

Research paper

The association between marital transitions and the onset of major depressive disorder in a south asian general population

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ABSTRACT

Background: Marriage in general is associated with better mental health in high-income industrialized countries, but it is unknown to what extent this is also the case in South Asia.

Methods: The Chitwan Valley Family Study (CVFS) in Nepal is a 24-year family panel study with a recent representative survey to investigate the association between sociodemographic changes and mental health ($N = 10,516$). We investigated timing of marital transitions and timing of onset of MDD in both male and female respondents, controlling for key confounders.

Results: In this setting the transition to marriage is associated with increased odds of subsequent MDD first onset (median OR = 2.28). For female respondents, divorce (OR = 2.68), early widowed (OR = 11.25), and even getting married significantly increased the odds of subsequent MDD onset (OR = 3.03). For male respondents, only becoming widowed increased the odds of subsequent MDD (OR = 16.32), but marriage did not reduce the odds of MDD.

Limitations: Limitations of the study include large-scale protocol that may have resulted in underreporting of MDD and the exclusion of sub-threshold cases that may otherwise have qualified as a case in a clinical setting.

Conclusions: In the Nepalese general population, marital transitions increase the odds of subsequent depression, especially among the female population. Results provide basic but essential vital health data that can guide clinicians to proactively plan sustainable healthcare both within South Asia and among many South Asians living in other places.

Introduction

Marriage is often considered protective from MDD, but this hypothesis has not been tested in arranged marriage settings with rare divorce. We use new high-quality measurement of MDD from Nepal, collected in an ongoing family panel study with precise measures of marital and childbearing events, to investigate the possibility that associations between marital events and subsequent MDD vary by setting.

In recent decades there has been a rapid demographic change in South Asia that significantly delayed entry into marriage, reduced death rates (delaying widowhood) and introduced divorce (Véron, 2008) with unknown consequences for mental health – and especially depressive disorders. Globally, major depressive disorder (MDD) is one of the most common mental disorders (Kessler and

Bromet, 2013) and the second in the top 20 causes of global burden of disease (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators, 2018). General population studies on mental health from rural populations of South Asia are scarce (Axinn et al., 2015; Ogbo et al., 2018; Risal et al., 2016). In addition to high overall mortality and poverty, within the past two decades this population experienced eight years of medium intensity armed conflict and related potentially traumatic events (Kohrt et al., 2012). Understanding factors that affect the rate at which individuals develop MDD in this setting provides basic but essential vital health data that can guide governments – but also clinicians – to proactively plan sustainable healthcare frameworks.

In general, marriage improves health and wellbeing and reduces MDD for both men and women (Williams et al., 2010; Braithwaite and Holt-Lunstad, 2017), though benefits are often better for men

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(Waite and Gallagher, 2000; Scott et al., 2010). Both divorce and widowhood reduce health and wellbeing for both men and women (Hewitt and Turrell, 2011). The associations between marriage and depression are fairly robust, although variations have been described for age (Uecker, 2012), race (Frech and Williams, 2007), or socioeconomic status (Carlson and Kail, 2018). One specific limitation is that studies are largely confined to Western countries, thus limiting the variability in the cultural context of marriage and MDD. This leaves the unresolved question of whether associations are universal or that context differences create variations in the observed associations. In addition, studies that investigate associations between marital transitions and MDD across the life course are mostly confined to the effects of marital dissolution on MDD and not entering marriage. Fewer studies investigate the effects of entering marriage on MDD (Scott et al., 2010) and many of those (Frech and Williams, 2007; Horwitz et al., 1996; Simon, 2002) are limited in their conclusions because of low statistical power or the absence of adjustment for the potential moderating effects of key covariates (such as anxiety or substance disorders).

The current study examines the role of marital transitions and subsequent MDD onset. To address the limitations of prior studies, we use full lifetime marital histories from 10,516 participants in the Chitwan Valley Family Study (CVFS) in Nepal, linked directly to age of onset of diagnosed MDD (Axinn et al., 2019). We were able to assess marital transitions and subsequent onset of MDD in a setting with high levels of arranged marriage, very little divorce, no non-marital cohabitation, and rigid gender roles within marriage (Ghimire et al., 2006). Building upon previous studies on depression in Nepal (Axinn et al., 2015; Axinn et al., 2013), the present study is new documentation of the potential for cultural context to shift the associations between marital dynamics and depression.

Method

Survey respondents

The CVFS launched in 1995 with a sample of 151 neighborhoods, fully representative of Western Chitwan Valley in Nepal. Every inhabitant of each selected neighborhood was included in the CVFS and those who joined these neighborhoods after 1995 were added to the CVFS. Individuals from the originally selected households remain sample members throughout their lives, being tracked and re-interviewed wherever they move. Individuals marrying or born to original sample members become sample members and are treated the same way. Periodically (2008 and 2016) the panel sample is “refreshed” to represent new in-migrants to the Valley to insure the CVFS represents the current population.

Monthly demographic information about all individuals, including migrants who left the selected neighborhoods, was recorded into a unique household registry system with a high retention rate of original respondents (92.51% after 11 years) (Axinn et al., 2012). The registry measures marital events (marriage, widowhood and divorce) with monthly precision. A specially designed Life History Calendar (Axinn et al., 1999) was deployed repeatedly to collect complete retrospective individual histories for in-migrants joining the sample (and registry system). A Nepal-specific version of the CIDI (CIDI 3.0) (Kessler and Üstün, 2004) was administered to a subset of the CVFS sample in 2016–2018, with a response rate of 93%. The diagnostic measures in the Nepal-specific World Mental Health Survey Composite International Diagnostic Interview (CIDI) were translated through a multi-step iterative process to insure validity in the local context (Axinn et al., 2019).

To analyze the association between marital transitions and the first onset of MDD, we linked the Nepal-specific CIDI with household registration data and three waves of life history calendar data (in 1996, 2008 and 2016) from the ongoing, long-term CVFS in Nepal. Together these multiple data sources provide a complete marital history,

including childbirth events, linked to lifetime MDD histories for each respondent in the CVFS. The sample yielded 10,516 individuals, aged 15–59 in 2016–2018.

Measures

Lifetime major depressive disorder and other mental disorders.

Lifetime DSM-IV disorders were measured using selected modules from the Nepal version of the CIDI-3.0 (Kessler and Üstün, 2004). The CIDI is designed to be administered by lay interviewers, to measure mental disorder prevalence rates. Following standard CIDI practice, professional interviewers were rigorously trained using computer-assisted interviewing techniques, and then contacted selected CVFS respondents, obtained consent, and administered the instrument. Retrospective age of onset (AOO) was obtained from respondents using the questionnaire in conjunction with the life history calendar, a protocol designed to avoid the implausible response patterns likely to come from a simple question asking for recall of age of first episode of a focal disorder. The modules included were major depressive disorder (MDD), mania, panic disorder, generalized anxiety disorder (GAD), post-traumatic stress disorder (PTSD), intermittent explosive disorder, and alcohol use disorders (AUD). The high effort to construct culturally and linguistically appropriate translations of diagnostic measures forced us to limit the focal disorders to a subset of all disorders included in the CIDI. The selection of these specific disorders was informed by prior studies as well as pilot data indicating the disorders anticipated to be most prevalent and/or clinically significant. Clinical validation of the Nepal CIDI against the gold standard of the clinician-administered Structured Clinical Interview for DSM-IV (SCID-IV) demonstrated high concordance, comparable to validation studies of the USA and European CIDI instruments (Ghimire et al., 2013). Analyses of pilot data from Nepal demonstrated expected associations of these conditions and potentially traumatic experiences with Nepal CIDI assessments of mental disorder (Axinn et al., 2015; Axinn et al., 2013). As our primary focus was on MDD, we classified those respondents who met criteria for any mental disorder other than MDD as those with ‘any other mental disorder’ before first marriage.

Marital and childbearing history. Complete lifetime marital histories were constructed for each respondent by linking the household registration data with life history calendar (LHC) data. For respondents who were not born into the CVFS, the LHC measures ensure a complete history covering any portion of life before the individual joined the CVFS. These LHC supplemental histories were collected in 1996, 2008, and 2016, covering cohorts who joined the CVFS at different times. This combination of measures provides detail in marital and childbearing status, allowing us to identify marital and childbirth transitions with monthly precision. Marital transition, as time-dependent variables, was categorized into four groups: never married, currently married, divorced, and widowed. We also control for the timing of the first childbirth.

Socio-demographic variables. Our multivariate assessment of the associations between marital experiences and MDD controlled for sex, age, birth cohort, ethnicity, and education (Scott et al., 2018). Birth cohort is categorized into four groups: 1957–1971, 1972–1981, 1982–1991, and 1992–2001. Ethnicity is measured through a set of dummy variables: Brahmin/Chhetri, Hill Janajati, Newar, Terai Janajati, Dalit or Others. Brahmin/Chhetri, the most privileged ethnic group in Nepal, is omitted from models as the comparison group. We summarized variability in education with a single dummy variable of receiving a “School of Leaving Certificate” or S.L.C. The S.L.C. is awarded to those passing a nationally standardized exam offered after the successful completion of 10th grade.

Statistical methods

Discrete-time hazards methods were used to estimate the hazard of

first onset of MDD as a function of time-dependent marital experiences, with socio-demographic covariates included in the models. The outcome variable was time to first onset of MDD. All respondents enter exposure to the risk of MDD at age 10, when none married. We assessed the role of the transition to marriage in first MDD onset (Table 2) and then the role of transitions to widowhood or divorce among those ever married (Table 3). In models 1 and 3 we examined associations between socio-demographic variables and first MDD onset separately in female and male respondents. In models 2, 4, and 5, we included time-dependent marital experiences and controlled for socio-demographic characteristics in females, males, and the total sample. To further examine the gender moderation on the association between marital transitions and MDD onset, we added interactions between gender and time-dependent marital experiences to the equation in model 6. To investigate the varied hazard of MDD onset, we focused on first marriages and explored the varied hazard of MDD onset from divorce and widowhood across time. All the analyses were performed using STATA 15.

Ethics and consent statement

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human subjects were approved by the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board (HUM00104171). These procedures were also approved by the Nepal Health Research Council (Reg. No. 323/2015). Written or verbal informed consent was obtained from all subjects. (Verbal consent was witnessed and formally recorded.)

Data availability

Authors had access to the anonymized mental health data in the Chitwan Valley Family Study (CVFS). The data reported here are currently in the documentation and archiving process and will be available through the Inter-university Consortium for Political and Social Research (ICPSR) in 2021.

Results

Description of the sample

Most respondents are currently married, with 25.40% (SE = 0.46) never married, 1.55% (SE = 0.13) widowed and less than 1% divorced. The young age of the sample (Carlson and Kail, 2018; Horwitz et al., 1996; Simon, 2002; Axinn et al., 2019; Ghimire et al., 2006; Axinn et al., 2013; Axinn et al., 2012; Axinn et al., 1999; Kessler and Üstün, 2004; Ghimire et al., 2013; Scott et al., 2018; Wells and Horwood, 2004; Patten, 2003; Eaton et al., 1992; Lam et al., 2017) results in rare experiences of widowhood. The divorce rate is low because divorce remains a rare event in Nepal. Overall, approximately 1 in 7 (14.75%; SE = 0.35) respondents met DSM-IV criteria for lifetime MDD (Table 1). Only 4.37% (SE = 0.20) of these respondents experienced another mental disorder before MDD.

Time-dependent transitions to marriage and onset of MDD

The results of analyses of the transition to marriage are shown in Table 2. Though all other covariates predict subsequent MDD as expected, relative to being single, becoming married more than doubles the hazard of subsequent onset of MDD. In the total sample (column 5 of Table 2), this association is statistically significant (OR = 2.28). Note that even though becoming married is closely tied to first childbirth in Nepal, and first childbirth also produces a significant increase in subsequent MDD (OR = 1.32, model 5), the association between marriage

Table 1
Sample description¹ of CVFS sample in 2016–2018 (N = 10,516).

	Mean or Percent	95% Confidence Interval
Lifetime major depressive disorder		
Yes	14.75	(14.08, 15.44)
No	85.25	(84.56, 85.92)
Marital experiences		
Currently married	72.21	(71.27, 73.13)
Never married	25.40	(24.51, 26.31)
Widowed	1.55	(1.31, 1.83)
Divorced	0.84	(0.67, 1.05)
Ever had first birth		
Yes	63.74	(62.82, 64.65)
No	36.26	(35.35, 37.18)
Lifetime any other mental disorder²		
Yes	4.37	(4.00, 4.78)
No	95.63	(95.22, 96.00)
Gender		
Male	45.88	(44.93, 46.84)
Female	54.12	(53.16, 55.07)
Birth cohort		
1992–2001	36.75	(35.84, 37.68)
1982–1991	28.10	(27.24, 28.96)
1972–1981	19.36	(18.62, 20.13)
1957–1971	15.79	(15.11, 16.50)
Ethnicity		
Brahmin/Chhetri	43.62	(42.67, 44.57)
Hill Janajati	19.85	(19.09, 20.62)
Dalit	12.22	(11.61, 12.86)
Newar	6.02	(5.58, 6.49)
Terai Janajati	18.30	(17.57, 19.05)
S.L.C. or more³		
Yes	38.32	(37.40, 39.26)
No	61.68	(60.74, 62.60)
Age	32.60	(32.37, 32.82)

¹We reported the descriptive statistics at the time of Nepal CIDI survey (2016–2018).

²Any other mental disorder before the first marriage includes Alcohol Abuse Disorder (ALA), Alcohol Dependence (ALD), Generalized Anxiety Disorder (GAD), Posttraumatic Stress Disorder (PTSD), Panic Disorder (PDS), Intermittent Explosive Disorder (IED), and Broad Bipolar (BIPOLAR).

³S.L.C. = Schooling Leaving Certificate.

and MDD is independent of the association with first births.

These strong associations are even stronger among female respondents. Relative to being single, women who experienced the transition to marriage had just over three times higher odds of developing subsequent MDD (OR = 3.03). These strong associations with marital experiences were independent of the association between having a first birth and MDD, though that association was also statistically significant (OR = 1.31). In male respondents the association between getting married and MDD was non-significant. In female and male respondents separately, and the total sample, the comparison of the models with and without marital experiences show that both the magnitude and significance of coefficients of other socio-demographic covariates are consistent. The results suggest that marital experiences are independently associated with the onset of MDD, even after controlling for a broad set of socio-demographic covariates.

Finally, in Model 6 (with the total sample), we tested the interaction between gender and the transition from single to married. Compared to male respondents, getting married increases the hazard of MDD for females by nearly double (OR = 1.94). This interaction is statistically

Table 2

Hazard model estimates of the association between marital experiences and subsequent onset of major depressive disorder (MDD), (odds ratios; 95% confidence intervals in parentheses; $N = 10,516$).

Model	Female 1	2	Male 3	4	Total 5	6
Marital experiences						
Ref: Never married						
Married		3.03*** (2.45, 3.74)		1.11 (0.77, 1.62)	2.28*** (1.91, 2.71)	1.42*** (1.09, 1.83)
Gender and marital experiences						
Female, married						1.94*** (1.49, 2.54 ¹)
Gender						
Ref: Male						
Female					3.96*** (3.48, 4.51)	2.54*** (2.04, 3.15)
Had first birth						
Ref: No						
Yes	1.87*** (1.46, 2.41)	1.31* (1.01, 1.69)	1.65 (0.92, 2.96)	1.58 (0.87, 2.88)	1.32* (1.05, 1.68)	1.32* (1.04, 1.67)
Covariates						
Any other mental disorder						
Ref: No						
Yes	34.55*** (26.63, 44.84)	51.17*** (38.83, 67.42)	2.72*** (1.64, 4.51)	2.81*** (1.67, 4.73)	19.40*** (15.42, 24.42)	18.03*** (14.28, 22.75)
Ethnicity						
Ref: High caste Hindu						
Dalit	1.36*** (1.14, 1.62)	1.37*** (1.15, 1.64)	1.35 (0.97, 1.89)	1.35 (0.96, 1.89)	1.35*** (1.16, 1.57)	1.36*** (1.17, 1.59)
Hill Janajati	1.01 (0.86, 1.18)	1.03 (0.88, 1.21)	1.20 (0.89, 1.63)	1.20 (0.89, 1.62)	1.03 (0.90, 1.19)	1.04 (0.90, 1.19)
Terai Janajati	0.94 (0.80, 1.11)	0.98 (0.83, 1.16)	0.92 (0.66, 1.30)	0.92 (0.66, 1.29)	0.96 (0.82, 1.11)	0.97 (0.83, 1.12)
Newar	0.91 (0.71, 1.18)	0.94 (0.72, 1.21)	0.84 (0.49, 1.44)	0.84 (0.49, 1.44)	0.92 (0.73, 1.16)	0.93 (0.74, 1.17)
Education						
Ref: No S.L.C.						
S.L.C. or more	0.63*** (0.53, 0.74)	0.76** (0.64, 0.90)	0.63*** (0.48, 0.83)	0.64** (0.49, 0.84)	0.70*** (0.61, 0.81)	0.72*** (0.63, 0.83)
Age						
Age	1.25*** (1.21, 1.29)	1.11*** (1.07, 1.16)	1.18*** (1.11, 1.25)	1.17*** (1.09, 1.25)	1.12*** (1.08, 1.16)	1.11*** (1.08, 1.15)
Birth cohort						
Ref: 1957–1971						
1972–1981	0.99 (0.85, 1.16)	1.04 (0.88, 1.21)	1.11 (0.78, 1.57)	1.11 (0.78, 1.58)	1.05 (0.91, 1.21)	1.05 (0.91, 1.21)
1982–1991	0.89 (0.75, 1.06)	0.94 (0.79, 1.11)	1.92*** (1.33, 2.78)	1.94*** (1.34, 2.80)	1.07 (0.91, 1.25)	1.06 (0.91, 1.24)
1992–2001	1.35** (1.09, 1.67)	1.52*** (1.23, 1.88)	5.81*** (3.90, 8.67)	5.92*** (3.95, 8.88)	2.00*** (1.67, 2.40)	1.98*** (1.65, 2.38)
N	116,107.00	116,107.00	114,371.00	114,371.00	230,478.00	230,478.00
Log likelihood (ll)	–6407.56	–6351.59	–2124.14	–2123.97	–8564.57	–8552.89
AIC	12,841.12	12,731.18	4274.27	4275.95	17,159.14	17,137.77
BIC	12,966.73	12,866.45	4399.69	4411.01	17,314.36	17,303.34

¹Likelihood Ratio Test comparing model fit for Model 5 and Model 6 shows Model 6 significantly improves fit (Chi-square = 23.37, $p < 0.001$).

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

significant and a likelihood ratio test for the fit of the model adding this interaction term is also statistically significant.

Fig. 1 summarizes the key findings from Model 6 in Table 2. Using the results in Model 6, we calculated the age-specific probability of MDD for females and males by current marital status. These predicted probabilities of MDD are much higher for females, but significantly higher still once females transition to marriage. Note the predicted probability of MDD for married males is never lower than the probability of MDD for unmarried males.

Time-dependent transitions from marriage to divorce or widowhood and onset of MDD

Table 3 examines transitions to divorce or widowhood among those who are married. In the total sample (column 5 of Table 3), these

associations are also statistically significant and large: becoming widowed increases the hazard of MDD tenfold ($OR = 11.25$) and divorce doubles the hazard of MDD ($OR = 2.22$). The very large OR for widowhood in this sample is consistent with the young age of the sample – these are large effects of the rare event of early widowhood.

The gender differences in these associations with transitions to the end of a marriage are less pronounced than from single to married. Among females, the association between divorce and subsequent MDD ($OR = 2.68$, model 2) is significant and larger than the same association among men ($OR = 1.71$, model 4), which is not statistically significant. In testing the interaction (model 6), however, even though the interaction term itself is just significant, other components of the test are not, and the test of improvement in the model fit indicates a model with the gender interactions fits the data no better than a model without the

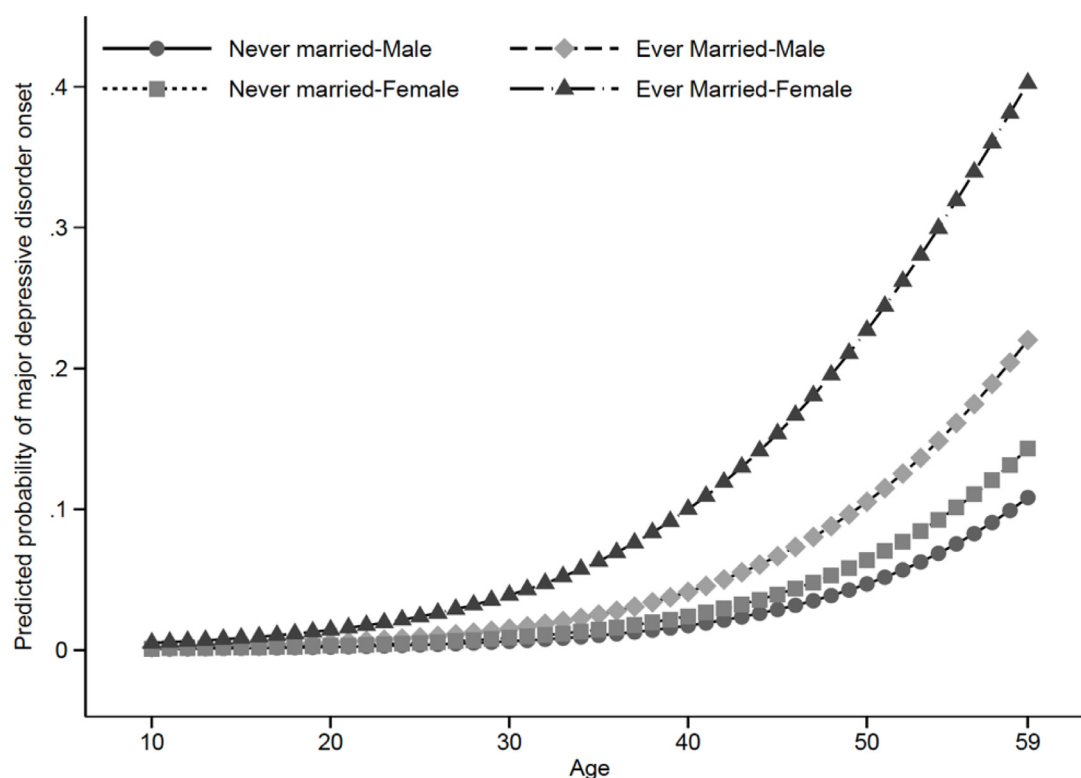


Fig. 1. Predicted probability of MDD onset for marriage by age and gender, adjusted for covariates. Note: Fig. 1 is based on Model 6 of Table 2.

gender interactions. Thus, though the association between becoming married and MDD is highly gendered in Nepal, the associations between both divorce and widowhood and MDD are not.

Discussion

The present study is the first study of mental health with a diagnostic interview in a systematic, representative sample of a general population of Nepal. We used time-varying data on marital transitions as well as a validated structured psychiatric interview to investigate the extent to which marital transitions are related to the subsequent onset of major depressive disorder. The most important finding is that marital transitions are associated with subsequent onset of MDD, even after controlling for a broad set of covariates. In particular, the finding that for women, transition *into* marriage increases the odds for subsequent onset of MDD, in a country where most marriages are arranged, is novel.

Our study should be interpreted within the context of the following six limitations. First is the retrospective assessment of MDD: the prevalence of lifetime MDD is likely to be underreported and biased in accuracy in the reported respondents' ages of onset (Wells and Horwood, 2004). The specially designed links between longitudinal measures of marital experiences and the life history calendar to support measurement of disorder timing (Axinn et al., 2019) were used to improve upon prior retrospective studies of this association. Second is a different potential source of underreporting. In this study MDD was assessed using structured interviews by trained lay interviewers. Although previous CIDI clinical validation studies in Nepal have shown acceptable validity and reliability (Ghimire et al., 2013), there may be an underestimation of lifetime prevalence of MDD because of the effect that self-reported data on mental health or quality of life data may be flawed (Patten, 2003), even in the case where we used innovative ways of assessing lifetime MDD (Axinn et al., 2019). Third, individuals with mental disorders could have more frequently refused to participate in the survey. Although response rates for this survey are exceptionally

high (93%), it is plausible that our results were biased because persons with a history of MDD might have been less likely to participate (Eaton et al., 1992). A fourth limitation pertains to the assessment of MDD. It might have been that the use of stem questions in the screening section of the CIDI-3.0 have led to underestimates of MDD. The interview translation, back-translation, and harmonization process included customization of the wording used to describe the core major depressive symptoms based on clinical experiences of local collaborators and the results of pilot studies. However, we made no attempts to develop cut-off points in the CIDI diagnostic algorithms for different countries or to go beyond the DSM-IV criteria to develop distinct criteria for different countries that might have increased our ability to detect depression or depression-equivalents. Fifth, because persons with depression may experience cognitive impairment and somatic symptoms as core symptoms, we might have excluded sub-threshold or atypical cases of depression that would otherwise have qualified for being a case and treatment in a clinical setting. Sixth, the Nepalese population very rarely has childbirth outside marriage, making it impossible to compare hazards of MDD by childbirth among the unmarried.

Our data are consistent with those from South Asia on prevalence of MDD (Scott et al., 2018) and sociodemographic correlates in other settings, such as lower education (Lam et al., 2017) or being widowed (Risal et al., 2016). Divorce and widowhood increase the hazards of MDD onset for both men and women, and it is in line with expectations that the increased MDD risk after divorce is somewhat higher for Nepalese women than men. More surprising is that the transition from being single to married increases the hazard of depression for females in Nepal. Psychiatric epidemiological and sociological studies show that, in general, there is an inverse association between marriage and mental health: persons who are married have better mental health outcomes than those who are not (Scott et al., 2010). Generally, marital disruption is associated with poorer mental health and getting married is associated with either no change or with better mental health outcomes. Our finding that women in Nepal are about 3 times more likely to develop MDD *after* getting married adds knowledge, and suggests

Table 3

Hazard model estimates of the association between divorce or widowhood and major depressive disorder (MDD) among those who are married, (odds ratios; 95% confidence intervals in parentheses; $N = 10,516$).

Model	Female 1	2	Male 3	4	Total 5	6
Marital experiences						
Ref: Married						
Divorced		2.68*** (1.98, 3.77)		1.71 (0.88, 3.33)	2.22*** (1.64, 3.01)	1.27 (0.66, 2.43)
Widowed		11.25*** (8.59, 14.74)		16.32*** (8.22, 32.40)	14.31*** (8.76, 14.46)	14.31*** (7.29, 28.08)
Gender and marital experiences						
Female, widowed						0.76 (0.37, 1.57)
Female, divorced						2.16 ^{1*} (1.04, 4.58)
Gender						
Ref: Male						
Female					4.65*** (3.93, 5.50)	4.50*** (3.78, 5.37)
Had first birth						
Ref: No						
Yes	1.27 (0.98, 1.64)	1.54 (0.83, 2.83)	1.46 (0.79, 2.69)	1.54 (0.83, 2.83)	1.30* (1.03, 1.65)	1.30* (1.03, 1.65)
Covariates						
Any other mental disorder						
Ref: No						
Yes	22.97*** (12.82, 41.16)	23.59 (13.15, 42.32)	6.03*** (2.40, 15.18)	4.53** (1.76, 11.66)	12.49*** (7.80, 20.01)	13.15*** (8.16, 21.20)
Ethnicity						
Ref: High caste Hindu						
Dalit	1.44*** (1.19, 1.74)	1.39*** (1.15, 1.69)	1.30 (0.82, 2.06)	1.25 (0.79, 1.99)	1.37*** (1.14, 1.63)	1.36*** (1.14, 1.63)
Hill Janajati	1.03 (0.86, 1.22)	1.01 (0.85, 1.21)	1.30 (0.87, 1.94)	1.29 (0.86, 1.93)	1.05 (0.89, 1.23)	1.05 (0.89, 1.23)
Terai Janajati	0.92 (0.76, 1.11)	0.89 (0.73, 1.08)	0.93 (0.59, 1.47)	0.82 (0.51, 1.30)	0.88 (0.73, 1.04)	0.87 (0.73, 1.04)
Newar	1.02 (0.77, 1.34)	0.98 (0.74, 1.30)	1.23 (0.66, 2.30)	1.25 (0.67, 2.34)	1.02 (0.79, 1.32)	1.02 (0.79, 1.32)
Education						
Ref: No S.L.C.						
S.L.C. or more	0.69*** (0.56, 0.85)	0.71** (0.58, 0.88)	0.52** (0.34, 0.81)	0.54** (0.35, 0.84)	0.67*** (0.55, 0.81)	0.67*** (0.55, 0.81)
Age						
Age	1.08*** (1.03, 1.13)	1.09*** (1.04, 1.14)	1.03 (0.92, 1.15)	1.05 (0.94, 1.17)	1.07*** (1.03, 1.11)	1.07*** (1.03, 1.12)
Birth cohort						
Ref: 1957–1971						
1972–1981	1.06 (0.90, 1.25)	1.14 (0.97, 1.35)	1.22 (0.83, 1.81)	1.32 (0.89, 1.96)	1.18* (1.01, 1.38)	1.17* (1.00, 1.36)
1982–1991	0.94 (0.79, 1.14)	1.04 (0.87, 1.26)	2.03** (1.31, 3.13)	2.24*** (1.43, 3.48)	1.17 (0.99, 1.39)	1.17 (0.98, 1.38)
1992–2001	1.43** (1.11, 1.84)	1.55*** (1.20, 2.00)	3.85*** (1.95, 7.60)	4.57*** (2.30, 9.08)	1.79*** (1.41, 2.27)	1.78*** (1.40, 2.26)
N	66,828.00	66,828.00	57,350.00	57,350.00	124,178.00	124,178.00
Log likelihood (ll)	–5062.18	–4953.87	–1164.81	–1146.52	–6118.63	–6115.86
AIC	10,150.36	9937.74	2355.62	2323.04	12,269.26	12,267.72
BIC	10,268.79	10,074.39	2472.06	2457.39	12,424.93	12,442.85

¹The likelihood ratio test between model 5 and 6 produces a Chi-square value is 5.53 (p-value = 0.063), which indicates the model with interaction terms is not a significantly better fit to the data.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

gender differences in peoples' response to marital transitions may be context-specific. In the Nepal-specific context, marriage may increase the risks of MDD through specific elements such as the fact that spouses are often selected by parents, especially among women (Ghimire et al., 2006), that divorce is rarely an option (Jennings, 2014), or that women's roles within marriage can be highly segregated (Bennett, 1983). We now provide the first evidence for this hypothesis. As this is a new finding, future studies should rule out whether this finding is spurious or more structurally imbedded in societies with arranged marriages.

Prior research does indicate women may react differently to marital transitions, but this was mostly confined to transitions of divorce or becoming widowed (Strohschein et al., 2005). Our findings point toward the potential for even greater gender differences in the experience of marriage. This is consistent with a gender role interpretation of gender and MDD: women's roles in marriage may be less satisfying, including higher levels of chronic stress, and a decreased sense of mastery (Mirowsky, 1996). This topic deserves greater research attention in the broad range of populations that may be more like Nepal than

like Europe. Finally, in our study we could not find evidence that marriage has a beneficial effect on MDD for either gender, in contrast to previous evidence (Frech and Williams, 2007).

Taken together, although prevalence estimates are comparable to earlier reports, we found that in Nepalese women, any marital transition carries a high risk for subsequent onset of MDD. Our findings add to the range of known risk factors that occur at a greater frequency in individuals with MDD but specifically call attention to the role of marriage in this complex interaction. To what extent these features are culturally, socially, or armed-conflict related is unknown and speculative, but they support the hypothesis that armed conflict events that increase rates of marriage in response, may also increase prevalence of MDD. Careful study of specific armed conflict events in Nepal demonstrates that these events speed transitions to marriage (Williams et al., 2012). In the immediate context of violent armed conflict individuals are motivated to marry to reduce risks, such as the risk of forced conscription for both males and females, or the risk of rape for females. However, the longer term consequence may be higher odds of MDD or at least, as we see for Nepalese men, no benefit of marrying to reduce the odds of MDD. This should be investigated in future studies.

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Author contribution

All authors significantly contributed to the acquisition, formal analysis, data curation, and interpretation of data. In addition, Axinn, Ghimire and Chardoul made substantial contributions to the conception/design of the work. Axinn, Bruffaerts and Zhang drafted the work and all the authors revised it critically for important intellectual content, review, and editing. All authors approved the final version to be published. All authors accept accountability for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

IRB details

All procedures involving human subjects were approved by the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board (HUM00104171). These procedures were also approved by the Nepal Health Research Council (Reg. No. 323/2015). Written or verbal informed consent was obtained from all subjects.

Declaration of Competing Interest

Axinn, Chardoul, Ghimire and Zhang report support from an NIH/NIMH grant during the conduct of the study. Axinn and Ghimire report support from an NIH/NICHD grant during the conduct of the study. Ghimire is also the Director of the Institute for Social and Environmental Research in Nepal (ISER-N) that collected the data for the research reported here. Ghimire's conflict of interest management plan is approved and monitored by the Regents of the University of Michigan.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2020.01.069.

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