequence as well as suggesting that the nature of the association between depression and marital distress may be different depending upon the stage of the maternal marital life course when the research is undertaken. After the birth of a child maternal depression and poor marital quality show a linear increase over the 21-year period of follow-up. The percentage of mothers who were depressed almost doubled over the period of follow-up; there was almost a sixfold increase in the percentage of women with no partner as well as a 50 % increase in the number of women reporting that they had a poor relationship with their partner. Given these changes in depression and marital quality, following the birth of a child, it can be expected that the magnitude of the association between depression and marital quality will be partly a function of the stage of the marital life course when the measures are obtained. In particular, we find that the relative risk of depression being associated with marital

quality is greater if the association is assessed prior to the birth of the study child (that is when rates of both depression and poor marital quality are relatively low).

A similar pattern of findings is apparent when we examine the findings for the lagged data. The lagged data (marital quality at one phase of the study predicting depression at a subsequent phase) produces estimates of association which are about half the magnitude of the cross-sectional associations. Excluding women who had a pre-existing depression (or poor marital quality/no partner) at a previous phase of the study that is limiting the study to 'new' cases of depression (or new cases of poor marital quality/no partner) attenuates some estimates of association but not others. Overall, excluding pre-existing case of respondents with poor marital quality or depression has little material impact on our findings.

Our general findings are that depression predicts subsequent marital distress and that marital distress predicts subsequent depression, but that the magnitude of these associations varies by the maternal stage of the life course and is substantially lower than the estimates of the magnitude of the association derived from cross-sectional data. Mothers who are depressed have a good likelihood of experiencing a subsequent breakdown in their marriage, as well as a higher likelihood of reporting that their marriage is of poor quality. The implications of this finding for service provision are important.

Limitations

There are some caveats that need to be considered when interpreting our findings. First, there is the concern with loss to follow-up. Although we recruited 7,223 mothers/children pairs to the study, only about 2,900 cases are available for this analysis. Most of the loss to follow-up occurred at the 5- and 14-year phases of the study (about 70 % of the sample respond in each instance). We have previously reported [54] that those lost to follow-up are disproportionately of lower income and education and have higher rates of mental health problems as well as high levels of marital distress. In Appendix we present comparisons of those who remained in the study and who were lost to follow-up. These differences are consistent with our precious reports [54]. Generally, those lost to follow-up are more residentially mobile and simply cannot be located (very few respondents refused the opportunity to continue to participate in the study). We have estimated the impact of selective loss to follow-up on our findings using multiple imputation and sensitivity analyses as well as using statistical modelling of best case/worst case scenarios. We have consistently found that our estimates of association are only minimally affected by loss to follow-up and that

this effect is that analyses without adjustment for loss to follow-up are conservative estimates of the association.

Second we note that we have not collected data on maternal depression prior to the beginning of the current relationship. In a related study of the children of these mothers, assessments at 21 years of age indicate that about 20 % of children had experienced a depression, suggesting that many of the mothers would have had their first episode of depression prior to the current relationship. Consequently, we have excluded women with pre-existing depression from the GEE analyses.

A third caveat concerns the period of time which elapses between phases of the study (FCV to 5 years; 5–14 years and 14–21 years). It appears likely that the gap in time between phases of follow-up will influence the strength of the associations. In particular, it is likely that shorter period of follow-up for some sequences (for example marital breakdown predicting depression) would yield a stronger association in say the period immediately after the marital breakdown, than will be the case some years later. Our findings need to be interpreted from the perspective of what are long time gaps between cause and effect; that is, the longer term consequences of depression and marital distress, not the immediate consequences.

Fourth, we note that we limited the sample to persons who supplied data on depression and marital distress at each phase of the study. We did not assess the extent to which there may have been changes in levels of depression or marital distress between phases of follow-up. Thus, some women may have had good dyadic adjustment at each phase of the study, but may have changed partners in between phases of the study. Much the same may occur with regard to depression between phases of data collection. It is unlikely that this possibility had a significant impact on our findings.

Conclusion

While this study has addressed the possible alternative associations between marital quality and depression, its findings may be of more general relevance. In many instances measures of the more common mental illnesses (e.g. depression, anxiety and substance use disorders) are interpreted as the outcome of a variety of exposures (e.g. poverty, experience of trauma or violence, loss of employment). Research examining the impact of stressful exposures on mental health is predicated on assumptions about the causal direction of the association. In some instances the causal direction of such associations is relatively unproblematic, for example exposure to say war or a natural disaster. Many other stressful exposures are chronic and recurrent over an extended period of time (e.g. marital

conflict, poverty). It is with regard to these latter types of exposures that the findings of this study are relevant.

The findings of this study suggest that the birth of a baby could be considered as a stressful event which impacts on family interactions, possibly placing increased demands on economic and other resources. The birth of a child appears to have a long-term negative impact on maternal depression and marital quality. Both increased maternal depression and a decline in marital quality are evident over a 21-year period following the birth of a child. We find a bidirectional association with increased depression and reduced marital quality following one another over the maternal reproductive life course.

We also find that when the exposure and assumed outcome are measured at the same time, the estimate of the magnitude of association is inflated, possibly because of the proximity in time between the exposure and outcome. This inflated estimate is not likely to be a good estimate of the magnitude of the association and may be misleading with regard to its direction. We also find that the magnitude of the association may differ depending upon the stage of the life course at which it is assessed. Our findings suggest that poor mental health appears to lead to some stressful experiences as often as stressful experiences may lead to poor mental health.

The implications of these findings for clinical and public health are several. The birth of a child is not generally viewed as a source of stress potentially leading to an increase in depression and a decline in marital quality. Clinicians may need to be more responsive to the maternal reproductive period as a time when support services may be indicated. From a public health perspective child rearing has undergone substantial changes in the past few decades. The majority of women are now in the workforce and many may have economic and career needs which may conflict with the demands of rearing a child. Great deal of child care is now provided by agencies and many marriages may involve expectations about child care that may not be met. These changes may be contributing to not only the decline in marital quality but also the increased level of maternal depression.

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Appendix

See Table 6.

Table 6 Comparison of the maternal characteristics of the women who have been included versus those who have been excluded at 21 years post-partum

Background characteristics	Women who have been included in the analyses ($n = 2,917$)	Women who have been excluded from the analysis ($n = 3,786$)	p value
Maternal age			
<30 years	81.6	83.7	0.025
30+ years	18.4	16.4	
n	2,917	3,786	
Maternal education			
Did not complete secondary education	14.5	21.1	
Completed secondary education	64.5	63.7	
Completed further or higher education	21.1	15.2	<0.001
n	2,902	3,751	
Race			
Caucasian	93.6	82.6	
Asian	31.6	5.5	
Aboriginal-Islander	3.2	8.9	<0.001
n	2,853	3,652	
Parity			
No previous child	44.3	43.5	
1–2	46.3	43.9	
3 or more	9.4	12.6	<0.001
n	2,917	3,786	
Maternal marital status at FCV			
Had partner	90.7	82.9	<0.001
Had no partner	9.3	17.1	
n	2,903	3,748	
Maternal depression during pregnancy (FCV)			
Not depressed	89.2	78.5	
Depressed	10.8	21.5	<0.001
n	2,917	3,786	
Dyadic adjustment at FCV			
Good adjustment	85.3	77.3	
Poor adjustment	12.0	16.7	<0.001
No partner	2.8	6.0	
n	2,917	3,693	

* p indicates the significance level of the difference by the characteristics of women who have been included in the analyses vs. women who have not included in the analysis

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