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Cultural Norms and Women's Health: Implications of the Practice of Menstrual Restrictions in Nepal

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Cultural Norms and Women's Health: Implications of the Practice of Menstrual Restrictions in Nepal*

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Abstract

We study the association between the ritual of menstrual restrictions and maternal healthcare access as well as women's subjective well-being. Similar restrictions, also practised around the time of childbirth, are based on the assumption that women are ritually impure during these phases of their lives. Although menstrual taboos and restrictions are common across many developing countries, we use micro-data from Nepal where these rituals are widely prevalent. We use a rich set of controls as well as assess the sensitivity of our results to alternative estimation methods. We find that women who face any menstrual restriction are also more likely to give birth at home and receive assistance only from untrained individuals during childbirth, which increases the risk of maternal mortality. We find that only the strictest menstrual restrictions are associated with a decline in subjective well-being. These findings indicate that menstrual restriction related rituals can have persistent negative implications on women's physical and mental health that is not just limited to the time of menstruation.

Keywords: menstruation; culture; health; subjective well-being; women; Nepal

JEL Codes: I14; I15; J16; Z12; Z13

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1 Introduction

Menstrual restrictions on women and girls are practised in many countries around the world[1]. Moreover, similar restrictions are also practised around the time of childbirth. These restrictions include being mandated to live in a separate house, separate room in the same house or, animal shed; eat a different type of food, bathe in a separate place, be absent from school/work and avoid social gathering. Although each of these restrictions are highly restrictive, those that mandate women to live in a separate house or in the animal shed, eat different kinds of food than what one usually consumes and bathe in a separate place are considered to be some of the strictest. In Nepal, menstrual restrictions are widespread and the strictest forms of restrictions is termed *Chhaupadi*[2]. These restrictions have arisen from the belief that women are ritually impure at the time of menstruation as well as childbirth (Thapa et al., 2019). Therefore, the practice of menstrual restrictions is deeply rooted in culture in Nepal [3]. Menstrual restrictions, including *Chhaupadi* have been categorized as one of the harmful practices prevalent in Nepal that arise from social norms that consider women to be inferior relative to men (UN, 2020). Such harmful practices like menstrual restrictions impose large costs on women's physical and mental health and impede their ability to acquire education and participate in the labour market (UN, 2020). Menstrual restrictions create barriers in guaranteeing good health and well-being for everyone and in achieving gender equality, which are important sustainable development goals (SDGs).

In this paper we study the association between menstrual restrictions, a gendered social norm, and physical and mental health indicators of women in Nepal. In particular, we study the association between individuals who face any menstrual restrictions and their access to healthcare around the time of childbirth and subjective well-being as measured by self-reported overall happiness. We use nationally representative data called the Multiple Indicator Cluster Survey (MICS) for Nepal, 2014 collected by the UNICEF for our analysis. The MICS survey is the only survey that we are aware of that asked respondents aged 15-49 years whether they face any restrictions at the time of menstruation. As similar restrictions are also prevalent around the time of childbirth (Amatya et al. (2018); Sharma et al. (2016)), this motivates us to study how these restrictions are associated with healthcare access at the time of childbirth. The outcomes we consider in this context are whether an individual

[1]For example, see Tan et al. (2017) for a description of these restrictions for countries around the world and Chawla (1994) for the origins of menstrual taboos in the context of India.

[2]Some of the strictest restrictions are largely prevalent in the mid and far-western regions of Nepal.

[3]In a different but related context of violence against women, Alesina et al. (2016) describe the cultural origins of actual prevalence as well as justification of violence against women for sub-Saharan Africa. Therefore, the cultural origins of practices that are detrimental to women has been well documented.

delivered her last child (born within the last 2 years of the survey) at home and if she was assisted only by a relative/friend (that is, no assistance from trained doctors, nurses, birth attendants) at the time of childbirth. These outcomes are important as home births and especially those that occur in the absence of trained medical personnel are typically associated with high rates of maternal mortality in Nepal on account of excessive bleeding and from otherwise preventable/treatable causes (Amatya et al., 2018). Lastly, the MICS collects information on subjective well-being of 15-24 year old women. We consider whether women report being overall unhappy with life as an indicator of subjective well-being and study whether being subjected to menstrual restrictions influences women's mental health as measured by overall happiness.

In the absence of exogenous variation in the likelihood of facing menstrual restrictions, identifying the causal impact of menstrual restrictions on our outcomes is challenging [4]. Therefore, our findings may be at best interpreted as correlations. However, we undertake the following steps with regard to the empirical analysis in the paper in the light of the absence of any exogenous shocks to the practice of menstrual restrictions.

Firstly, we carefully include a rich set of socio-economic and demographic controls in our analysis that could also potentially influence our outcome variables in addition to menstrual restrictions and some of them are also correlated with the likelihood of facing menstrual restrictions. For example, one's community identity such as religion and caste/ethnic identity are important factors that influence the likelihood of facing menstrual restrictions. For instance, Hindu and upper caste such as Brahman/Chhetri women are more likely to face menstrual restrictions relative to women belonging to other religious or caste/ethnic groups (Mukherjee et al. (2020); Rothchild and Piya (2020)). Therefore, inclusion of these variables can reduce bias arising from omitted variables. Further, one's age, educational attainment, residence in urban area can have important influence on whether an individual is likely to face any menstrual restriction. Younger women and especially women who are more educated are less likely to face menstrual restrictions as a number of qualitative analyses also show (Mukherjee et al. (2020); Rothchild and Piya (2020)). Individuals residing in rural areas in developing countries often rely on their community level informal networks for smoothing consumption or health shocks and for information (Fafchamps (2011); Munshi (2011)). Therefore, non-compliance with social norms such as menstrual restrictions may have costs; unlike for individuals residing in urban areas where reliance on informal community based networks may be relatively less important. Therefore, residence in a rural area may have

[4] Thapa et al. (2019), however, mention that women typically cannot choose whether to follow these restrictions as they are are mandated to follow these rituals on account of the prevailing social norms in their communities.

different implications for facing menstrual restrictions relative to residing in an urban area; in addition to having implications for accessing maternal healthcare and mental well-being resources. Also, richer households may have better exposure to information about menstruation, importance of maternal physical healthcare as well as mental well-being. We, therefore, include each of these socio-economic and demographic controls in our analysis. Additionally, we include region of residence fixed effects that attempt to account for unobserved differences across provinces, such as overall economic activity, culture as well as geographical differences that could also potentially influence the availability of health infrastructure. Importantly, the inclusion of region fixed effects is also likely to control for unobserved time-invariant cultural differences across provinces that could drive the adherence to the ritual of menstrual restrictions. For instance, menstrual restrictions (including the strictest forms) are more widely prevalent in western and far western regions of Nepal relative to other regions. Therefore, our results may be interpreted as correlations conditional on a rich set of potentially relevant socio-economic and demographic controls as well as region of residence fixed effects. We report the conditional odds ratios from logistic regression in our analysis as our outcome variables are binary. Additionally, we also report our findings from the linear probability model for the ease of interpretation of the coefficients.

Secondly, given the importance of observables such as religion, caste/ethnic group, education, location and region of residence etc. for explaining the variation in menstrual restrictions across individuals, we conduct several estimations that rely on selection on observables to assess the sensitivity of our results obtained from logistic (and linear probability) models with controls. In particular, we conduct propensity score matching using alternative numbers of nearest neighbours, inverse probability weighting and inverse probability weighted regression adjustment. It is important to note that although we conduct the sensitivity checks of our findings to alternative estimation methods, we cannot claim causality of our results [5].

We find that after including the full set of socio-economic and demographic controls and

[5]It is likely in our context that observables can shed some light on the role of any potential unobservables in influencing the association between menstrual restrictions and our outcomes. In other words, given our context and the role of observables such as one's social identity, for instance, in influencing the likelihood of facing any menstrual restrictions; we can use the selection on observables to assess the extent of selection on unobservables in our analysis. Therefore, we present selection (on unobservables) bias adjusted treatment effect of menstrual restriction on our outcomes under alternative assumptions of the degree of selection on unobservables relative to selection on observables in the spirit of Altonji et al. (2005). For this we follow the methodology developed by Oster (2019). For this analysis, we use the linear probability model as our estimation model (eg: see Ray et al. (2020) who conduct a similar analysis using linear probability model with binary outcome variable). This method attempts to provide bounds on the estimated relationship between menstrual restrictions and our outcomes of interest under the assumption that our observables can provide insights on the role of potential unobservables in our analysis. Because our outcomes are binary and we need to rely on the linear probability model for this analysis, we report these findings only in the appendix.

region of residence fixed effects, individuals who faced any menstrual restrictions have a nearly 53% higher odds of delivering at home and 62% higher odds of receiving assistance only from a relative/friend (that is, no assistance from trained doctors, nurses or birth attendants) during delivery; relative to individuals who faced no menstrual restrictions. The linear probability model coefficient estimates show that women who faced any menstrual restriction are 7 percentage points more likely to deliver at home and receive no medical assistance at delivery, conditional on the controls. Relative to the means of these outcome variables, facing any menstrual restriction is found to be associated with an increase of nearly 17% in the likelihood of delivering at home and 26% in the likelihood of being assisted only by a relative/friend at childbirth from the linear probability model coefficient estimates. In general, the odds ratios from the logistic regression and linear probability model results provide similar implications. We also study whether the lack of utilization of any formal medical care at the time of childbirth is a reflection of a general lack of willingness to accept medical care during other times when issues of ritual uncleanliness is not of paramount concern as during menstruation or childbirth. We find that facing any menstrual restriction is uncorrelated with receiving any type of antenatal care including tetanus injections and iron/folic tablets during pregnancy, conditional on all the controls and region of residence fixed effects. This provides some suggestive evidence that menstrual restrictions are indeed more likely to capture gendered social norms that emphasize ritual purity/cleanliness instead of a society's overall unwillingness to utilize modern medical care as concerns of ritual uncleanliness are not likely to arise during pregnancy but only at the time of menstruation and childbirth. Delivering at home and in the absence of trained medical personnel is associated with an increased risk of maternal mortality through haemorrhage in most low and middle income countries (Montgomery et al., 2014). Therefore, facing menstrual restrictions is likely to be associated with an increased risk of maternal mortality. With regard to subjective well-being, we did not find any significant association between facing any menstrual restrictions and self-assessed level of overall unhappiness among the youngest cohort of women. We categorized restrictions such as being mandated to live in a different house or animal shed, consume a different kind of food than usual or bathe in a separate place as some of the strictest restrictions. We find that women who face some of these strictest restrictions are more likely to assess that they are overall unhappy relative to women who face any other restriction or no restriction at all, conditional on all the controls and region of residence fixed effects. In particular, facing any of the strictest restrictions is found to be associated with an 189% increased odds of reporting being overall unhappy (from logistic regression) or a nearly 150% increase in the conditional likelihood of reporting being overall unhappy, relative to the mean (from linear probability model estimates). As the strictest set of menstrual

restrictions impose seclusion and mandate significant behavioural changes, it is possible that they are more likely to be associated with lower subjective well-being relative to the other restrictions or no restrictions at all. Lastly, our results from alternative estimation methods such as propensity score matching, inverse probability weighting as well as inverse probability weighted regression adjustment remain similar to our findings from the logistic and linear regression models.

Our findings, although not causal, are interesting from the perspective of policy makers as they demonstrate the negative association of cultural practices on individual well-being and in sustaining gender gaps especially in developing countries. Although we use data from Nepal, the issue of menstruation and childbirth related taboos and restrictions are prevalent in a large number of countries. Therefore, our findings are relevant for a large number of low and middle income countries. Importantly, our findings show that these restrictions are associated with potentially higher risk of maternal mortality through poor healthcare access. As maternal mortality explain a significant proportion of missing women in developing countries (Anderson and Ray, 2010), our findings reflect the need for future research to understand the causal impacts of traditional cultural practices on the prevalence of excess morbidity and mortality among women in these countries.

Contribution to the Literature

Studies examining the roles of menstrual restriction on women's well-being have been largely conducted in the field of public health (see for instance, Ranabhat et al. (2015); Amatya et al. (2018); Robinson (2015)). Most of the studies are qualitative and do not usually utilize samples that are nationally representative. Further, most studies have focused on menstrual hygiene practices and how it affects the health and schooling of adolescent girls and women (Adinma and Adinma (2008); Narayan et al. (2001); Hennegan and Montgomery (2016); Sommer (2010); Montgomery et al. (2012); Sivakami et al. (2019)) as well as how women perceive such restrictions (Mukherjee et al., 2020). Specifically studies in economics have also largely investigated the impact of menstruation on school or work absenteeism (Ichino and Moretti (2009); Herrmann and Rockoff (2012); Herrmann and Rockoff (2013); Krenz and Strulik (2019)); effect of onset of menstruation on school drop out (Khanna, 2019); determinants of uptake of menstrual hygiene products (Oster and Thornton, 2012) or interventions such as availability of menstrual hygiene products, sex-specific toilet infrastructure on schooling and labour market participation (Oster and Thornton (2011); Adukia (2017); Benshaul-Tolonen et al. (2019); Czura et al. (2019)). The possible association between menstrual restrictions and women's health related indicators that are not necessarily

limited around the time of menstruation has remained largely unexplored in the existing literature, especially in economics. This analysis seeks to contribute to the literature in this context.

Our paper attempts to contribute to the larger literature in economics that has highlighted the importance of religion, identity and culture, broadly, in influencing economic outcomes such as health, education and labour market participation as well as gender gaps in such outcomes (Iannaccone (1998); Akerlof and Kranton (2000); Guiso et al. (2006); Iyer (2016); Jayachandran (2015); Jayachandran (2020); Rammohan and Vu (2018); De Giusti and Kambhampati (2016); Xiao and Asadullah (2020); Blau et al. (2020), Salari (2020)). Secondly, our paper attempts to contribute to the growing literature in economics that studies the reasons for the persistence and the roles of harmful traditional practices in sustaining gender gaps in economic outcomes (Chesnokova and Vaithianathan (2010); Bellemare et al. (2015); Wagner (2015); Blaydes and Platas (2020)). As most of the existing studies have focused on female genital cutting or other traditional practices such as polygyny, dowry and bride price (Wagner and Rieger (2015); Mbaye and Wagner (2017); Ashraf et al. (2020); Anderson (2007)); our paper instead investigates the association of a different traditional practice, namely menstrual restrictions on women's health. Thirdly, our study also contributes to the branch of economics that studies subjective well-being (Deaton (2008); Dolan et al. (2008)) and the possible influence of discriminatory practices against women on their subjective well-being. Lastly, we believe our analysis complements the rich body of qualitative analyses in public health and other social sciences by employing quantitative tools such as regression and other alternative estimation methods (matching, inverse probability weighting, inverse probability weighted regression adjustment) using nationally representative data.

2 Cultural Context of the Analysis

Menstruation and in some instances childbirth are considered ritually polluting/unclean in many cultures. In Nepalese society, menstrual taboos and restrictions are widespread and are deeply rooted in culture. Qualitative studies have extensively documented the type of menstrual restrictions that are prevalent in Nepal (Amatya et al. (2018); Morrison et al. (2018); Rothchild and Piya (2020); Mukherjee et al. (2020)). These restrictions range from complete seclusion/segregation in a different house or room including animal shed; the prohibition on entering kitchens; preparing foods; consuming dairy products, salt or even any food of one's choice; touching plants, crop, livestock; coming in contact with any male family members; entering places of worship; the requirement to bathe in a different place than usual

and significant restrictions on mobility that would adversely affect attending school, work or any social gathering. Cleaning of the room, kitchen, bed on the fourth day of menstruation is also widely practised. The roles of one's social identity such as religion and caste/ethnic identity have significant influence on the practice of menstrual restrictions. For example, Rothchild and Piya (2020) mentions that although almost all castes held strong views about the ritual impurity of menstruation, different castes followed different practices and customs around menstruation. Their study notes that while upper caste Hindus such as Brahmans viewed menstruation as ritually unclean and the need to follow restrictions at the time of menstruation, people belonging to the Newar community viewed menstruation as a rite of passage to adulthood for girls. The authors also find that menstrual restrictions among lower caste Hindus such as Dalits as well as other social groups such as Janajatis are relatively not widespread; but are gaining popularity on account of emulation of upper caste norms. Further, Morrison et al. (2018) confirm that girls belonging to more traditional families, likely proxied by their upper caste status, reported that their families were more likely to strictly enforce menstrual restrictions with a view to protecting the family's honour. Older female family members and in their absence one's community plays a proactive role in enforcing these restrictions (Morrison et al., 2018). Significant differences also exist around the notion of ritual uncleanliness of menstruation by religion. Hindus are more likely to adhere to extreme forms of seclusion/segregation or completely prohibit mobility during menstruation relative to other religious groups such as Muslims and Buddhists who may follow limited restrictions such as prohibition on entering places of worship/touching religious texts; but permitting most other activities during menstruation (Amatya et al. (2018); Morrison et al. (2018)). Concerns of ritual pollution also exist around the time of childbirth and postpartum confinement practices that are similar to menstrual restrictions are followed (Amatya et al., 2018).

Concerns of ritual purity and cleanliness can have implications on women's healthcare access and overall assessment of subjective well-being in general that is not just limited to the time of menstruation. Cultural norms mandating seclusion or behavioural changes such as significant restrictions on mobility on account of concerns about ritual uncleanliness may impact accessing maternal healthcare around childbirth when similar concerns are also likely to arise. Further, seclusion and significant behavioural changes could affect one's mental well-being. Therefore, our study focuses on implications of cultural norms such as menstrual restrictions on maternal physical healthcare access that could in turn influence maternal mortality risk as well as subjective well-being among women in general.

3 Data

The dataset we use in this paper comes from the Nepal Multiple Indicator Cluster Survey (MICS), 2014 conducted by UNICEF for monitoring the situation of women and children. As our key explanatory variable of interest is facing any menstrual restriction, the MICS is the only dataset we are aware of that provides us with this information [6]. The data collection was carried out between February 2014 and June 2014 and collected nationally-representative data for a total of 12,405 households with a response rate of 98.5%. We use the individual woman dataset from MICS which provides information on women aged 15-49 years old.

3.1 Outcome Variables

We consider two outcome variables related to maternal healthcare in our analysis. In particular, we consider whether the respondent delivered her last child at home and if she was assisted only by a relative/friend during delivery (instead of trained medical personnel) for the last child born during the two years preceding the survey. These are binary variables that assume the value 1 if the variable description is true and is 0 otherwise. These variables attempt to capture important dimensions of women's physical health.

The MICS survey asks women aged between 15 and 24 years to assess their overall happiness on a scale of 1 to 5 [7]. Respondents were shown pictures of smiling/happy as well as not so smiling/happy faces and sad faces to assist them with answering these questions. We convert these scales to a binary variable that assume the value 1 if the individual reported that she is very unhappy or somewhat unhappy and 0 if she is neither happy nor unhappy, somewhat happy or very happy. We consider this outcome as a measure of women's subjective well-being and therefore as an indicator of women's mental health.

We report the summary statistics of the outcome variables in Table 1 here. We find that about 42% women had delivered their last child at home and around 27% women were assisted only by their friend/relative during delivery (that is, no trained doctor, nurse, skilled birth attendant was available). We also find that among 15-24 year old women, around 2% report being overall unhappy.

Table 1: Summary Statistics: All Variables

Variable	Mean	SD	Observations
Outcomes:			
If Delivered at Home	0.42	0.49	2,086
Assistance at Delivery only by Relative	0.27	0.44	2,056
If Unhappy	0.02	0.14	5,227
Explanatory Variable of Interest:			
If faces any Menstrual Restriction	0.69	0.46	14,091
If faces Strict Menstrual Restriction	0.11	0.32	14,091
Controls:			
Woman's Age (in years)	29.27	9.5	14,162
Combined Wealth Score	0.23	0.96	14,162
If Household Head is Female	0.28	0.45	14,162
If Household Head has No Education	0.40	0.49	14,162
Woman's Education Categories:			
No Education (omitted category)	0.37	0.48	14,162
Primary Education	0.14	0.35	14,162
Secondary Education	0.27	0.44	14,162
Higher Education	0.21	0.41	14,162
Religion Categories:			
Hindu (omitted category)	0.85	0.35	14,162
Buddhist	0.07	0.25	14,162
Muslim	0.03	0.18	14,162
Kirat	0.02	0.15	14,162
Christian	0.02	0.13	14,162
Prakriti	0.0004	0.02	14,162
Bon	0.0001	0.01	14,162
Jain	0.0001	0.01	14,162
Sikh	0.0005	0.02	14,162
Other Religion	0.003	0.05	14,162
No Religion	0.0005	0.02	14,162
Caste/Ethnic Group Categories:			
Janajati (omitted category)	0.30	0.46	14,138
Brahman/Chhetri	0.34	0.47	14,138
Dalit	0.11	0.31	14,138
Terai/Madhesi Other Castes	0.14	0.34	14,138
Newar	0.06	0.23	14,138
Muslim	0.04	0.19	14,138
Others	0.001	0.03	14,138
Urban (rural omitted category)	0.20	0.40	14,162

Note: Data source is 2014 Nepal MICS. Weighted means are reported."SD" refers to standard deviation. Observations are at the individual level. All variables are binary variables that assume the value 1 if the variable description is true and is 0 otherwise; except age of the woman (in years) and the combined wealth score. Sample sizes vary as outcomes such as place of delivery and assistance by relative at delivery are recorded for the last birth that occurred within two years preceding the survey. Question on happiness is asked to women aged 15- 24 years only.

3.2 Explanatory Variables

The main explanatory variable of interest is whether a respondent has faced any restriction around the time of menstruation. Respondents were asked if they faced any of the following restrictions at the time of menstruation which include being mandated to live in a different house, in a different room of the same house, in animal shed, eat a different type of food, bathe in a separate place, be absent from school/work, avoid social gathering. Our main explanatory variable is a dummy that assumes the value 1 if respondents have faced at least one of these restrictions and is 0 otherwise. Table 1 reports the summary statistics for the main explanatory variable of interest. We find that around 69% of women in the entire sample report facing at least one restriction around the time of menstruation. Further, we also created a binary variable that assumes the value 1 if a respondent lived in a different house or animal shed, or ate a different type of food or bathed in a separate place during menstruation. This variable assumes the value 0 if the respondent faced any other restrictions outlined above or no restrictions at all during menstruation. This variable is meant to capture whether a respondent faced any of the strictest menstrual restrictions or not. We find that around 11% respondents in our sample have faced at least one of the strictest restrictions during menstruation from Table 1.

The MICS provides information on a number of socio-economic and demographic characteristics of individual respondents which we use as controls in our analysis. These include controls for the individual's age in years, educational attainment, indicators for religion and caste/ethnic group of the household head, type of place of residence (that is, rural/urban), the combined wealth score (calculated using principal component analysis using information on water, sanitation facilities, dwelling characteristics and consumer durables ownership by MICS analogous to DHS) or alternatively indicators of household wealth quintiles (categories being poorest, poorer, middle, richer and richest quintiles) generated from this combined wealth score, whether the household head is female and the educational attainment of the household head. Inclusion of these variables is important in our regression analysis as they influence the practice of menstrual restrictions as well as our outcomes and as such omitting them would contribute to omitted variable bias in our estimations. Lastly, it is also important to include region of residence fixed effects to account for time invariant unobserved differences across provinces that influence both the culture of the practice of menstrual restrictions as well as availability of health infrastructure at a given point in time.

[6]No information on menstrual restrictions have been collected so far for the Nepal Demographic and Health Surveys.

[7]1=Very Happy, 2=Somewhat Happy, 3=Neither Happy nor Unhappy, 4=Somewhat Unhappy, 5=Very Unhappy.

Table 1 reports the summary statistics of the controls as well. We find that the average age of the respondents is around 29 years. The mean combined wealth score is around 0.23 with a standard deviation of 0.96. About 37% respondents have no education, 14% have completed primary education, 27% have completed secondary education and 21% have completed post-secondary education in the sample. We also find that around 28% of the households are female headed and 40% household heads have no education.

Religion and caste/ethnic group identity influence cultural practices in Nepal as in other countries in South Asia and these include cultural norms around menstruation as well. Not surprisingly, we find that the sample is dominated by Hindus who comprise 85% of the respondents. The Nepalese society is caste-based and we find a large number of caste/ethnic groups in our sample that are representative of Nepal. We rely on the classification of caste/ethnic groups in Bennet et al. (2008) which in turn follows the Census of Nepal (2001) to create our broad caste/ethnic group categories because a large number of caste/ethnic groups have been reported in the data. For example, respondents reporting their household head's caste/ethnic groups as *Hill Brahman*, *Chhetri*, *Thakuri*, *Sanyasi* as well as *Madhesi Brahman*, *Nurang*, *Rajput* and *Kayastha* have been coded as Brahman/Chhetri caste group; those reporting *Kewat*, *Mallah*, *Lohar*, *Nuniya*, *Kahar*, *Lodha*, *Rajbhar*, *Bing*, *Mali Kamar*, *Dhuniya*, *Yadav*, *Teli*, *Koiri*, *Kurmi*, *Sonar*, *Baniya*, *Kalwar*, *Thakur/Hazam*, *Kanu*, *Sudhi*, *Kumhar*, *Haluwai* , *Badhai*, *Barai*, *Bhediyar/ Gaderi* are coded as Terai/Madhesi other castes; those reporting *Kami, Damai/Dholi, Sarki, Badi, Gaine, Unidentified Dalits* as well as *Chamar/Harijan, Musahar, Dushad/Paswan, Tatma, Khatwe, Dhobi, Baantar, Chidimar, Dom, Halkhor* are coded as Dalits. Respondents who reported their household head's ethnic groups as *Tamang, Kumal, Sunuwar, Majhi, Danuwar, Thami/Thangmi, Darai, Bhote, Baramu/Bramhu, Pahari, Kusunda, Raji, Raute, Chepang/Praja, Hayu, Magar, Chyantal, Rai, Sherpa, Bhujel/Gharti, Yakha, Thakali, Limbu, Lepcha, Bhote, Byansi, Jirel, Hyalmo, Walung, Gurung, Dura* as well as *Tharu, Jhangad, Dhanuk, Rajbanshi, Gangai, Santhal/Satar, Dhimal, Tajpuriya, Meche, Koche, Kisan, Munda, Kusbadiya/Patharkata, Unidentified Adibasi/Janajati* have been coded as Janajati. The sample also contained individuals who identified their household heads as belonging to Muslim caste/ethnic group and we, as such, code them as Muslims. Lastly, other groups include respondents who reported their household heads as *Marwari, Bangali, Jain, Punjabi/Sikh, Unidentified Others* and they were coded as Others. We find from Table 1 that around 30% of the respondents identify their household as Janajati, 34% as Brahman/Chhetri, 11% as Dalit, 14% as Terai/Madhesi caste groups, 6% as Newar, 4% as Muslim and 0.01% as other caste groups.

Around 20% of the respondents report living in an urban area from Table 1. There were five broad regions in Nepal at the time of the survey that include Eastern, Central, Western,

Mid-Western and Far-Western regions. Each of these regions had three sub-regions called the Mountain, Hill and *Terai* [8]. We find that the *Terai* sub-regions in each of the regions have a greater proportion of respondents (we do not present these in the table for conciseness). We include sub-region level dummies to account for unobserved heterogeneities in culture, economic opportunities as well as availability of public goods across different regions in Nepal.

4 Empirical Strategy

4.1 Empirical Specification

We estimate the odds ratio from the following logistic regression model as our outcome variables are binary:

$$P(y_{ir} = 1) = F(\beta_0 + \beta_1 MR_{ir} + \beta_2 X_{ir} + \delta_r) \tag{1}$$

Here, $F(z)$ is the cumulative distribution function of the logistic distribution.

Additionally, we also present the coefficient estimates from a linear probability model for the ease of interpretation of the coefficients:

$$P(y_{ir} = 1) = \beta_0 + \beta_1 MR_{ir} + \beta_2 X_{ir} + \delta_r \tag{2}$$

y_{ir} refers to outcome variables of interest for individual woman i in sub-region r. These outcome variables in alternative specifications refer to women's healthcare access around the time of childbirth - whether the respondent delivered her last child at home, if the respondent was only assisted by relatives/friends during delivery; and an indicator for subjective well-being - if the respondent is overall unhappy (among 15-24 year old women only). All our outcome variables are binary variables that assume the value 1 if the variable description is true and is 0 otherwise.

MR_{ir} is our explanatory variable of interest which assumes the value 1 if the respondent i in sub-region r faces any menstrual restriction and is 0 otherwise. Therefore, β_1 is our coefficient of interest. X_{ir} are the vector of controls that include age of the respondent in years; the respondent's household's combined wealth score calculated by MICS (alternatively, one could include dummy variables that indicate the wealth quintile the respondent's household belongs to with the poorest wealth quintile being the omitted category); dummies for the respondent's educational attainment, if the respondent's household head is female, if the

[8] *Terai* implies lowlands that are to the south of the Himalayas and form the centres of major economic activities in Nepal.

household head has no education, if the respondent resides in an urban area as well as a number of dummies that control for religion and caste/ethnic group of the household head. δ_r are sub-region of residence fixed effects. We apply weights for individual women provided in the MICS survey. The regression disturbance term is adjusted for heteroscedasticity.

Since we do not have experimental variation in facing menstrual restrictions, an important concern is likely to be of omitted variable bias where there could be unobserved differences between individuals who face and those who do not face menstrual restrictions. Therefore, absent exogenous shocks that could vary the practice of menstrual restrictions, it is best to be cautious and interpret our findings as correlations. However, we attempt to control for a rich set of socio-economic and demographic factors that are both likely to influence our outcomes as well as the practice of menstrual restrictions; thereby potentially reducing some concern about omitted variable bias.

In particular, the existing literature has shown that one's religion, caste/ethnic group identity and education are important correlates of the practice of menstrual restrictions (Mukherjee et al., 2020). Religion, caste/ethnic group identity and educational attainment also influence an individual's beliefs and ability about accessing maternal healthcare and education influences awareness about one's mental health. We therefore control for these variables in our regression analysis. Older women may be more likely to face menstrual restrictions and may also have very different patterns of healthcare utilization at childbirth, relative to their younger counterparts. Therefore, we control for the respondent's age in all our specifications. Similarly, residence in urban area may lead to relatively weaker compliance to menstrual restrictions. However, Mukherjee et al. (2020) note that the idea that menstruation is ritually polluting is deeply culturally rooted and therefore, is also prevalent in some form in the urban Nepalese society. Further, residence in an urban area can also influence access to maternal physical and overall mental healthcare. Therefore, we control for residence in an urban area in our estimations. We also include controls for household wealth as well as the gender and educational attainment of the household head as these could influence our outcomes of interest. Further, there exists regional variation in cultural norms around menstruation (as well as childbirth). Mid-Western and Far-Western regions of Nepal are more likely to adhere to the norm of menstrual restrictions, particularly those which are very strict. Inclusion of region fixed effects and in particular sub-region fixed effects are likely to account for unobserved cultural differences as well as geographic constraints that could influence the delivery of public goods, information campaigns discouraging traditional practices such as menstrual restrictions at a given point in time. Hence, our findings may be interpreted as correlations conditional on a rich set of potentially relevant socio-economic and demographic controls and sub-region fixed effects.

4.2 Alternative Estimation Methods for Sensitivity Analysis

We conduct a number of estimations using alternative estimation methods to assess the sensitivity of our findings to these alternative estimation models. In particular, we conduct propensity score matching, inverse probability weighting and inverse probability weighted regression adjustment. Although we cannot claim that our estimations have a causal interpretation, conducting these alternative estimations may be important in our context given the roles of observable characteristics in influencing the adherence to menstrual restrictions. The practice of menstrual restrictions is deeply rooted in culture and religion in Nepal. Both quantitative and qualitative studies have indicated that menstrual restrictions stem from the belief of ritual impurity (Thapa et al. (2019); Mukherjee et al. (2020); Amatya et al. (2018); Rothchild and Piya (2020)). For example, Rothchild and Piya (2020) mentions that beliefs around ritual impurity of menstruation and childbirth are widely prevalent among Hindus; while Amatya et al. (2018) notes that most Buddhists regard menstruation as a natural physical process. Further, upper castes such as Brahman/Chhetri households are more likely to mandate the practice of menstrual restrictions relative to Dalit and Janajati households; although these practices are gaining acceptability among the latter on account of emulation of upper caste norms (Rothchild and Piya, 2020). Further, it has already been noted that there exists regional variation in the practice of menstrual restrictions. Therefore, one's cultural identity as proxied by religion, caste/ethnic group and region of residence are important correlates of whether an individual is likely to face menstrual restrictions. Further, one's age, educational attainment and type of place of residence may be important in influencing the practice of menstrual restrictions. For example, older women, those with lower levels of education and those residing in rural areas where community networks are strong are more likely to face menstrual restrictions. Given the importance of observable covariates in influencing selection into facing menstrual restrictions and in the absence of exogenous shocks to facing menstrual restrictions, we rely on propensity score matching, inverse probability weighting and inverse probability weighted regression adjustment methodologies commonly used with observational data for our sensitivity analyses.

5 Results

We first report odds ratios from logistic regression of menstrual restrictions on our outcomes by successively adding more controls, including sub-region of residence fixed effects. Additionally we report the coefficient estimates from a linear probability model as well. We then consider whether facing some of the strictest menstrual restrictions has any differential

implications on our outcomes vis-a-vis facing any menstrual restrictions. Lastly, we report our findings from alternative estimation methods to assess the sensitivity of our results to these alternative models.

5.1 Regression Results: Physical Health Indicators

Table 2: Regression Results: Physical Health Indicators - Maternal Healthcare

	(1)	(2)	(3)	(4)	(5)	(6)
	Logistic (OR)	Logistic (OR)	Logistic (OR)	Logistic (OR)	Logistic (OR)	LPM
Panel A: If Respondent Delivered at Home						
If Faced Any Menstrual Restrictions	1.43***	1.59***	1.64***	1.58***	1.53***	0.07**
	(0.18)	(0.21)	(0.24)	(0.24)	(0.24)	(0.03)
Constant	0.57***	0.20***	0.82	0.39**	1.12	0.54***
	(0.06)	(0.06)	(0.30)	(0.16)	(0.55)	(0.09)
Psuedo-R^2/R^2	0.005	0.048	0.144	0.203	0.224	0.254
Observations	2,084	2,076	2,076	2,076	2,076	2,078
Panel B: If Assisted by Relative/Friend at Delivery						
If Faced Any Menstrual Restrictions	1.48***	1.72***	1.77***	1.72***	1.62***	0.07***
	(0.21)	(0.26)	(0.29)	(0.29)	(0.28)	(0.03)
Constant	0.28***	0.14***	0.48*	0.24***	0.62	0.42***
	(0.03)	(0.05)	(0.19)	(0.11)	(0.32)	(0.09)
Psuedo-R^2/R^2	0.006	0.046	0.120	0.161	0.181	0.166
Observations	2,054	2,044	2,044	2,044	2,044	2,048
Religion & Caste/Ethic Group Controls		✓	✓	✓	✓	✓
Individual's Age		✓	✓	✓	✓	✓
Individual's Education Category Controls			✓	✓	✓	✓
Urban Residence Dummy			✓	✓	✓	✓
Household Wealth Index				✓	✓	✓
Household Head Controls				✓	✓	✓
Sub-Region of Residence Fixed Effects					✓	✓

Note: Data source is 2014 Nepal MICS. Observations are at the individual level. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels of significance respectively. Regressions are weighted by the survey weight of the individual woman. For the logistic regression model, odds ratios (OR) are reported. Psuedo-R^2 applies to the logistic regression model. "LPM" refers to the linear probability model. All outcome variables are binary variables that assume the value 1 if the variable description is true and is 0 otherwise. Outcomes such as place of delivery and assistance by relative at delivery are recorded for the last birth that occurred within the 2 years preceding the survey. Age of the respondent is reported in years. We include dummies for education categories of the respondent (no education being the omitted category), dummies for religion of the household head (Hindu being the omitted category), dummies for caste/ethnic group categories (Janajati being the omitted category), dummy for if the respondent lives in urban area. Household head controls include a dummy for if the household head is female and a dummy if the head has no education.

Table 2 here presents the odds ratios from the estimation of the logistic regression model with varying set of controls in columns (1)-(5). Column (1) includes no controls, except the explanatory variable of interest, if the respondent faced any menstrual restrictions, and a constant. Column (2) additionally controls for the household head's religion and caste/ethnic group dummies and age of the respondent; Column (3) further includes controls for the individual's education categories as well as a dummy for whether the respondent resides in

an urban area; Column (4) additionally includes the respondent's household's wealth index and controls for whether the household head is female and if he/she has no education. Lastly, Column (5) includes the full set of socio-economic and demographic controls as in Column (4) and additionally includes the sub-region of residence fixed effects. Column (6) reports the coefficient estimates from a linear probability model (LPM) of our outcomes on the full set of controls and sub-region of residence fixed effects as in Column (5). The outcome variable of interest in Panel A is whether the respondent delivered her last child (born within the 2 years preceding the survey) at home and that in Panel B is if she was assisted only by a relative/friend at delivery (that is, no assistance from trained doctors, nurses, skilled birth attendants).

Across all columns in Panels A and B of Table 2, we find that respondents who faced any menstrual restrictions are more likely to give birth at home and be assisted only by a relative/friend (that is, no trained medical personnel) at the time of delivery. The odds ratios from the logistic regressions corresponding to our explanatory variable of interest are above 1 and statistically significant. We focus on Column (5) of Table 2 for the purpose of interpretation of our results [9]. Conditional on all controls and including sub-region of residence fixed effects, we find that women who faced any menstrual restrictions have a 53% higher odds of delivering their last child at home and 62% higher odds of being assisted by only a relative/friend at delivery. The LPM coefficient estimates from Column (6) reveal that conditional on the full set of controls as in Column (5), women who faced any menstrual restrictions are nearly 7 percentage points more likely to deliver at home and be assisted only by a relative/friend at delivery. Relative to the respective means, the LPM coefficient estimates imply an increase of nearly 17% in the likelihood of delivering at home and 26% increase in the likelihood of being assisted only by a relative/friend at childbirth. Therefore, LPM coefficient estimates from Column (6) are qualitatively similar to the the odds ratio from the logistic regressions in Column (5).

Given the above associations between menstrual restrictions and maternal healthcare at childbirth, it is important to discuss the significance of these findings, even if they are correlations. Direct obstetric causes such as haemorrhage is one of the most common causes of maternal deaths in many low and middle income countries and access to maternal healthcare can reduce otherwise avoidable maternal deaths (Montgomery et al., 2014). Institutional births have been shown to be associated with low maternal mortality in other low and middle income countries (Hieu et al., 1999). Historically, the introduction of sulfa drugs resulting in the medicalization of childbirth through institutional deliveries has been seen to contribute

[9]Including dummies for wealth quintiles instead of a continuous measure such as wealth index generates very similar results; therefore, we do not present them here.

to a decline in maternal mortality in the United States (Thomasson and Treber, 2008). Further, women legislators have played important role in reducing maternal mortality by aiding increased prevalence of skilled birth attendants at childbirth (Bhalotra et al., 2020). Policies that incentivize institutional deliveries are also associated with higher postnatal health check-up prevalence among beneficiaries (Sen et al., 2020). Even in the context of rich countries, institutional deliveries have shown reductions in newborn mortality even in low-risk pregnancies on account of access to medical technologies (Daysal et al., 2015). Given the importance of institutional births and trained medical personnel attending childbirths for maternal survival, cultural norms that are associated with increased prevalence of home births and lack of presence of medical personnel are likely to substantially increase the likelihood of maternal mortality. Around 40% of maternal deaths occur at home in Nepal (Devkota et al., 2020). Suwal (2008) points out the importance of cultural practices among various caste and ethnic groups, the lack of sanitary condition at home on maternal mortality as well as the role of institutional births as one of the mechanisms of ensuring maternal survival. Menstrual restrictions including *Chhaupadi* are practised not just around the time of menstruation, but also around the time of childbirth as women are considered to be ritually impure around these phases of their lives. It is possible that women who face menstrual restrictions are also likely to face similar restrictions around the time of childbirth which, in turn, is likely to be associated with an increased risk of maternal mortality (Amatya et al., 2018).

5.2 Are Menstrual Restrictions Correlated with Other Prenatal Healthcare Utilization?

The earlier findings point towards decreased probability of accessing healthcare at the time of childbirth. An important question that might arise in this context is that do menstrual restrictions generally capture a society's overall unwillingness to accept modern medicine instead of capturing a cultural norm that places importance on isolation and confinement on account of concerns about ritual uncleanliness. It might be important to make this distinction because, contrary to cultural norms that place importance on ritual purity (and in most cases on women), cultural norms that signify unwillingness to accept modern medicine may not have gender specific implications or intergenerational impacts on children through their effect on women.

Table 3 presents the association between facing any menstrual restriction on some indicators of antenatal healthcare utilization such as the likelihood of receiving any antenatal

Table 3: Regression Results: Correlations with Other Prenatal Healthcare Utilization

	(1) Has Received Any Antenatal Care	(2) Given Tetanus Shot During Pregnancy	(3) Given/Bought Iron-Folic Tablets
Panel A: Logistic (Odds Ratio)			
If Faced Any Menstrual Restrictions	0.83	1.07	1.08
	(0.19)	(0.23)	(0.39)
Psuedo-R^2	0.193	0.150	0.160
Observations	1,953	2,025	1,402
Mean of Dependent Variable	0.88	0.88	0.97
Panel B: LPM			
If Faced Any Menstrual Restrictions	-0.02	0.003	0.003
	(0.02)	(0.02)	(0.01)
R^2	0.121	0.104	0.050
Observations	2,051	2,029	1,753
Mean of Dependent Variable	0.88	0.88	0.97
All Controls	✓	✓	✓
Sub-Region of Residence Fixed Effects	✓	✓	✓

Note: Data source is 2014 Nepal MICS. Observations are at the individual level. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels of significance respectively. Indicators of prenatal healthcare utilization outcomes refer to the last birth that occurred within the 2 years preceding the survey and are binary variables that assume the value 1 if the variable description is true and is 0 otherwise. Weighted means of the dependent variables have been reported. "All controls" refers to the full set of socio-economic and demographic controls included in Column (4) of Table 2. For all other details, refer to table notes of Table 2.

care, any tetanus injection and been given/buying iron and folic tablets during the last pregnancy. We report the odds ratio estimates from logistic regressions in Panel A and the LPM coefficient estimates in Panel B. We use the full set of socio-economic and demographic controls as well as sub-region of residence fixed effects as in Column (5) or (6) of Table 2 as our estimation specification. We do not find any statistically significant association between facing any menstrual restriction and the probability of receiving any antenatal care, tetanus injection, access to iron and folic tablets during the pregnancy with the last child who was born within the two years before the survey (the means of the dependent variables are also reasonably high). Therefore, there does not appear to be a significant association between facing any menstrual restriction and antenatal healthcare access/utilization, conditional on the controls. This provides some suggestive evidence that facing menstrual restrictions is unlikely to indicate a society's overall unwillingness to utilize modern medicine and that they are more likely to capture a society's gender specific requirements of ritual purity/cleanliness. As issues of ritual uncleanliness/impurity arise at the time of childbirth and not during pregnancy, it is possible that cultural norms such as menstrual restrictions (similar restrictions are also practised around the time of childbirth) that lay stress on ritual purity are more likely to influence healthcare access and utilization during the time when ritual uncleanliness is imminent in contrast to time periods when ritual uncleanliness is not of paramount

concern.

5.3 Regression Results: Mental Health Indicator - Overall Happiness

Table 4: Regression Results: Mental Health Indicator - Overall Unhappiness

	(1)	(2)	(3)	(4)	(5)	(6)
	Logistic (OR)	Logistic (OR)	Logistic (OR)	Logistic (OR)	Logistic (OR)	LPM
If Respondent is Overall Unhappy						
If Faced Any Menstrual Restrictions	1.13	1.28	1.23	1.22	1.29	0.005
	(0.30)	(0.37)	(0.36)	(0.36)	(0.39)	(0.006)
Constant	0.02***	0.02***	0.05***	0.05***	0.11*	0.05**
	(0.004)	(0.02)	(0.05)	(0.05)	(0.13)	(0.03)
Psuedo-R^2/R^2	0.0003	0.047	0.073	0.073		0.027
Observations	5,172	5,151	5,151	5,151	5,091	5,163
Religion & Caste/Ethic Group Controls		✓	✓	✓	✓	✓
Individual's Age		✓	✓	✓	✓	✓
Individual's Education Category Controls			✓	✓	✓	✓
Urban Residence Dummy			✓	✓	✓	✓
Household Wealth Index				✓	✓	✓
Household Head Controls				✓	✓	✓
Sub-Region of Residence Fixed Effects					✓	✓

Note: Data source is 2014 Nepal MICS. Observations are at the individual level. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels of significance respectively. Regressions are weighted by the survey weight of the individual woman. For the logistic regression model, odds ratios are reported. Psuedo-R^2 applies to the logistic regression model. "LPM" refers to the linear probability model. Outcome variable is binary variable that assumes the value 1 if the variable description is true and is 0 otherwise. Sample is restricted to include 15-24 year old women. We include dummies for education categories of the respondent (no education being the omitted category), dummies for religion of the household head (Hindu being the omitted category), dummies for caste/ethnic group categories (Janajati being the omitted category), dummy for if the respondent lives in urban area. Household head controls include a dummy for if the household head is female and a dummy if the head has no education.

We study the implications of facing any menstrual restriction on an indicator of mental health for women aged 15-24 years old at the time of the survey, namely their subjective assessment of how "happy" they felt overall. Studying cultural norms that mandate ritual purity on women is important not only from the point of view for their implications on women's physical health; but also for their potential implications for women's mental health.

Table 4 here reports the association between facing any menstrual restrictions and overall unhappiness conditional on the set of socio-economic and demographic controls as well as sub-region of residence fixed effects. Columns (1)-(5) report the odds ratio from logistic regression of menstrual restriction on our indicator of mental health by successively adding additional controls including sub-region of residence fixed effects and Column (6) reports the coefficient estimate from the LPM using the full set of controls as in Column (5) of Table 4. An odds ratio higher than 1 from logistic regression or a positive coefficient on menstrual restrictions (both of which when statistically significant) would indicate that women who faced any menstrual restrictions are more likely to report that they are overall unhappy.

However, we do not find any significant association between facing any menstrual restriction on perception of overall unhappiness from either the logistic regression or linear probability model estimates.

One concern from this finding is that the respondents may not have understood the question on assessing their overall happiness correctly and therefore these findings may indicate a noisy estimate of the association between facing any menstrual restriction and overall unhappiness. However, we think that this is unlikely for the following reasons. Firstly, questions on the assessment of overall happiness are asked to the cohort of youngest women in the survey, that is, those who are 15-24 years old. Unsurprisingly, our data show that women's age is negatively correlated with their educational attainment. Therefore, younger women are more likely to be more educated in our sample. It may therefore seem more likely that younger women may be more able to understand the question on assessment of their overall happiness correctly on account of their higher educational endowment. Secondly, respondents were provided with pictorial depictions of emotions to assist them with their answers on subjective well-being. Lastly, we also study whether facing some of the strictest set of menstrual restrictions instead of any or no menstrual restriction influences the assessment of overall happiness in the subsequent section. We find that facing the strictest set of restrictions is associated with a higher likelihood of reporting being overall unhappy among 15-24 year old women. If respondents are more likely to incorrectly understand the question, it is unlikely that we might find a positive correlation between facing the strictest set of restrictions and overall unhappiness. We elaborate on this finding in the next section.

5.4 Correlations Of Health Indicators with "Strict" Menstrual Restrictions

Here we study the association between facing the strictest set of menstrual restrictions on our outcomes of interest - both physical and mental health outcomes. We classify the restrictions that mandate women either to live in a different house or animal shed, eat a different type of food than what they usually consume or bathe in a separate place during menstruation as the strictest set of restrictions. Our explanatory variable of interest here assumes the value 1 if a respondent has faced at least one of the aforementioned restrictions and is 0 if she faced any of the other menstrual restrictions or no restriction at all. Therefore, here we seek to compare women who faced the strictest set of menstrual restrictions with women who face other "milder" forms of restrictions as well as no restriction at all, conditional on the controls and sub-region of residence fixed effects.

Table 5 reports the odds ratio from the logistic regression in Panel A and coefficient estimates of strict menstrual restrictions on each of our outcomes using the LPM in Panel

Table 5: Correlations with "Strict" Menstrual Restrictions

	(1) If Respondent Delivered at Home	(2) If Assisted Only by Friend/Relative at Delivery	(3) If Overall Unhappy
Panel A: Logistic (Odds Ratio)			
If Faced Any "Strict" Menstrual Restrictions	1.46*	1.15	2.89***
	(0.33)	(0.29)	(1.06)
Psuedo-R^2	0.222	0.175	0.124
Observations	2,076	2,044	5,091
Panel B: LPM			
If Faced Any "Strict" Menstrual Restrictions	0.06	0.02	0.03**
	(0.04)	(0.04)	(0.01)
R^2	0.251	0.161	0.029
Observations	2,078	2,048	5,163
All Controls	✓	✓	✓
Sub-Region of Residence Fixed Effects	✓	✓	✓

Note: Data source is 2014 Nepal MICS. Observations are at the individual level. Robust standard errors are in parentheses. ***, **, * indicate statistical significance at the 1%, 5% and 10% levels of significance respectively. All outcomes are binary variables that assume the value 1 if the variable description is true and is 0 otherwise. "All controls" refers to the full set of socio-economic and demographic controls included in Column (4) of Table 2 or 4. For all other details, refer to table notes of Table 2 or Table 4.

B. We use the full set of socio-economic and demographic controls as well as sub-region of residence fixed effects as in Columns (5) and (6) of Tables 2 and 4 as our estimation specification. Panel A shows that conditional on the full set of controls, the odds ratio on facing at least one of the "strict" menstrual restrictions is higher than 1 for all our outcomes and is statistically significant for the outcome if the respondent delivered at home and if the respondent said that she was overall unhappy (although the odds ratio corresponding to if the respondent delivered at home is significant at the 10% level of significance). These indicate that respondents who faced any of the "strict" menstrual restrictions had a 46% higher odds of delivering at home and 189% higher odds of reporting being overall unhappy. Panel B reports the coefficient estimates from the LPM. Here, we find that women who faced any of the "strict" menstrual restrictions are around 3 percentage points more likely to report being overall unhappy. Relative to the mean of this outcome variable, this translates to 150% higher likelihood of reporting being overall unhappy. The coefficient estimates on the physical health indicators are statistically insignificant, which is largely similar to what we found from the odds ratios of these outcomes from Panel A.

Although these estimates are correlations, they are nevertheless interesting in the sense that facing the strictest set of menstrual restrictions appear to have largely weak or no additional disadvantage with regard to maternal healthcare utilization or access at the time of childbirth; however, strictest restrictions appear to have large negative implications for

one's mental health among 15-24 year old women. This is in contrast to the situation of facing any menstrual restriction that has negative implications for maternal physical health but has no significant association with the mental health of the youngest cohort of women. A potential explanation of this finding might be that facing some of the strictest set of menstrual restrictions mandates complete seclusion and significant changes in one's diet and daily life. These are likely to have a larger influence on one's mental health in contrast to facing any of the "milder" restrictions that may not mandate large behavioural changes or complete seclusion.

5.5 Sensitivity of Results to Alternative Estimation Methods

Table 6: Sensitivity Analysis

	PSM Nearest Neighbor (1 Nearest)	PSM Nearest Neighbor (5 Nearest)	Inverse Probability Weighting	IPW Regression Adjustment
Panel A: If Delivered at Home				
Any Menstrual Restrictions (ATET)	0.11**	0.12***	0.11***	0.09**
	(0.05)	(0.03)	(0.03)	(0.04)
Observations	2,078	2,078	2,078	2,078
Panel B: If Assisted Only by Relative				
Any Menstrual Restrictions (ATET)	0.10**	0.10***	0.10***	0.08*
	(0.04)	(0.03)	(0.03)	(0.04)
Observations	2,048	2,048	2,048	2,048
Panel C: If Overall Unhappy				
Any Menstrual Restrictions (ATET)	-0.01	-0.005	0.0002	-0.005
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	5,163	5,163	5,163	5,163

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels of significance respectively. PSM refers to propensity score matching, IPW refers to inverse-probability weighting. Abadie-Imbens robust standard errors are reported for PSM. ATET refers to the average treatment effect on the treated.

We assess the sensitivity of our results obtained from logistic regressions with relevant set of controls and region of residence fixed effects to alternative estimation methods. In particular, we conduct propensity score matching, inverse probability weighting and inverse probability weighted regression adjustment. We use our covariates on age, education, urban residence, religion, caste/ethnic group identity, characteristics of household head, household wealth index and region of residence dummies as determinants of facing any menstrual restriction [10]. We use logistic regression to predict the role of these different variables in

[10]Here, we aggregate some of our variables to ensure "sufficient" number of observations in both treatment and control groups. For example, we club together different sub-regions like Eastern Mountains, Eastern Hills and Eastern *Terai* into Eastern region and analogously for the sub-regions of the other regions. We club

determining the likelihood of facing any menstrual restriction. For propensity score matching, we match each treated individual with 1 and alternatively 5 nearest neighbours in the control group based on the estimated propensity score [11].

Table 6 here reports the results from these alternative estimation methods. The table reports the average treatment effect on the treated (ATET). We see that the findings from the propensity score matching, inverse probability weighting and inverse probability weighted regression adjustment across all our outcome variables are qualitatively similar to the findings obtained in Tables 2 and 4. In other words, facing any menstrual restriction is found to be associated with higher likelihood of delivering at home and receiving no assistance from trained medical personnel at delivery; which is potentially indicative of following similar restrictions around childbirth on account of similar concerns about ritual uncleanliness during childbirth. The ATET estimates across all the estimation methods show that respondents facing any menstrual restriction are between 9 to 12 percentage points more likely to deliver at home and between 8 and 10 percentage points more likely to be assisted only by a relative/friend at delivery. While comparing the point estimates from Table 6 and the odds ratios from Table 2 is not straightforward, it is comforting to find that the findings from alternative estimation methods in both the tables are in the same direction. Lastly, facing any menstrual restriction is not found to be significantly associated with being overall unhappy among 15-24 year old women. This finding from Table 6 is again similar to what we obtained from Table 4 above.

6 Conclusion

This paper studies the implications of a gendered cultural norm, menstrual restrictions on women's physical and mental health indicators. Using nationally representative data from Nepal where these practices are widely prevalent and controlling for a rich set of socio-economic and demographic variables we find that facing any menstrual restriction is asso-

together all other religions apart from Hinduism as non-Hindus and Janajatis, Muslims and other unidentified caste/ethnic groups together as other caste/ethnic groups.

[11] Appendix Figure A.1 reports the overlap graphs for the propensity score matching. The top graph corresponds to the outcomes related to place of and assistance at delivery, while the bottom graph is for the outcome overall unhappiness. We report different graphs due to varying sample sizes. The overlap graphs plot the estimated probabilities that an individual who did not face any menstrual restriction does not face such a restriction and that an individual who faced any menstrual restriction does not face such a restriction. We see that the estimated densities have their masses mostly over the regions where they overlap, indicating that the overlap or common support condition is unlikely to be violated here. Appendix Table A.1 presents the covariate balance table. As our sample size changes between outcomes, we report the covariate balance results separately for the different sample sizes. We find that across most covariates, matching improves covariate balance.

ciated with an increase in the likelihood of delivering at home and without any assistance from trained medical personnel; thereby increasing the risk of maternal mortality. Although we did not find that facing any menstrual restriction is associated with a significant decline in self-assessed overall happiness among younger women; we find that facing the strictest set of restrictions that mandate complete seclusion/segregation as well as large behavioural changes are associated with a decline in subjective well-being. As menstrual restrictions are influenced by one's social identity such as religion, caste/ethnic group, region of residence as well as other observables such as one's education, urban location of residence (which we also control for in our analysis as these variables also influence our outcome variables); we also use alternative estimation methodologies that rely on selection on observables such as propensity score matching, inverse probability weighting and inverse probability weighted regression adjustment to assess the sensitivity of our findings to these alternative estimation methods. Although we do not claim that our results are causal, our findings are largely similar across alternative set of control variables and estimation methods.

A limitation of our study is that we are not in a position to claim that our findings are causal as exogenous changes to or experimental variation in cultural norms are very hard to encounter. Nevertheless, our analysis provides some important insights for policymakers. Our study highlights that it is imperative to consider the role of traditional cultural norms in understanding how they can likely influence health outcomes, especially for women in developing countries where adherence to socio-cultural and religious norms are strong. We believe that information based campaigns that seek to de-stigmatize menstruation and promote menstruation and childbirth as normal biological processes can be a potentially important first step in changing cultural norms as standalone sweeping legal changes, although necessary, may not be able to bring about much success in discouraging practices that are deeply rooted in culture. Policy makers can then assess the extent to which changing norms about menstrual restrictions can improve women's physical and mental health in developing countries where traditional cultural practices are widely prevalent.

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Appendix A

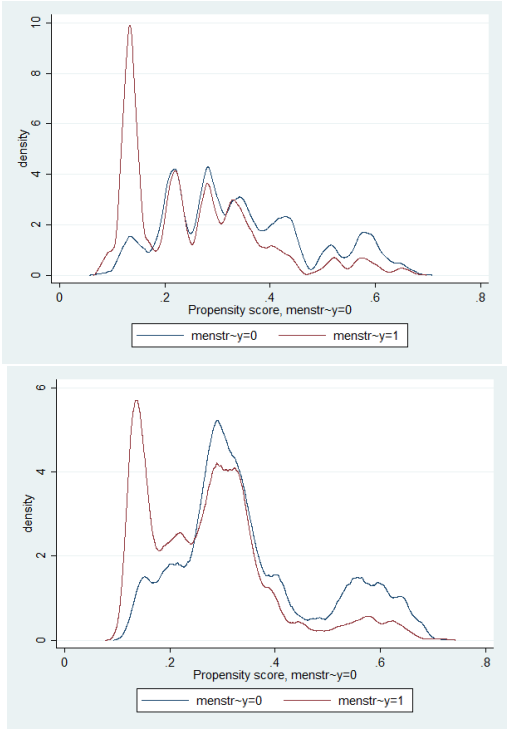

Figure A.1: Overlap graphs for outcomes: Delivery at Home/Assistance at Delivery by Relative (top) and If Unhappy (bottom)

Appendix B

Assessing Selection on Unobservables From Selection on Observables

The practice of menstrual restrictions is deeply rooted in culture and religion in Nepal. Both quantitative and qualitative studies have indicated that menstrual restrictions stem from the belief of ritual impurity (Thapa et al. (2019); Mukherjee et al. (2020); Amatya et al. (2018); Rothchild and Piya (2020)). For example, Rothchild and Piya (2020) mentions that beliefs around ritual impurity of menstruation and childbirth are widely prevalent among Hindus; while Amatya et al. (2018) notes that most Buddhists regard menstruation as a natural physical process. Further, upper castes such as Brahman/Chhetri households are more likely to mandate the practice of menstrual restrictions relative to Dalit and Janajati households; although these practices are gaining acceptability among the latter on account of emulation of upper caste norms (Rothchild and Piya, 2020). Further, it has already been noted that there exists regional variation in the practice of menstrual restrictions. Therefore, one's cultural identity as proxied by religion, caste/ethnic group and region of residence are important correlates of whether an individual is likely to face menstrual restrictions. However, even after including a rich set of controls, one cannot be certain that there are no potential role of unobservables in influencing the selection into menstrual restrictions and our outcomes of interest. However, given the important role of these observable covariates in influencing the selection into facing menstrual restrictions, it is likely that we might be able to assess the role of selection on unobservables from the selection on observables. In other words, we try to understand what might be the role of unobservables in influencing our results, given the importance of observable characteristics in our set-up. For this we follow the methodology developed by Oster (2019) which we describe here. Because we need to rely on linear probability models despite our outcome variables being binary for this methodology, we discuss this here in the appendix instead of the main body of the paper.

We calculate the bias adjusted treatment effect on our outcomes of interest under the assumptions about the relative degree of selection of unobserved to observed variables, denoted by δ, and a value of R_{max}, where R_{max} is the R^2 from a hypothetical regression of the outcome variables on all the observed and unobserved variables and the treatment. Following Altonji et al. (2005), $\delta = 1$ is suggested as an appropriate upper bound for δ by Oster (2019), indicating equal selection based on observables and unobservables. Further, Oster (2019) notes that in most empirical studies, considering $R_{max} = 1$ may not be feasible (on account of plausible measurement error, say). Instead the paper proposes considering a value of $R_{max} = 1.3 * R^2_{controlled}$, where $R^2_{controlled}$ is the R^2 from the linear regression with

all possible observable controls. Let us denote the coefficient on our treatment as β. Oster (2019) proposes calculating the bias adjusted treatment effect β by assuming $\delta = 1$ and $R_{max} = 1.3 * R^2_{controlled}$.

Further, one can also calculate how large δ would need to be such that it would render the estimated treatment effect β to be zero for $R_{max} = 1.3 * R^2_{controlled}$. In the spirit of Altonji et al. (2005), Oster (2019) explains that a cut-off of $\delta = 1$ can be taken as an appropriate upper bound. This is because if $\delta > 1$, then selection on unobservables would need to be more important relative to selection on observables in rendering the estimated treatment effect to zero. Because researchers are usually careful in selecting their control sets, it makes it reasonable to consider a cut-off of $\delta = 1$ as an appropriate upper bound of δ that would drive the estimated treatment effect to zero. Further, Oster (2019) finds the average value of δ to be around 0.545 and 86% of the values lying in the interval $[0, 1]$. In the situation where δ was found to be greater than 1, 92% of such studies had excluded at least one relevant control. Therefore, Oster (2019) states that when relevant/most important controls are selected first and included in an analysis, δ lying in the $[0, 1]$ interval would constitute the vast majority of the cases. Hence, $\delta = 1$ can be taken as an appropriate upper bound of δ. Consequently, given the set of relevant controls included in the analysis, if a value of $\delta > 1$ is found to render the estimated treatment effect to zero; one can get some assurance that the results are unlikely to be driven by omitted variable bias[12].

We apply the aforementioned method suggested by Oster (2019) to understand to what extent our estimated coefficients of MR_{ir} are likely to be affected by omitted variable bias. We compute the selection on unobservables adjusted treatment effect of MR_{ir} under alternative assumptions of δ and a value of $R_{max} = 1.3 * R^2_{controlled}$. We further compute how large δ would need to be for the estimated treatment effect of MR_{ir} to be zero, given our set of controls. Since we found statistically significant association between facing any menstrual restriction on maternal physical healthcare access and it is unlikely that the insignificant association found for subjective assessment of overall happiness is on account of imprecision; we focus on maternal physical healthcare access outcomes for understanding the selection on unobservables, given the selection on observables.

Appendix Table B.1 reports the coefficient on whether an individual faced any menstrual restriction that measures our treatment effect. The first row reports the coefficient from the LPM model where facing any menstrual restriction is the only explanatory variable included in the regression. We denote this by "Uncontrolled β". The second row reports the R^2 from this regression, which is denoted by $R^2_{uncontrolled}$. The third row reports the

[12]We use the STATA module "psacalc" for the computations (Oster, 2016)

coefficient estimate of MR_{ir} from a LPM that includes the full set of controls, including the sub-region of residence fixed effects. The coefficient estimate, denoted by "Controlled β" is identical to column (6) of Table 2. The fourth row reports the R^2 from this regression, which is denoted by $R^2_{controlled}$. The fifth row reports the 95% confidence interval of the "Controlled β". The sixth row, which is of interest to us, presents the estimate of β under the assumption of equal proportional selection on unobservables and observables, that is, $\delta = 1$ and $R_{max} = 1.3 * R^2_{controlled}$ for each of the outcomes. In other words, we compute a value for β under the assumption that unobservables are equally important as observables in influencing our results and $R_{max} = 1.3 * R^2_{controlled}$. The seventh row presents the identified set that is bounded on one side by "Controlled β" and on the other by β computed under the assumption of $\delta = 1$ and $R_{max} = 1.3 * R^2_{controlled}$. The eighth row presents an analogous computation as the sixth row, but under the assumption that $\delta = 2$, that is, selection on unobservables is twice as important as selection on observables. The last row computes the value of δ that would render the estimated β to zero, given the observables included in the control set and $R_{max} = 1.3 * R^2_{controlled}$. In other words, the last row would show how large the selection on unobservables would need to be relative to that on observables for our estimated treatment effect to be zero, given the set of observables included in the control set.

From the sixth row of Appendix Table B.1 we find that the estimated β under the assumptions that $\delta = 1$ and $R_{max} = 1.3 * R^2_{controlled}$ is 0.064 and 0.069 for the outcomes corresponding to if the respondent delivered at home and if she was assisted only by a relative/friend at delivery respectively. Therefore, under the assumption that unobservables are equally important as observables and $R_{max} = 1.3 * R^2_{controlled}$, the estimated β for each of the outcomes is lower than, but close in, magnitude to the "Controlled β". The seventh row shows the identified set which is given by $[0.064, 0.071]$ for the outcome if the respondent delivered at home and $[0.069, 0.071]$ for the outcome if the respondent received no assistance from trained medical personnel at delivery. We see that for both the outcomes, the identified set does not include 0. The 95% confidence interval of the "Controlled β" given in the fifth row is found to contain the identified set for both the outcomes. This shows that even if we assume that selection on unobservables is just as important as selection on observables, $R_{max} = 1.3 * R^2_{controlled}$ and given our set of control variables, the estimated β is non-zero; indicating that facing any menstrual restriction is positively associated with delivering at home and receiving no assistance from medical personnel during childbirth.

We also compute what the estimated β would be if selection on unobservables would be twice as important as selection on observables (that is, $\delta = 2$)and $R_{max} = 1.3 * R^2_{controlled}$. These are reported in the eighth row of Appendix Table B.1. We find that assuming $\delta = 2$ further lowers the estimate of β, but it remains greater than 0.

The last row of Appendix Table B.1 computes how large δ would need to be for the estimated β to be zero, given the variables included in the control set and the assumption that $R_{max} = 1.3 * R^2_{controlled}$. We find that δ would need to be around 5 when we consider the outcome to be if the respondent delivered at home and around 8 when we consider the outcome if the respondent received assistance only from a relative/friend at delivery. Given the influence of one's social identity such as religion, caste/ethnic group, education, age as well as region of residence on the likelihood of facing any menstrual restriction and that we have included these observables in our control set, it seems unlikely that we have obtained these values of δ on account of excluding relevant observable variables from the control set in our context. In other words, in each of the cases we find that δ would need to be greater than 1 to render the estimated β to 0, which is otherwise more likely to arise on omission of relevant controls (Oster, 2019). This is unlikely to be the case given our context and inclusion of observables that influence the practice of cultural norms such as menstrual restrictions. Although we do not make any causal claims for our analysis, this provides some assurance that our findings are unlikely to be entirely driven by omitted variable bias.

Table A.1: Propensity Score Matching: Covariate Balance

	Standardized Differences		Variance Ratio	
	Raw	Matched	Raw	Matched
Outcome: If Delivered at Home:				
If Hindu	0.47	0.01	0.48	0.97
If Brahman/Chhetri	0.80	-0.06	2.05	1.00
If Dalit	0.19	0.12	1.60	1.31
If Terai/Madhesi Other Groups	-0.07	-0.03	0.83	0.92
Combined Wealth Score	-0.32	-0.09	0.95	0.99
If Completed Primary Education	-0.06	0.01	0.91	1.03
If Completed Secondary Education	-0.08	0.06	0.90	1.09
If Completed Higher Education	0.03	-0.13	1.04	0.85
Region of Residence: Central	-0.26	-0.01	0.69	0.99
Region of Residence: Western	-0.16	-0.12	0.81	0.84
Region of Residence: Mid-Western	-0.14	-0.004	0.77	0.99
Region of Residence: Far-Western	0.30	-0.19	1.56	0.86
Age (in years)	-0.01	0.03	0.98	1.04
Urban Residence	-0.19	-0.03	0.73	0.94
If HH head has no education	0.09	0.11	1.03	1.04
If HH head is female	-0.06	-0.05	0.92	0.93
Number of observations	2,078	2,998	2,078	2,998
Treated Observations	1,499	1,499	1,499	1,499
Control Observations	579	1,499	579	1,499
Outcome: If Assisted by Relative/Friend at Delivery:				
If Hindu	0.47	0.02	0.48	0.96
If Brahman/Chhetri	0.80	-0.06	2.07	1.00
If Dalit	0.19	0.12	1.59	1.33
If Terai/Madhesi Other Groups	-0.07	-0.01	0.83	0.98
Combined Wealth Score	-0.32	-0.10	0.95	1.02
If Completed Primary Education	-0.04	-0.02	0.94	0.96
If Completed Secondary Education	-0.08	0.04	0.90	1.06
If Completed Higher Education	0.03	-0.18	1.05	0.82
Region of Residence: Central	-0.26	0.02	0.69	1.03
Region of Residence: Western	-0.15	-0.14	0.82	0.83
Region of Residence: Mid-Western	-0.15	-0.04	0.76	0.91
Region of Residence: Far-Western	0.30	-0.14	1.57	0.89
Age (in years)	-0.02	0.08	0.96	1.10
Urban Residence	-0.19	-0.02	0.72	0.96
If HH head has no education	0.09	0.18	1.03	1.08
If HH head is female	-0.05	0.02	0.93	1.03
Number of observations	2,048	2,956	2,048	2,956
Treated Observations	1,478	1,478	1,478	1,478
Control Observations	570	1,478	570	1,478
Outcome:If Overall Unhappy:				
If Hindu	0.46	0.01	0.50	0.97
If Brahman/Chhetri	0.74	-0.04	1.73	1.00
If Dalit	0.09	0.09	1.24	1.26
If Terai/Madhesi Other Groups	0.03	0.002	1.09	1.005
Combined Wealth Score	-0.31	-0.13	0.97	1.02
If Completed Primary Education	-0.02	-0.03	0.96	0.94
If Completed Secondary Education	-0.001	0.08	1.00	1.02
If Completed Higher Education	-0.05	-0.12	0.96	0.91
Region of Residence: Central	-0.21	-0.04	0.75	0.94
Region of Residence: Western	-0.10	-0.25	0.89	0.78
Region of Residence: Mid-Western	-0.08	0.03	0.86	1.07
Region of Residence: Far-Western	0.15	-0.01	1.28	0.99
Age (in years)	-0.09	0.02	1.05	1.11
Urban Residence	-0.21	-0.10	0.79	0.87
If HH head has no education	0.08	-0.02	1.03	0.99
If HH head is female	-0.02	-0.02	0.98	0.98
Number of observations	5,163	7,272	5,163	7,272
Treated Observations	3,636	3,636	3,636	3,636
Control Observations	1,527	3,636	1,527	3,636

Note: Data source is 2014 Nepal MICS. Observations are at the individual level. No education, rural and region of residence: eastern are omitted categories for education, rural/urban residence and region of residence in generating the propensity scores. We report the covariate balance summary from 5 nearest neighbour matching based on estimated propensity scores.

Table B.1: Oster Bound Analysis: Treatment Effect of Facing Any Menstrual Restriction

Outcome Variable:	If Delivered at Home	If Assisted by Only by Relative/ Friend at delivery
Uncontrolled β	0.089	0.076
$R^2_{uncontrolled}$	0.007	0.006
Controlled β	0.071	0.071
$R^2_{controlled}$	0.254	0.166
95% CI for Controlled β	[0.016, 0.127]	[0.019, 0.123]
β for $\delta = 1$ and $R_{max} = 1.3 * R^2_{controlled}$	0.064	0.069
Identified Set	[0.064, 0.071]	[0.069,0.071]
β for $\delta = 2$ and $R_{max} = 1.3 * R^2_{controlled}$	0.055	0.066
δ for $\beta = 0$ and $R_{max} = 1.3 * R^2_{controlled}$	5.6	8.7

Note: Data source is 2014 Nepal MICS. Linear regression models are used for this analysis. The uncontrolled regression controls only for the whether an individual faces any menstrual restriction. The controlled regression includes the full set of controls as in column (5) of Table 2.