




ARTICLE

Interrelatedness of women's health-behaviour cognitions: A dyadic study of female family members on carrying heavy loads during pregnancy in Nepal

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Abstract

Objectives: Decisions about reproductive health are often influenced by women's female family members, particularly in low-resource contexts. However, previous research has focused primarily on individual behavioural determinants. We investigated the interrelatedness of female family members' reproductive health behaviour with a dyadic version of an extended health action process approach. We investigated this for carrying heavy loads during pregnancy and postpartum, a risk factor for reproductive health in many low-income countries such as Nepal.

Design: This cross-sectional study included dyads of daughters-in-law and mothers-in-law in rural Nepal ($N = 476$, nested in 238 dyads).

Methods: Dyads of daughters- and mothers-in-law were surveyed about avoiding carrying heavy loads during pregnancy and postpartum. The effects of a woman's cognitions and her female dyadic partner's cognitions on their intention and behaviour about avoiding carrying loads were estimated using linear mixed models.

Results: The results showed that a mother-in-law's cognitions were related to her daughter-in-law's intentions and vice versa. The mother-in-law's cognitions were also related to the daughter-in-law's behaviour. The mother-in-law's self-efficacy and injunctive norms related to the daughter-in-law's intention and behaviour over and above the daughter-in-law's own self-efficacy and injunctive norms.

Conclusion: Female Nepali family members' cognitions about carrying heavy loads during pregnancy and postpartum are interrelated. Including female family members in

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interventions to help women manage their reproductive health in low-resource populations seems promising. These novel findings add to the growing body of research indicating the importance of including a dyadic perspective when understanding and changing health behaviour.

KEY WORDS

actor partner interdependence model, dyadic data, health action process approach, low-resource populations, reproductive health, social influence

Statement of Contribution

What is already known on this subject?

- Decisions on women's reproductive health behaviours are often influenced by their social environment, particularly in low-resource populations.
- One central social source of influence in the realm of reproductive health are women's social relationships with other women. In low-resource settings, the relationship of daughter- and mother-in-law has been found to be particularly relevant.
- Only few studies have incorporated dyadic perspectives in health behaviour models.

What this study adds?

- A dyadic version of the HAPA model can explain the interrelatedness of women's reproductive health behaviour in a low-resource population.
- Partner's self-efficacy and injunctive norms related to women's intentions and behaviour over and above their own cognitions

INTRODUCTION

Improving women's reproductive health and reducing related mortality is a global priority (United Nations, 2015). Reproductive health includes freedom to choose whether and when to reproduce and a healthy pregnancy, childbirth, and postpartum period (UN Population Fund [UNFPA], 1994). Women's ability to make decisions about their reproductive health is crucial for achieving gender equality and global access to sexual and reproductive rights (Hameed, 2019).

Engaging in reproductive health behaviours such as using contraception, seeking professional maternity care, and reducing heavy work in the perinatal period are major factors in reducing these risks, particularly in low-resource populations (Gunasekera et al., 2007; Sieverding, 2001). Previous research has described women's barriers to and resources for reproductive health behaviours in these contexts, including the structural (e.g., geography and financial means), social (e.g., social expectations), and individual-level determinants of these behaviours (e.g., risk knowledge and individual motivation) (Bute & Jensen, 2010; Hirani, 2015; Kumar et al., 2016; Mumtaz & Salway, 2007; Sieverding, 2001; Thapa & Niehof, 2013; Tomberge, Shrestha, et al., 2021; Yount, 2002). Less attention has been directed to understanding how women's cognitions interact with social influences and expectations. However, including a social perspective is especially relevant in low-resource populations because, in these contexts, women's decisions about their reproductive health are often influenced by their social environment, including their family members (Benyamini et al., 2009; Hirani, 2015; Kumar et al., 2016; Lee et al., 2013; Mumtaz

& Salway, 2007; O'Connell et al., 2021; Plourde et al., 2017; Raman et al., 2014; Sapkota et al., 2014; Tomberge, Shrestha, et al., 2021; Yount, 2002).

Understanding the social–cognitive determinants of reproductive health behaviour

The health action process approach (HAPA) is a well-evidenced and cross-culturally valid model of health behaviour change that provides a good understanding of the social-cognitive determinants of health behaviour (Schwarzer, 2008; Zhang et al., 2018), including reproductive health behaviour in low-resource populations such as carrying heavy loads during pregnancy and postpartum in rural Nepal (Tomberge, Shrestha, et al., 2021). The HAPA model posits that people are more likely to form an intention to change their behaviour if they have high risk perception, favourable outcome expectancies (i.e., beliefs about the consequences of protective behaviour), and higher self-efficacy (i.e., belief in the ability to perform protective behaviour). In turn, people with stronger intention, detailed action planning about when, where, and how to manage protective behaviour, and coping planning that anticipates barriers and makes alternative plans are more likely to realize a behaviour. Nonetheless, the HAPA shares a limitation with many other health behaviour models in that it is mostly focused on individuals and largely overlooks social determinants of behaviour change.

Extending the HAPA with social norms such as perceptions of what others do, here termed the *descriptive norm*, and what others approve of, here termed the *injunctive norm*, has been shown to provide insights (Chow & Mullan, 2010; Cialdini et al., 1990; Tomberge, Shrestha, et al., 2021; Zhang et al., 2020). Social norms have been found to be relevant predictors for many health behaviours (Reid et al., 2010) and may explain some of the variance of intention and the transition from intention to behaviour (Chow & Mullan, 2010; Tomberge, Shrestha, et al., 2021; Zhang et al., 2020). However, studies that include social norms to explain behaviour take an actor's perspective and fail to consider the perspectives and cognitions of social partners. This means they investigate, for example, how a woman's risk perception may influence her behaviour, from the actor perspective, rather than how her husband's risk perception may influence her behaviour, from the partner perspective.

Some studies have recently extended individual-focused health behaviour models such as the HAPA to include a dyadic perspective that accounts for bidirectional effects in interpersonal relationships (e.g., romantic partners, close friends, and family members) that mutually influence behaviours (Berli et al., 2018; Howland et al., 2016; Joyal-Desmarais et al., 2019; Kenny et al., 2006). Using dyadic frameworks is an innovative conceptual and methodological approach that can account for both the interrelatedness and the bidirectional influences of two individuals (Kashy & Kenny, 2000). Adding a partner perspective can give greater fidelity to individual data by providing a genuinely interpersonal, ecologically valid context of health cognitions and behaviour (Kashy & Kenny, 2000; Sadler et al., 2011; Sadler & Woody, 2003). Until now, however, no research has examined women's reproductive health behaviour using dyadic health psychology models.

The interrelatedness of female family members' health behaviours in low-resource contexts

One central social source of influence and support in reproductive health is women's social relationships with other women, particularly in low-resource contexts (Mumtaz & Salway, 2007; Raman et al., 2014). Close women-to-women bonds between female family members, including mother-daughter dyads and sisters, can offer a low-threshold, safe space in which to exchange personal experience and advice (Hirani, 2015; Mumtaz & Salway, 2007; Raman et al., 2014; Sapkota et al., 2014; Tomberge, Shrestha, et al., 2021). Also during pregnancy and the postpartum period, younger women base their own health behaviour in such areas as nutrition, antenatal care, and workload on female relatives' accounts and

advice (Mumtaz & Salway, 2007; Pun et al., 2016; Raman et al., 2014; Sapkota et al., 2014; Tomberge, Shrestha, et al., 2021). Female family members have been found to interrelate in many cognitions and behaviours related to reproductive health, including first sexual intercourse, desired family size, and circumcision status (Kumar et al., 2016; Pun et al., 2016; Tomberge, Shrestha, et al., 2021; Vladimirova & Amudzhiyan, 2020; Yount, 2002). However, the influence of female family members can also be harmful when discriminatory social norms or cultural ideologies and beliefs cause women to pressure younger female relatives into risky practices. These include coercing them to undergo female genital cutting or to work hard during pregnancy and postpartum (Pun et al., 2016; Tomberge, Shrestha, et al., 2021; Yount, 2002). Conversely, increasing education and disapproval of health-harming practices in the younger generation can also be transmitted to older family members (Allendorf, 2017; Kumar et al., 2016; Yount, 2002); for instance, a daughter's increased risk perception may elicit a change in her mother's health-impeding cognitions.

In many South Asian cultures, for example, Nepal, one female family dyad has been described as of particular relevance to women's health behaviours: daughters-in-law and their mothers-in-law. At least 30% of South Asian women move in with their mothers-in-law after getting married (Bietsch et al., 2021). Daughters- and mothers-in-law typically live and work together in proximity with clear areas of responsibility (Allendorf, 2017). Research has shown that, particularly during pregnancy and postpartum, the mother-in-law is an important source of both support and distress. For instance, the mother-in-law can decide to decrease the daughter-in-law's workload during pregnancy by allocating tasks to other family members, but the mother-in-law can also decide that the daughter-in-law must continue working (Raman et al., 2014; Tomberge, Shrestha, et al., 2021).

The quality of the relationship can help explain whether it is characterized by support or pressure (Howland et al., 2016). For example, tentative evidence from India has shown that women who experience high-quality relationships with their mothers-in-law often receive their support, whereas women in relationships characterized by hurtful exchanges and periods of not speaking receive less support (Allendorf, 2017). In conclusion, consistent with research on other social relationships, female family members such as mothers-in-law can both support and impede reproductive health behaviour (Hohl et al., 2018, 2019; Raman et al., 2014). However, research on this interrelatedness in reproductive health behaviour is sparse.

The present study

Because no study has used dyadic health psychology methods in a low-resource context or in mother- and daughter-in-law dyads, basic research in this field is needed to understand whether there is a correlation between the reproductive health cognitions and behaviours of women and those of their female family members. This study addresses this research gap by using a dyadic and extended version of the HAPA model and thus including a social perspective often neglected in health behaviour models. As an example, we focus on rural Nepal, a low-resource setting in which social influence on women's reproductive health behaviour has been shown to be particularly pronounced (Allendorf, 2017; Earth & Sthapit, 2002; Raman et al., 2014; Regmi, 2007; Sapkota et al., 2014; Sieverding, 2001; Simkhada et al., 2010; Tomberge, Shrestha, et al., 2021). Nepal has an estimated maternal mortality ratio of 380 per 100,000 pregnancies, and every 10th woman in Nepal reports a pelvic organ disorder such as incontinence (Jelovsek et al., 2007). Engaging in physically demanding work, such as carrying heavy loads during pregnancy and postpartum, is one of the main behavioural risk factors for pelvic organ disorders and can increase the risk of spontaneous abortion (Earth & Sthapit, 2002; Koyuncu et al., 2021; Meierhofer et al., 2022). However, carrying heavy loads falls within the daily routines of many women in Nepal and other low- and middle-income countries (Geere & Cortobius, 2017). For example, 25% of households worldwide lack improved household water access (World Health Organization, & UNICEF, 2017), and so heavy water containers are carried from more distant sources, usually by women. Decisions on whether women continue this practice during pregnancy and postpartum are, similarly to many other

reproductive health behaviours, made in agreement with their family members, often their mothers-in-law (Allendorf, 2017; Pun et al., 2016; Raman et al., 2014; Sapkota et al., 2014; Simkhada et al., 2010; Tomberge, Shrestha, et al., 2021).

The present study aims to extend previous research by examining the dyadic influences of the intentions and behaviours of daughters- and mothers-in-laws about reproductive health, specifically avoiding carrying heavy loads of water during pregnancy and postpartum. Working from previous dyadic health behaviour research (Berli et al., 2018; Howland et al., 2016), we investigated how daughters- and mothers-in-law's cognitions relate to their own and their dyadic partner's behavioural intentions over and above their own cognitions (see Figure 1, Model 1). We further aimed to identify how daughters- and mothers-in-law's cognitions relate to the daughter-in-law's behaviour (see Figure 1, Model 2). Considering that the mother-in-law was often beyond reproductive age, we only investigated the intentions, not the behavioural effects, of daughters-in-law's cognitions on their mothers-in-law.

As summarized in Figure 1 (Model 1), we hypothesized that (H1) daughters- and mothers-in-law's cognitions and behaviours correlate, specifically their risk perception, outcome expectancies, self-efficacy, injunctive and descriptive norms, action and coping planning, and their avoiding carrying heavy loads of water during pregnancy and postpartum. We further hypothesized (H2a, where 'a' stands for actor) that a woman's cognitions of risk perception, outcome expectancies, self-efficacy, and injunctive and descriptive norms are positively associated with her intention to avoid carrying loads during pregnancy and postpartum. Additionally (Figure 1, Model 2), we hypothesized (H3a) that the daughter-in-law's self-efficacy, injunctive and descriptive norms, and action and coping planning are positively associated with her behaviour in avoiding carrying loads during pregnancy and postpartum. These intrapersonal paths, which we term *actor effects*, are depicted as solid lines in Figure 1.

We further investigated what we term *partner effects* (Figure 1, dashed lines); we hypothesized that the woman's dyadic partner's cognitions relate positively to their own intentions (H2p, where 'p' stands for partner) and behaviours (H3p) in avoiding carrying loads during pregnancy and postpartum. To investigate whether mothers-in-law's cognitions relate to daughters-in-law's intentions in a different way than vice versa, for hypothesis H2, we explore family role as a moderator.

Given the importance of relationship quality to dyadic influences on health behaviour (Allendorf, 2017; Howland et al., 2016), we further explore how the quality of the relationship between the two women can moderate the actor and partner effects such that the intention and behaviour in high-quality relationships are more strongly influenced by the dyadic partners' cognitions. However, studies on this aspect of relationship quality and reproductive health behaviour are rare, so we cannot postulate the direction of this relationship.

METHODS

This dyadic cross-sectional survey of daughters- and mothers-in-law was part of a larger study conducted from September to November 2019 in the hilly regions of five rural communities of Bagmati province whose health centres were affiliated with the Kathmandu University Hospital. The overall study investigated individual predictors and consequences of women's water-carrying practices in daily life (Meierhofer et al., 2022; Tomberge, Bischof, et al., 2021; Tomberge, Shrestha, et al., 2021). Ethical clearance was given by the Nepal Health Research Council (Reg No. 517/2019) and the Ethical Board of the University of Bern, Switzerland (No. 2019-10-00003).

Participants and procedures

A random sample of women was selected with the random route method (Hoffmeyer-Zlotnik, 2003): Four teams of trained local research assistants started from the local health centre in different directions and randomly approached one in two or three households, depending on the number of households in

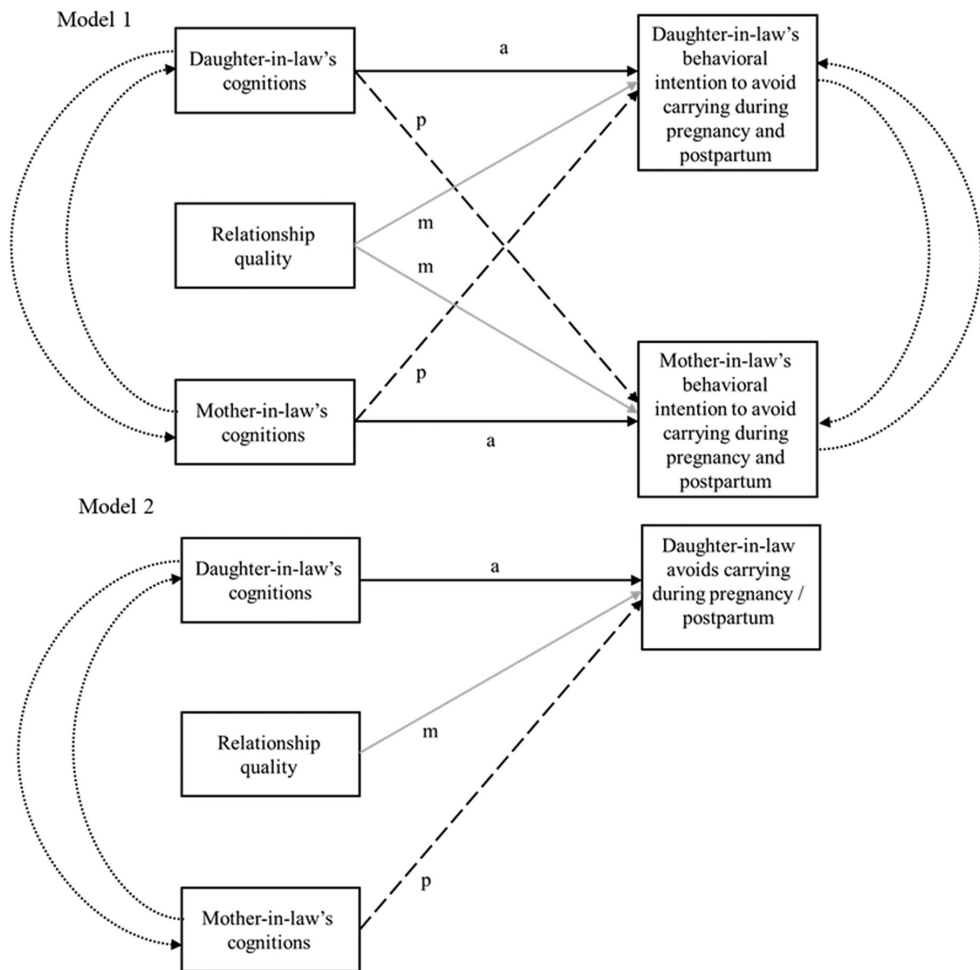


FIGURE 1 Hypothesized actor and partner effects on avoiding carrying water during pregnancy and postpartum and its moderation by relationship quality. Model 1 depicts two dyad members, daughter-in-law and mother-in-law, within the actor-partner interdependence framework with the cognitions risk perception, outcome expectancies, self-efficacy, and injunctive and descriptive norms to avoid carrying during pregnancy and postpartum of each member as predictors and behavioural intentions of each member as outcomes (Hypothesis 2). These predictors were selected based on an extended health action process approach (HAPA). Model 2 also uses a dyadic version of the HAPA model, including both members' cognitions, specifically self-efficacy, injunctive and descriptive norm, action planning, and coping planning to avoid carrying during pregnancy and postpartum, but looking at daughters-in-law's behaviour only as an outcome (Hypothesis 3). Actors' cognitions (actor effects, black solid lines) and their dyadic partner's cognitions (partner effects, dashed lines) are associated with their reproductive health behavioural intentions (Model 1 upper part of the figure) and daughters-in-law's behaviour (Model 2 lower part of the figure) and the moderation by relationship quality (moderator, grey solid line) is visualized. Dotted lines represent the interrelatedness of cognitions.

a compound. Selection criteria were being 16–50 years old, residing permanently in the community, and being involved in water carrying. Whenever a mother-in-law was available in the compound and willing to participate, she was included as the dyadic counterpart of her daughter-in-law. This resulted in 238 dyads ($N = 476$: 238 daughters-in-law and 238 mothers-in-law). All participants provided written informed consent or fingerprints before the research assistants interviewed both women separately in computer-assisted structured face-to-face interviews.

TABLE 1 Example items and descriptive statistics.

Concept	Example items	Cronbach's alpha	Daughter-in-law		Mother-in-law		ICC (min-max)
			M	SD	M	SD	
Avoid carrying pregnancy/postpartum	How often in one week did you carry water during pregnancy/in the three months after delivery? 0 = every day to 1 = no days	.79, 2 items	.48	.37	.04	.14	-.24 to .24
Risk perception	Compared to other women with the same age, how much higher or lower are your chances of getting uterine prolapse? 0 = lower to 1 = higher ^a	1 item	.72	.31	.60	.38	.10 to .46
Outcome expectancies	I would prevent uterine prolapse if I avoided water carrying during pregnancy 0 = agree not at all to 1 = agree very much	.88, 2 items	.82	.22	.65	.33	-.09 to .35
Self-efficacy	How sure are you that you can always avoid carrying water during and after pregnancy even if it might be difficult for your household to have enough water? ^a	.85, 3 items	.46	.32	.19	.25	.05 to .43
Behavioural intention	How strongly do you intend to always avoid water carrying during and after pregnancy? ^a	.85, 2 items	.67	.27	.34	.28	-.04 to .38
Action planning	Can you tell me what you can do to avoid carrying water during and after pregnancy? 1 = Ask for help; Carry less water; Tell other people I don't want to carry water; Buy water; other specific plan; 0 = No plan	1 item	.90	.30	.54	.50	.03 to .42
Coping planning	How can you overcome difficulties that prevent you from avoiding carrying water during and after pregnancy? 1 = Ask someone for help; Tell that I do not want to carry water; other specific coping plan; 0 = No plan	1 item	.50	.50	.26	.44	-.64 to .02
Injunctive norm	How much would people who are important to you approve if you carry water during and after pregnancy [for mother-in-law: how much would they have approved if you had carried during your pregnancy]? ^a	.69, 3 items	.60	.23	.32	.24	-.08 to .35
Descriptive norm	How many women in your community carry water during and after pregnancy? 0 = Almost nobody (0%) to 1 = almost all of them (100%)	1 item	.57	.26	.64	.26	-.31 to .21
Relationship quality	How much do you trust your mother-in-law/daughter-in-law? ^a	.94, 7 items	.67	.22	.70	.25	.35*** to .45

Note: N = 476, M = Mean, SD = standard deviation, Min, Max = minimum and maximum of the within-couple correlation (ICC). All items used a 5-point Likert scale and were recoded to a range between 0 and 1.

* $p < .05$, ** $p \leq .01$, *** $p \leq .001$.

^a0 = not at all, .25 = somewhat, .5 = rather, .75 = quite, 1 = very much.

Measures

The structured questionnaire included questions on women's cognitions and behaviours related to avoiding carrying heavy loads during pregnancy and postpartum. All items were carefully adapted to the local context and had been translated from English to Nepali and back translated. All items were discussed with the local research assistants in a one-week training program and pretested in mock sessions between team members and in two villages not included in the analyses. Psychological constructs were assessed using unipolar 5-point Likert scales supported by a visual 5-dot scale (Harter et al., 2020), which had previously been used in this and other low-resource populations. The items measuring a construct were averaged and recoded into a range from 0 to 1. Please consult 1, for example, items, descriptive statistics, and internal consistencies. Consult [Table S1](#) for all items used.

We asked participants about a physically demanding everyday task (Geere et al., 2018): carrying water containers with an average weight of 20 kg during pregnancy and postpartum (Earth & Sthapit, 2002; Regmi, 2007; Tomberge, Bischof, et al., 2021). We used a self-report behaviour index to measure water-carrying frequency in one week during pregnancy and three months postpartum, referring to the previous pregnancy with answer options 1 = carrying no days to 5 = carrying every day. The answers were then reversed to measure the protective reproductive health behaviour of avoiding carrying during pregnancy and postpartum.

We measured the psychosocial cognitions about avoiding carrying water during a prospective pregnancy and postpartum from the mothers-in-law's and daughters-in-law's perspectives with the HAPA constructs by Schwarzer (2008). For instance, for behavioural intention, the participant was asked, 'How strongly do you intend to always avoid water carrying during and after pregnancy?' and answered between 1 = 'intend to not at all' and 5 = 'intend to very much'. Triangulation with qualitative data has been described in detail elsewhere and has provided high convergent validity (Tomberge, Shrestha, et al., 2021). Since many mothers-in-law were beyond reproductive age, we asked their intention to carry water during a hypothetical future pregnancy. Relationship quality was measured as a moderator with the Perceived Relationship Quality Components inventory (Fletcher et al., 2000) from the perspective of the actor: for instance, 'How much do you trust your mother-in-law [daughter-in-law], 1 = "do not trust at all" to 5 "trust very much"'.

Data analysis

To examine the interrelatedness of daughters- and mothers-in-law's cognitions and behaviour, we calculated within-couple correlations (intraclass correlations: ICC) for behavioural intention, behaviour, and all other HAPA predictors related to avoiding carrying water during pregnancy and postpartum (Berli et al., 2018) (see [Table 1](#)). To test our hypotheses, we computed two models (see [Figure 1](#)).

Behavioural intention (model 1)

Given the dyadic interdependence of daughters- and mothers-in-law in behavioural intention, we used the actor-partner interdependence model (APIM) (Kashy & Kenny, 2000) to analyse the data for Model 1. To investigate the actor effects of each woman's cognitions and the partner effects of her dyadic partner's cognitions on behavioural intention, we followed established approaches for testing dyadic health behaviour models that have successfully used the APIM to analyse dyads (Berli et al., 2018; Howland et al., 2016). In the APIM, the dyad is treated as the unit of analysis. Our covariance structure assumes that within the dyad, the two members' observations are equally correlated, but that there are no correlations between members of different dyads (Kenny et al., 2006). First (Model 1, H2a & H2p), we included actors' and partners' risk perception, self-efficacy, outcome expectations, and descriptive and injunctive norms as independent variables to model their

links with the behavioural intention to avoid carrying water during pregnancy and postpartum: the dependent variable. All actor effects were adjusted for the woman's dyadic partner's scores on the same cognitions, and all partner effects were adjusted for the woman's own scores on the same cognitions. We further included interaction terms of all actors' and partners' cognitions, which allowed us to examine women's behavioural intention when both women's cognitions were above average: for instance, when both women indicating high risk perception.

Second, we included family role as a moderator, coded 0 for daughter-in-law and 1 for mother-in-law. This allowed us to estimate actor and partner effects separately for daughters- and mothers-in-law in distinguishable dyads. This approach is analogous to dyadic studies of heterosexual couples, where gender is used as a moderator to distinguish the dyadic partners (Howland et al., 2016).

Third, given the importance of relationship quality in dyadic influences on health behaviour (Allendorf, 2017; Howland et al., 2016), we included relationship quality to investigate whether this can moderate the impact of a partner's influence on the actor's behavioural intentions. We investigated significant interactions further by analysing simple slopes ($M \pm 1 SD$).

Behaviour (model 2)

We tested a dyadic model to explain the daughter-in-law's behaviour. This model did not include the interrelationship between her and her mother-in-law's behaviour because the mothers-in-law's previous pregnancy most likely occurred when the daughter-in-law was not yet present. Bidirectional interdependence, which is a central component of the APIM (Kashy & Kenny, 2000; Kenny et al., 2006), is therefore not provided for behaviour. Thus, actor effects and partner effects were only investigated for the daughter's behaviour using multiple linear regressions.

We included the daughter-in-law's actor cognitions and the mother-in-law's partner cognitions as independent variables in Model 2: self-efficacy, action planning, coping planning, and descriptive and injunctive norms for avoiding carrying water during pregnancy and postpartum. The dependent variable was the daughter-in-law's behaviour, the frequency of avoiding carrying water during pregnancy and postpartum. We further tested the moderating effects of relationship quality: whether the degree of mother-in-law's influence on daughter-in-law's behaviour differed in dyads with lower or higher relationship quality.

The models were computed using SPSS software (version 21), modifying a syntax by Howland et al. (2016) and Kenny et al. (2006) that uses cross-sectional dyadic data to study interpersonal influence processes that occur within relationships. A sample of the syntax can be found in the [Supporting Information \(S2\)](#). Simple slopes for interactions were calculated in R using the interaction package (Long, 2021).

RESULTS

For daughters-in-law, avoiding carrying water during pregnancy and postpartum was around the mid-scale ($M = .48$, $SD = .37$), and intention to avoid carrying was moderate to high ($M = .67$, $SD = .27$). In contrast, mothers-in-law reported having carried almost every day ($M = .04$, $SD = .14$), and their intention to avoid was low to moderate ($M = .34$, $SD = .28$). See [Table 1](#) for all descriptive statistics, internal consistencies, and within-couple correlations.

Supporting our H1, the dyads correlated significantly with behavioural intention. However, they did not correlate significantly with behaviour. Noteworthy, as shown in [Table 1](#), the range of within-couple correlations was high. Regarding the HAPA predictors of intention and behaviour, the within-couple correlation between daughters- and mothers-in-law's risk perception, self-efficacy, and action planning was significant. For outcome expectancies, coping planning, and injunctive and descriptive norms, we did not find significant correlations, but very broad ranges of within-couple correlations.

Intention to avoid carrying during pregnancy and postpartum

Partly confirming hypotheses 2a and 2p, some of women's own cognitions related to their behavioural intention (H2a, actor effects) and some of the women's dyadic partners' cognitions related to women's behavioural intention (H2p, partner effects). Given that partner effects are bidirectional, this means that a mother-in-law's cognitions were related to her daughter-in-law's behavioural intentions, and a daughter-in-law's cognitions were related to her mother-in-law's behavioural intentions. Results for actor effects are shown in [Table 2](#) (Model 1): The higher the daughter-in-law's own self-efficacy and injunctive norm were, the higher her behavioural intention to avoid carrying during pregnancy and postpartum, independent of her mother-in-law's social cognitions. Conversely, the result also means that the mother-in-law's own self-efficacy and injunctive norm are positively related to the mother-in-law's behavioural intention.

For partner effects, a main effect of the partner's self-efficacy indicates that mothers-in-law's self-efficacy is negatively related to daughters-in-law's behavioural intention and vice versa. However, there was an interaction effect of mothers-in-law's and daughters-in-law's self-efficacy (see actor-partner interaction in [Table 2](#)). We found a synergistic actor-partner interaction effect for self-efficacy ([Figure 2](#), left side): The daughter-in-law's behavioural intention to avoid carrying was highest when, in addition to her own increased self-efficacy, her mother-in-law's self-efficacy was also high (low partner self-efficacy: $B = .44, p < .001$, average partner self-efficacy: $B = .53, p < .001$, high partner self-efficacy: $B = .63, p < .001$). For the moderating effect of daughter-in-law's self-efficacy on the association of mother-in-law's self-efficacy and daughter-in-law's behavioural

TABLE 2 Generalized linear mixed models of daughter- and mother-in-law's intention to avoid carrying loads during pregnancy within a dyadic version of the health action process approach.

Parameter	Model 1
	Estimate (SE)
Intercept	.16 (.13)
Actor effects	
Actor risk perception	.01 (.08)
Actor outcome expectancies	.11 (.12)
Actor self-efficacy	.13 (.07)*
Actor injunctive norm	.40 (.10)***
Actor descriptive norm	-.02 (.12)
Partner effects	
Partner risk perception	-.08 (.08)
Partner outcome expectancies	-.01 (.12)
Partner self-efficacy	-.20 (.07)**
Partner injunctive norm	.04 (.10)
Partner descriptive norm	.11 (.12)
Actor Partner Interactions	
Actor risk perception × Partner risk perception	.09 (.10)
Actor outcome expectancies × Partner outcome expectancies	.08 (.15)
Actor self-efficacy × Partner self-efficacy	.40 (.13)**
Actor injunctive norm × Partner injunctive norm	-.11 (.17)
Actor descriptive norm × Partner descriptive norm	-.09 (.18)

Note: Outcome: actor's behavioural intention to avoid carrying loads of water during pregnancy and postpartum. * $p < .05$, ** $p \leq .01$, *** $p \leq .001$. Models including the moderation by family role and by relationship quality are not displayed here but can be found in detail in the [Tables S3](#) and [S4](#).

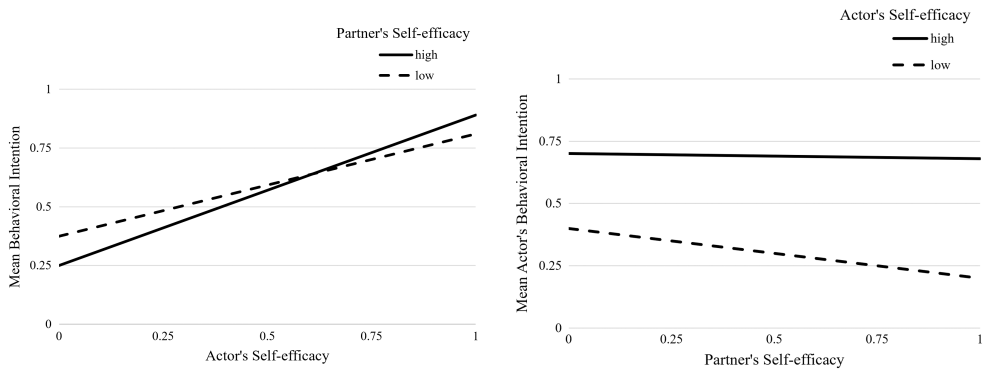


FIGURE 2 Interaction effect of actor's and partner's self-efficacy on behavioural intention to avoid carrying loads during pregnancy and postpartum. High/low designations reflect one ± 1 standard deviation from the mean. A graph with observation points can be found in the Supporting Information ([Figure S1](#)).

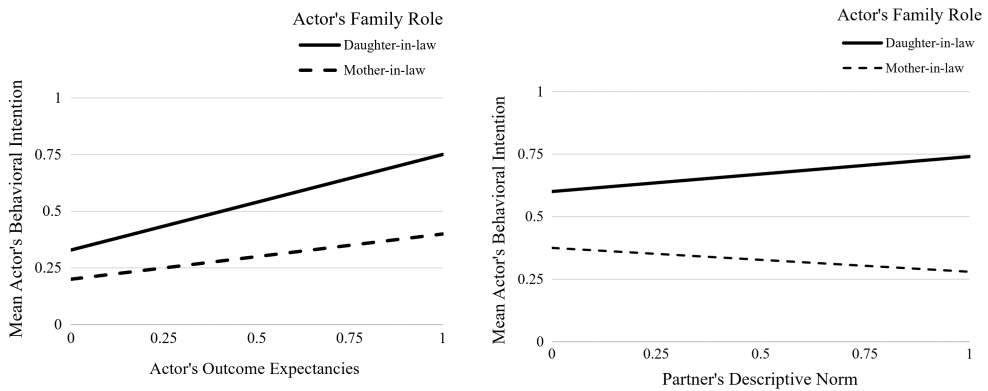


FIGURE 3 Moderation effects of the actor's family role and actor's outcome expectancies (left) or partner's descriptive norm (right) on actor's behavioural intention to avoid carrying loads during pregnancy and postpartum. Graphs with observation points can be found in the Supporting Information ([Figure S2](#)).

intention in turn (see [Figure 2](#), right side), simple slope analysis indicated that higher mother-in-law's self-efficacy only related to her daughter-in-law's lower behavioural intention when the daughter-in-law's own self-efficacy was below average ($M - 1$ SD) ($B = -.21$, $p < .001$), or average ($B = -.11$, $p < .001$), but no negative partner effect was found when the daughter-in-law had high self-efficacy ($B = -.02$, $p = .770$).

When looking at moderation by family role, we found differing effects for daughters-in-law and mothers-in-law in actor and partner effects (see [Table S3](#) and [Figure 3](#) left). For actor effects, the relationship between outcome expectancies and intention was significantly weaker for mothers-in-law than for daughters-in-law (*Estimate* [SE] = $-.22$ [$.11$], $p = .041$), although for both women, outcome expectancies related positively to intention when investigated in isolation in simple slopes (mothers-in-law: $B = .21$, $p < .001$; daughters-in-law: $B = .39$, $p < .001$). For role differences in partner effects, the mother-in-law's descriptive norm was positively related to her daughter-in-law's intention (slopes: $B = .16$, $p = .02$), whereas the daughter-in-law's descriptive norm was not linked to her mother-in-law's intention (slopes: $B = -.04$, $p = .50$; interaction: *Estimate* [SE] = $-.18$ [$.09$], $p = .036$, see [Figure 3](#) right).

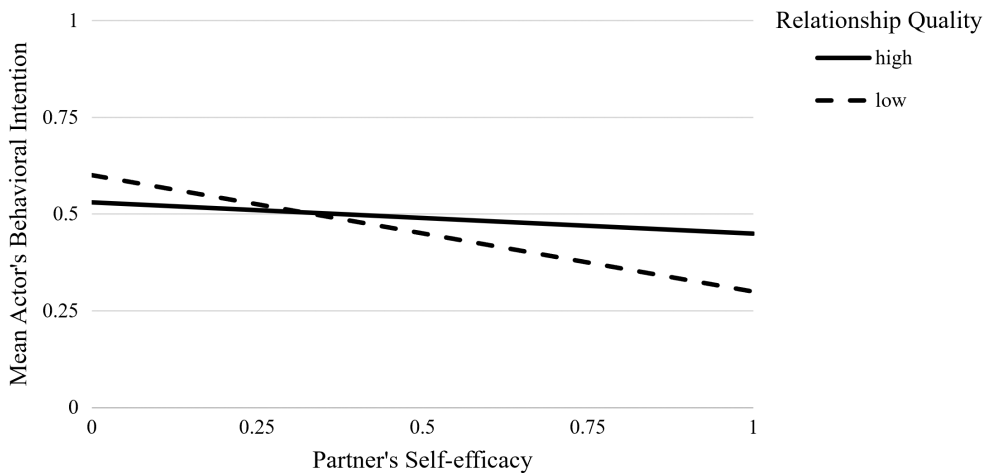


FIGURE 4 Moderation effects of relationship quality on the role of partner's self-efficacy in actor's behavioural intention to avoid carrying loads during pregnancy and postpartum. High/low designations reflect one ± 1 standard deviation from the mean. A graph with observation points can be found in the Supporting Information (Figure S3).

We performed another exploratory analysis of relationship quality as a moderator and found one significant result: Relationship quality moderated the association of partner's self-efficacy with the actor's behavioural intention towards avoiding carrying loads during pregnancy (Table S4, Estimate [SE] = .53[.23], $p = .020$). The effect that the mother-in-law's self-efficacy negatively related to the daughter-in-law's intention and vice versa came into play only when their relationship quality was below average ($M - 1 SD$) ($B = -.22$, $p < .001$) or average ($B = -.15$, $p < .001$) but had no impact when the women's relationship was characterized by high quality ($B = -.09$, $p = .180$; see Figure 4). Relationship quality did not moderate any of the other associations between cognitions and behavioural intention.

Behaviour related to avoiding carrying during pregnancy and postpartum

Our third hypothesis investigating daughters-in-law's behaviour was also supported for the effect of some of their own cognitions (H3a) and some cognitions of their mothers-in-law (H3p) (see Table 3 and Table S5, Model 2a). Actor effects showed that the higher the daughter-in-law's self-efficacy and behavioural intention to avoid carrying, the less she carried during pregnancy and postpartum. For partner effects, the higher the mother-in-law's self-efficacy in avoiding carrying, the less her daughter-in-law carries during pregnancy and postpartum. However, when the mother-in-law reported a higher injunctive norm to avoid carrying during her pregnancy, the daughter-in-law carried more. For hypothesis H3, we also explored relationship quality as a moderator: Relationship quality did not moderate any of the associations of cognitions on carrying behaviour (see Table S5, Model 2b).

DISCUSSION

This is the first dyadic investigation of how women's reproductive health cognitions and behaviours interrelate. We studied this using a dyadic version of an extended HAPA model with the carrying of heavy loads during pregnancy and postpartum by Nepali daughters-in-law and their mothers-in-law. Our findings showed that mothers-in-law and daughters-in-law are similar in their behavioural intentions but can greatly vary in their behaviour in carrying during pregnancy and postpartum, which partly

TABLE 3 Results for daughter-in-law's reduced carrying behaviour during pregnancy and postpartum within a dyadic version of the health action process approach.

Parameter	Model 2a
	Estimate (<i>SE</i>)
Intercept	.12 (.11)
Actor effects	
Actor self-efficacy	.36 (.09)***
Actor behavioural intention	.29 (.09)**
Actor injunctive norm	.06 (.12)
Actor descriptive norm	-.03 (.08)
Actor action planning	.02 (.08)
Actor coping planning	-.03 (.04)
Partner effects	
Partner self-efficacy	.31 (.12)**
Partner behavioural intention	-.16 (.09)
Partner injunctive norm	-.30 (.12)*
Partner descriptive norm	.05 (.09)
Partner action planning	.05 (.05)
Partner coping planning	-.07 (.05)

Note: Outcome: Daughters-in-law's behaviour: Avoid carrying loads of water during pregnancy and postpartum. * $p < .05$, ** $p \leq .01$, *** $p \leq .001$. Model 2b (moderation by relationship) was not significant for any of the effects and is not displayed here but can be found in detail in the Table S5.

supports our hypotheses. Further, our results indicated that daughters and mothers-in-law's cognitions can relate both positively and negatively to each other's intentions and behaviour. The mothers-in-law's self-efficacy and injunctive and descriptive norms relate to the daughters-in-law's intentions and behaviour over and above their own self-efficacy, intention, and injunctive norm. Similarly, the daughters-in-law's self-efficacy and injunctive norm relate to the mothers-in-law's behavioural intentions towards avoiding carrying during pregnancy and postpartum. Further, we found a synergistic effect for self-efficacy, such that the relationship between daughters-in-law's self-efficacy and their intention was stronger when the mothers-in-law's self-efficacy was high. However, when the daughter-in-law's own self-efficacy was below average, a higher mother-in-law's self-efficacy had detrimental effects on behavioural intention. Finally, relationship quality moderated the association between partner's self-efficacy and behavioural intention to avoid carrying, indicating that the mother-in-law's self-efficacy was related to the lower daughter-in-law's intentions to avoid carrying during pregnancy and postpartum when relationship quality was low.

How similar are Nepali daughters- and mothers-in-law in their cognitions and behaviour related to reproductive health?

Consistent with previous research, at least half of the daughters-in-law and almost all mothers-in-law in rural areas of Nepal reported risky behaviour by carrying water during pregnancy and postpartum (Earth & Sthapit, 2002; Geere et al., 2018). In contrast with dyadic health behaviour change research in romantic couples (Berli et al., 2018), we found no within-couple correlation in women's carrying behaviour during pregnancy and postpartum. One explanation may be a ceiling effect in mothers-in-law's behaviour, because most of them reported having carried heavy loads during pregnancy and postpartum,

whereas daughters-in-law's behaviour was more varied. This may mark an intergenerational change towards healthier reproductive health behaviours. This intergenerational change has also been reported in some other studies for more frequent maternal health care seeking, resting, and nutritious eating during pregnancy and postpartum, and for the abandonment of harmful practices such as female genital cutting (Pun et al., 2016; Thapa et al., 2019; Yount, 2002).

Significant within-couple correlations were found for psychosocial cognitions about carrying loads during pregnancy and postpartum, indicating that family members may have similar risk perception, self-efficacy, and action planning. This supports our hypothesis that daughters- and mothers-in-law may influence each other's cognitions related to reproductive health behaviour.

However, different patterns of interrelatedness were found between dyads for behaviour and for certain cognitions such as intention, outcome expectancies, coping planning, and injunctive and descriptive norms towards carrying during pregnancy and postpartum. Some dyads covaried highly and positively in the indicated cognitions and their behaviour, whereas other dyads covaried in the opposite manner: the more the mother-in-law carried during her pregnancy, the less the daughter-in-law carried during her pregnancy. Such heterogeneous couple patterns have also been reported in previous dyadic studies (Berli et al., 2018). Further research needs to incorporate moderators to investigate why some daughters-in-law aligned their cognitions and behaviours with those of their mothers-in-law while others did not. For example, individuals who have a partner affected by impaired health have been reported to be more likely to change their behaviour to avoid experiencing similar ill health (Humpel et al., 2007; Pun et al., 2016).

How are a female family members' cognitions, intentions, and behaviour related to reproductive health interrelated?

The results of our dyadic analysis on carrying during pregnancy and postpartum indicated that over and above the woman's own cognitions, her dyadic partner's cognitions, specifically their self-efficacy and injunctive and descriptive norms, were linked to the woman's behavioural intention and behaviour to avoid carrying during pregnancy and postpartum. Consistent with previous research (Hohl et al., 2018, 2019; Raman et al., 2014; Tomberge, Shrestha, et al., 2021), this relationship can be both positive, so that the mother-in-law may motivate her daughter-in-law to avoid carrying because she observes other women also avoid carrying, and negative, so that the mother-in-law's perception of others' disapproval towards avoiding carrying may spill over to her daughter-in-law.

Particular importance was found not only in the daughter-in-law's own but also in mother-in-law's self-efficacy. The higher mothers-in-law's self-efficacy in avoiding carrying was related to the daughters-in-law's lower behavioural intention to avoid carrying during pregnancy and postpartum. Potentially explaining the effect of mothers-in-law's self-efficacy, we found that the mother-in-law's self-efficacy predominantly had a negative effect when the daughter-in-law's own self-efficacy or their relationship quality was low. The behavioural intention to avoid carrying was strongest when both women's self-efficacies were high. For behaviour, the mother-in-law's self-efficacy was related to her daughter-in-law's carrying during pregnancy and postpartum in addition to the daughter-in-law's own self-efficacy. Thus, mothers-in-law's self-efficacy may generally support their daughters-in-law in avoiding carrying but might have detrimental effects when their daughters-in-law's own self-efficacy or the relationship quality is low.

The positive effects of actor and partner self-efficacy on carrying behaviour are in line with health behaviour theories, which suggest that self-efficacious women are likely to confidently engage in healthy behaviour and may, in a similar way, take action and provide assistance to social partners, for instance by providing social support (Bandura, 1977; Silver et al., 1990). The synergistic effects of both women's cognitions on daughters-in-law's protective carrying practices during pregnancy suggest that interventions to promote reproductive health behaviours should target both dyad members' self-efficacy simultaneously. Bandura's sources of self-efficacy (Bandura, 1977), verbal

persuasion of capability, focus on past success, and model learning such as other women practicing reproductive health behaviour are promising for increasing the self-efficacy of dyad members and might thus bring out the positive side of social influence (Bandura, 1977; Connell et al., 2019; Michie et al., 2013).

However, the finding that mothers-in-law's self-efficacy can also negatively relate to daughters-in-law's behavioural intention indicates that social partners' positive cognitions can also negatively impact women's motivation, particularly when partners apply social pressure to change (Hohl et al., 2018). Particularly low-quality relationships may be characterized by social pressure that weakens self-efficacy and motivation to engage in healthy behaviour (Allendorf, 2017; Hohl et al., 2018, 2019; Raman et al., 2014; Tomberge, Shrestha, et al., 2021). This aligns with the finding that a partner's self-efficacy in low-quality relationships had detrimental effects on behavioural intentions towards avoiding carrying while they were not harmful in high-quality relationships.

Additional partner effects were found for social norms. The greater mothers-in-law's descriptive norm, the greater daughters-in-law's behavioural intention to avoid carrying during pregnancy and postpartum. However, the greater the mothers-in-law's injunctive norm, the more the daughters-in-law actually carries during pregnancy and postpartum. Overall, these results further confirm the importance of the social context assumed for women's reproductive health behaviour. Women may conform to the perceived norm and align their behaviours with expectations, for instance, to signal membership in a group or avoid feeling rejected by their social group (Bute & Jensen, 2010; Prentice & Miller, 1993). However, in our study, the mothers-in-law's injunctive norms were associated with directly opposite behaviour. To understand this result, further investigation is needed of underlying mechanisms. One explanation might be that when the mother-in-law had experienced disapproval of resting behaviour from her family when she had been pregnant herself, she might rather support her daughter-in-law than replicate this experience of disapproval. However, these are merely initial speculations that would benefit from qualitative examinations of this result.

Interventions that target reproductive health behaviours may facilitate new behavioural norms by promoting non-harmful family role models, such as other women resting and avoiding heavy carrying during pregnancy (Paluck et al., 2016). Given the potentially detrimental effects of mothers-in-law's cognitions on daughters-in-law's behaviour when relationship quality is low, further considering family dynamics in intervention planning may be helpful to prevent family members' potentially harmful influences on women's reproductive health behaviours. Interventions that include active promotion of equal relationships, for example, such as exploring and reshaping gender and family roles and decision-making within relationships, have been found promising for promoting women's reproductive health (Barker et al., 2010; Robinson et al., 2017).

Overall, the present findings indicate the benefit and importance of including a dyadic perspective in the HAPA model and explicitly extending it with social norms when understanding women's reproductive health behaviour in the light of the influence of female family members. This study specifically supports female family members' interrelatedness for a reproductive health behaviour that may need social acceptance and social cooperation, such as taking over the water carrying, or providing resources, such as hiring someone to carry (Tomberge, Shrestha, et al., 2021), and for which independent individual decision-making power cannot be presumed. Accounting for a social perspective in the HAPA model might also be beneficial when investigating reproductive behaviours that require social cooperation or resources from others, such as new mothers' resting and recovering in general, seeking maternal healthcare, consuming nutritious food during pregnancy (World Health Organization (Ed.), 2016), and taking contraception (; Plourde et al., 2017). All of these behaviours require access to resources, such as transportation to health centres, financial resources, medications, and food, or taking over work tasks that are likely to be comanaged by other family members, especially in low-resource populations (Allendorf, 2017; Simkhada et al., 2010; Thapa & Niehof, 2013). We recommend that future studies on reproductive health include dyadic perspectives to investigate whether the results derived from daughter- and mother-in-law dyads are

transferrable to other family members or women-to-women bonds outside the family system, such as female friends, and to other reproductive health behaviours.

Strengths, limitations, and future directions

This study provides quantitative dyadic data on reproductive health behaviour for a large, randomly selected sample from a rural Nepali population. It is the first study to test dyadic health psychology models in a non-western, educated, industrialized, rich, and democratic (WEIRD) sample and the first to examine in-laws' perspectives. Whereas studies with a focus on actor and partner perspectives tend to include romantic couples or intergenerational relationships involving parents (Joyal-Desmarais et al., 2019; Lewis & Rook, 1999), the fact that 12% of women worldwide and 30–50% of South Asian women live with their in-laws (Bietsch et al., 2021; Huber et al., 2017) indicates the need to span this research gap.

One limitation may be the generalizability of the results. We focused on the specific reproductive health behaviour of carrying heavy loads, such as water during pregnancy, which is particularly relevant for women in the Global South. Future studies should determine whether these findings are transferable to other family relationships, cultural contexts, and reproductive health behaviours. Further, there is a need to understand the mechanisms of women's interrelationships, such as persuasion and providing information and resources (Rothman et al., 2020; Scholz et al., 2020).

Another limitation of the study is its cross-sectional design: No conclusions can be drawn about the causality of relationships between actor and partner cognitions and behaviour. However, as this is the first dyadic study on women's reproductive health behaviour in a low-resource setting, these results provide highly valuable evidence for the interrelatedness of women's health behaviour in such contexts. This research goal is also in line with the original idea of the APIM, which was to investigate whether and which partners' cognitions are related to an individual's behaviour in addition to their personal cognitions (Ackermann et al., 2010). Now, our results seem to warrant longitudinal studies and randomized controlled trials to further investigate the directionality of these relationships.

CONCLUSION

Our results showed that female family members' reproductive health behaviours and cognitions can be interrelated. A dyadic partner's cognitions can add to understanding the behaviour of the other woman, such as heavy carrying during pregnancy and postpartum. This indicates the benefit of including a dyadic perspective for understanding and changing reproductive health behaviour. From our results, we can more specifically recommend targeting women's and their close female family members' social norms to enhance healthy behaviours during pregnancies and postpartum and self-efficacy to engage in reproductive health behaviours. Self-efficacious families may be central to enabling women to overcome behavioural barriers to reproductive health decisions and targeting equal access to reproductive rights (Hameed, 2019; World Health Organization, 2010).

AUTHOR CONTRIBUTIONS

Vica Marie Jelena Tomberge: Conceptualization; data curation; formal analysis; investigation; methodology; software; visualization; writing – original draft. **Akina Shrestha:** Conceptualization; investigation; project administration; resources; software; supervision; writing – review and editing. **Regula Meierhofer:** Conceptualization; investigation; project administration; resources; software; supervision; writing – review and editing. **Jennifer Inauen:** Conceptualization; investigation; methodology; project administration; resources; supervision; validation; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

All syntax and output resulting from data analysis are publicly available in the open science repository https://osf.io/73xhk/?view_only=797e7f8f581f4584bb92654d62de85e5. The data set is not openly available only to ensure confidentiality and anonymity of participants. The informed consent sheets for the participants indicated as following "I know that all personal data will be kept confidential and will not be shared with anyone other than members of our survey team. I do agree that the researchers involved in this study, public authorities, and the members of the ethical review boards in Nepal and in Switzerland while keeping confidentiality can access original data. I was informed that any information about me will have an identification number on it instead of my name. I can request the deletion of my personal data until the link between my name and the data will be deleted."

ETHICS STATEMENT


The study was approved by the Ethical Review Committee of Nepal [Reg No. 517/2019] and the Ethical Board of the University of Bern, Switzerland [2019-10-00003]. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

INFORMED CONSENT STATEMENT

All participants provided written informed consent prior to their interviews and observations. Potential study participants who could not sign their names were permitted to indicate consent with a thumbprint.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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