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ORIGINAL ARTICLE

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Marital quality in a context of displacement: the role of union formation characteristics among Syrian refugee and Jordanian youth

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Abstract

Marital quality is an important determinant of well-being and is related to how unions are formed. Both processes of union formation and marital relationships may be influenced by stressful conditions, including insecurity and displacement. We leverage unique representative data on young Syrian refugees in Jordan to learn more about the interplay between displacement, union formation characteristics and marital quality. Through comparisons with youth from the Jordanian host population, we assess the role of key contextual predictors of marital quality, such as consanguinity and young people's role in choosing their spouse, with a focus on gender differences. We measure marital quality with six separate items capturing aspects of equality, respect and interpersonal communication and a unidimensional scale identified through exploratory factor analysis. Results show that consanguinity, marital duration and number of children are generally unrelated to marital quality in both populations. In contrast, involvement in spouse choice emerges as the strongest predictor, with both Syrians and Jordanians in family-arranged unions experiencing lower-quality marriages. Among Syrians, women suffer more from lower marital quality, especially when arranged unions happen at a young age, and marriages formed after displacement to Jordan appear more fragile. The study is one of the first to explore predictors of marital quality in a non-Western, conflict-affected population. The findings emphasise the importance of the demographic study of family dynamics in situations of insecurity and displacement moving beyond a narrow focus on marriage timing to cover a wider range of marriage outcomes related to family well-being.

Introduction

Exposure to conflict and forced displacement disrupts marriage markets and union formation processes (Abbasi-Shavazi et al., 2018). How unions are formed, in turn, has implications for marital quality, which is an important determinant of physical health (Umberson et al., 2006), mental well-being (Proulx et al., 2007), union stability (Kanter et al., 2022) and resilience (Masarik et al., 2016). Yet the extensive global literature on marital quality is almost entirely separate from the literature on marriage among conflict-affected populations, which focuses heavily on early marriage of girls (e.g., Elnakib et al., 2023; Neal et al., 2016) and has paid very little attention to other aspects of union

formation. Only a handful of studies from psychology have attempted to examine marital quality in the context of war stressors (Shamai & Lev, 1999; Shamai et al., 2016, 2018). This is an important gap in the literature due to the implications of marital quality for well-being in populations that are already subject to multiple other conflict- and displacement-related vulnerabilities.

Both the impacts of conflict and displacement on marriage markets and the relationship between union formation and marriage quality are highly contextual. The existing literature on marital quality is based largely on Western contexts, where norms of choosing one's spouse are well established and pre-marital relationships and divorce have become more common and increasingly accepted (Umberson et al., 2006; VanLaningham et al., 2001). The relatively more limited literature on marital quality in low- and middle-income countries (LMICs) comes primarily from (South) Asia, and highlights how the spread of Western norms around marriage interacts with local schemas of marriage to influence marital quality and how it is experienced (Allendorf & Ghimire, 2013; Hoelter et al., 2004; Pimentel, 2000). The gendered nature of expectations around marriage and marriage formation emerges as a key theme in this literature, particularly the argument that norms around marriage may change more quickly for men than women (Allendorf, 2017).

The experience of conflict and displacement may challenge normative gender roles within marriage as well as the gender dynamics of marriage markets (Abbasi-Shavazi et al., 2018). While these effects are far-reaching, spanning from the availability of potential spouses to changes in men's ability to fulfil traditional breadwinner roles, the literature on marriage in situations of conflict and displacement has yet to capture this complexity (Abbasi-Shavazi et al., 2018). A growing body of research has addressed the prevalence and determinants of early marriage of girls in conflict-affected populations, demonstrating that the impact of conflict and displacement on marriage timing is context- and conflict-specific (e.g., Elnakib et al., 2023; Neal et al., 2016). However, the literature is thin on evidence about the dynamics of marriages (early or otherwise) in conflict and displacement after they are formed. While early marriage is associated with a wide range of negative outcomes (Malhotra & Elnakib, 2021), fully understanding how those outcomes take shape requires us to examine the dynamics of these marriages after they are formed. More broadly, more research is needed on intra-household dynamics among conflict-affected populations to generate a fuller picture of the implications of conflict and displacement for family dynamics in LMICs.

Leveraging nationally representative survey data, in this paper we contribute to the literature by examining associations between union formation characteristics and marital quality among a displaced population of Syrian youth in Jordan. This analysis brings to the literature on marital quality a perspective from the Middle East and North Africa (MENA) region, an area of the world where marital quality is under-studied, and the prevalence of conflict, insecurity and displacement likely influence both marriage markets and marital relationships (Cetorelli, 2014; Sieverding et al., 2020). Given the paucity of literature on marital quality in the MENA region and among displaced populations in general, we adopt a comparative approach with youth from the Jordanian host population. While this comparison does not allow us to fully disentangle sociocultural differences in the two populations from displacement-related influences on marital quality, it

provides broader context for the interpretation of the results for Syrian refugee youth. As the first examination of determinants of marital quality in a non-Western context affected by displacement, this study contributes to the literature on the consequences of conflict and insecurity for family dynamics. The findings point to the importance of further research on how conflict and displacement may be related to marriage dynamics beyond timing and on how marriage timing interacts with other aspects of union formation to shape family well-being.

The setting

Marriage is an essential step in the transition to adulthood and the only legitimate pathway to sexual relationships and childbearing in the MENA region (Dhillon & Yousef, 2009). Sexuality outside of marriage is heavily stigmatised and interactions with the opposite sex carry considerable reputational risk for young women (DeJong et al., 2005). Correspondingly, families are traditionally heavily involved in the selection of spouses and kin (consanguineous) marriage is common (Othman & Saadat, 2009; Tadmouri et al., 2009). Marriage in the region is patrilocal. For the majority Muslim population, substantial financial outlays are expected from both families—but particularly the groom's side—to establish the young couple upon marriage (Salem, 2012). These financial outlays are generally seen as security for the bride, given the social expectation that women will be economically dependent on their husbands.

As in other regions (e.g., Allendorf & Pandian, 2016; Ghimire et al., 2006; Nedoluzhko & Agadjanian, 2015), these traditional dynamics of union formation in MENA have increasingly come to coexist with alternative schemas of marriage based on a more Westernised model of self-arranged marriages. Average ages at marriage have increased in many countries of the region, in part due to preferences among young people for nuclear (rather than extended-family) residence, which increases the costs of marriage (Singerman, 2007). Few studies have examined changes in marriage customs over time, but the literature generally suggests that consanguinity is declining in some—although not all—MENA countries (Tadmouri et al., 2009). Very little is known about how young people meet their spouses, but in Egypt, for example, a substantial minority of young people report meeting their spouse through personal networks (Sieverding & Ragab, 2015).

Jordan is typical of these regional trends in marriage practices. The median age at marriage has been gradually increasing, reaching 27 for men and 22 for women in 2016 (Krafft & Assaad, 2021). Early marriage (before age 18) has declined considerably among Jordanian women, such that among 25–29-year-olds in 2016, 10% had married before age 18 as compared to a quarter of women aged 55–59 (Sieverding et al., 2019). Consanguinity has also declined: of marriages formed in the late 1960s, just over 40% were consanguineous, compared to 26% of marriages formed between 2005 and 2010 (Salem, 2012). Of marriages formed between 2012 and 2016, 22% were consanguineous (Sieverding et al., 2019). To the best of our knowledge, there are no previous studies examining spouse selection processes in Jordan, so we know little about how young people are involved in choosing their spouses. Nevertheless, Jordanian youth can be considered to represent a 'typical' MENA pattern in terms of marriage formation in a non-conflict-affected population.

Since 2011, Jordan has become host to a large population of Syrian refugees fleeing the civil war. The vast majority of refugees arrived between 2013 and 2015, before Jordan closed its border to new arrivals in 2016 (Sieverding & Calderón-Mejía, 2020). Since that point, the number of registered Syrian refugees has been stable at around 650,000–680,000 (UNHCR, 2023). There are three official refugee camps for Syrians in Jordan, but the majority of refugees are self-settled in Jordanian host communities in the capital Amman and the northern part of the country.

The widespread displacement of Syrians both internally to Syria and to other countries severely disrupted marriage markets. The literature on marriage among Syrians post-displacement has focused heavily on the early marriage of girls. Although about a quarter of Syrian refugee women in Jordan married before age 18, the evidence suggests that this is a continuation of pre-conflict patterns in Syria (Sieverding et al., 2020). Nevertheless, the literature widely documents increased concerns over security, exposure to sexual violence, reputational risk, and economic vulnerability as drivers of early marriage as a form of ‘protection’ for Syrian refugee girls in the region (e.g., Elnakib et al., 2023; Mourtada et al., 2017; Sieverding et al., 2020). Even if these dynamics do not result in increased rates of early marriage in all Syrian refugee populations, they may lead to differences in the characteristics of marriages (including early marriages) that are formed. The limited literature on other characteristics of Syrian marriages in Jordan post-displacement indeed indicates that consanguinity has declined (yet remains relatively high, at 23% of marriages formed post-displacement compared to 42% of marriages formed just before the war), spousal age gaps may have increased slightly, and marriage expenditures have declined (Sieverding et al., 2019). Finally, it is important to note that intermarriage between Syrian refugees and the Jordanian host population is very rare (Sieverding et al., 2019). Thus, despite residing in the same space, the two populations navigate mostly separate marriage markets.

Background and hypotheses

Determinants of marital quality and the implications of displacement

We draw on available evidence from the MENA and other LMICs where traditional forms of family formation are common to generate hypotheses on how different processes of union formation may influence marital quality among Syrian refugees and the Jordanian host population. In addition, we discuss other marriage-specific factors that are known to predict marital quality in Western contexts and how they may play (dis)similar roles for couples in the MENA. Given the scarce empirical literature on how conflict and displacement shape marital quality, we also draw on qualitative evidence (e.g., Shamai et al., 2018) and the conceptual framework for family formation during displacement proposed by Abbasi-Shavazi et al. (2018) to reflect on how these experiences may influence marital quality. Finally, since our context is characterised by rigid household gender norms, we frame the discussion around gendered (marital) roles and consider how processes of union formation may influence women’s and men’s marital quality differently (Hoelter et al., 2004).

Union formation characteristics: involvement in spouse choice, consanguinity and age at marriage

In settings where the practice of arranged marriages is prevalent, the extent of familial involvement in spouse selection and the biological relationship between the spouses (consanguinity) represent important predictors of future marital quality (Hoelter et al., 2004; Olcay Imamoğlu et al., 2019). In theory, the influence of these two union formation processes is, however, ambiguous.

In self-arranged marriages (also described as “self-choice”, “free-choice”, or “autonomous”), romantic love is typically seen as a precondition for the formalisation of unions. Spouse selection thus emerges as a product of independent decision-making based on factors that are built over time and before union formalisation (e.g., physical attraction, emotional intimacy and companionship). The priority given to personal compatibility, free will and pre-existing interactions in self-arranged marriage can be expected to produce greater marital quality, within-couple support and commitment to care for each other compared to unions determined by family (Allendorf & Ghimire, 2013). This may be especially true for young people given increasing exposure to modern ideals of individuation, independence, and assertiveness (Baptist et al., 2012).

However, many of the sociocultural factors sustaining the practice of arranged marriage relate directly to the expectation that this process of union formation creates more supportive long-term trajectories for the couple. For example, matchmaking by family members may ensure greater familial support (emotional and financial) to the spouses (Applbaum, 1995). Such forms of support can be important assets, especially in times of crisis (Christ & Etzold, 2022) and, in patrilocal societies, can ease the marital transition for the bride (Bittles, 1994). Spouses in arranged marriages may also show greater marital quality as a result of more realistic expectations about marriage compared to self-arranged unions (Pimentel, 2000). Parents’ understanding of their children’s nature and ability to evaluate options without the influence of emotions/hormones may generate better matches, especially when the bride and groom are young (Bowman & Dollahite, 2013).

Although consanguineous marriage should not be necessarily equated with arranged marriage (Allendorf & Pandian, 2016), there is often considerable overlap between the two (Rashad et al., 2005) and the theoretical benefits of arranged marriage may be heightened in this case. Consanguineous marriages strengthen overlapping social connections that help to preserve family assets and may foster more caring relationships with in-laws (Tadmouri et al., 2009). They may also improve women’s status within marriage because of the greater proximity of kin networks and/or their position as kinswomen (Salem & Shah, 2016).

Existing empirical work on the link between union formation and spouses’ subsequent marital quality in LMICs is based primarily in Asian countries. This literature generally finds a positive association between self-arranged marriages and several dimensions of marital quality, including happiness, closeness and interpersonal communication (e.g., Jeejeboy et al. (2013) in India, Allendorf and Ghimire (2013) in Nepal; Pimentel (2000) and Xiaohe and Whyte (1990) in China; Olcay Imamoğlu et al. (2019) in Turkey) and, for women in particular, health-protective consequences (e.g.,

lowering the risk of physical violence and depression) (Zhang & Axinn, 2021). Nevertheless, in Asian contexts, men appear more likely to self-arrange their marriages (Ghimire et al., 2006).

At the same time, a few studies show no influence of family-arranged or consanguineous unions on marital quality (e.g., Hoelter et al., 2004). Consanguinity may also have protective effects in some contexts. In the MENA, consanguinity has been found to improve women's decision-making power in Jordan, but not in Egypt and Tunisia (Salem & Shah, 2016) and to moderately protect against domestic violence (Usta et al., 2015). As exposure to conflict and displacement disrupts marriage markets and may reduce families' ability to 'vet' potential spouses (Abbasi-Shavazi et al., 2018), the buffering role of consanguinity may be expected to increase in a displacement context.

Given this empirical ambiguity, we only hypothesise that involvement in spouse choice influences marital quality. Independent of its direction, we expect the association to be stronger for women (*Hypothesis 1*). However, we expect that consanguinity will be associated with better marital quality and that this relationship will be stronger for Syrian refugee women who may benefit more from family networks in times of displacement and overall uncertainty (*Hypothesis 2*).

Often interconnected with marriage arrangements and consanguinity (Assaf & Khawaja, 2009), the age at which one marries may matter for future relationship quality. On the one hand, later marriage may be beneficial due to a "maturation effect" (Lehrer, 2008); as individuals age, their degree of optimism bias in expectations reduces, while their relational experiences, and understanding of their (and their spouse's) personality and preferences improves. On the other hand, the coordinated development hypothesis suggests that by marrying at an early age, spouses have more opportunities to build compatible lifestyles and a stronger couple identity, thereby benefitting the quality of their relationship (Glenn et al., 2010).

The above hypotheses have been developed and mostly tested in Western settings, where early marriages are generally less common and analytical age "cut-offs" used to determine early unions are often different from how early marriage is defined and measured in LMICs.¹² With this caveat in mind, the empirical literature quite unanimously documents greater instability and lower "survival" rates in early marriages (e.g., Dahl, 2010; Rotz, 2016). Research on the relationship between age at marriage and dimensions of marital quality in intact unions is thinner. Although extant work using continuous measures of age at marriage tends to suggest null results (Allendorf & Ghimire, 2013), studies focused on specific age "cut-offs" (e.g., before/after legal marriage age) generally find lower marital quality for those married in their teens and late adolescence (Glenn et al., 2010).

¹ In proposing the "coordinated development hypothesis", Glenn et al. (2010) study the US where they define early marriage as unions formalised between individuals aged <20. This cut-off is relevant to the context under study, but it is not in line with current international definitions of early marriage as formal marriage or informal union between an individual under the age of 18 and an adult or another child (UNFPA, 2023).

² In addition to individual-level age variables, spousal age gaps and/or mismatches between one's ideal and actual age at marriage may influence marital quality (e.g., Lee & McKinnish, 2018). Since we are not able to examine these factors due to data constraints, we limit our theoretical discussion to the union formation processes for which we can provide formal tests.

Since we are concerned with young adults, we expect worse marital quality outcomes with lower age at marriage, particularly when unions are contracted before age 18 (*Hypothesis 3*). While we hypothesise that this relationship holds regardless of gender and displacement status, we expect age at marriage to matter more for Syrian refugee women. In a displacement context where earlier marriages may be driven by security and economic concerns, parents and girls themselves may be willing to sacrifice spouse quality or compatibility to obtain the perceived security of a marriage match (Shemyakina, 2013; Torrisi, 2022), resulting in lower marriage quality.

Marriage-specific characteristics: marital duration and number of children

Other marriage-specific characteristics, including marriage duration and presence of children, may be associated with how spouses evaluate the quality of their marriages (Lyngstad & Jalovaara, 2010).³ Research in the West suggests that marital quality and satisfaction start high (including the transient “honeymoon phase”) to then decline as time passes for reasons that include boredom and diminished sexual and/or emotional compatibility among spouses (Umberson et al., 2005; VanLaningham et al., 2001). However, in other cultures, this pattern may be mediated by some of the factors discussed above, including marital arrangements (Blood, 1967). For example, it has been hypothesised that relationship quality in arranged marriages may improve as spouses stick and practise life together (Allendorf & Ghimire, 2013; Xiaohe & Whyte, 1990).

In a context of protracted displacement such as that of Syrian refugees in Jordan, marital duration is also correlated with whether the union was formed pre- or post-displacement. Displacement is an incredibly stressful experience that may result in changes in typical household gender roles as well as periods of spousal separation (Abbasi-Shavazi et al., 2018). Refugees in Jordan are also subject to significant economic stressors, including limited employment opportunities, widespread poverty and food insecurity (UNHCR, 2022). We are not aware of any studies that examine how displacement affects marital quality. In theory, shared experiences of traumatic events may create greater emotional bonding in the couple and improve marital quality over time (Shamai et al., 2018). However, the marital stress model posits that external stress, i.e. stress originating from outside the wife–husband dyad (e.g., financial strain, workplace tensions, the death of a family member) can degrade communication and sexual intimacy in couples (e.g., Cutrona et al., 2003; Umberson, 1995).

Given this ambiguity, we formulate two hypotheses on the relationship between marriage duration and marital quality. First, since improvements in marital quality in arranged marriages remain theoretical speculations, we expect marriage duration to behave similarly to what has been empirically observed in Western settings, i.e. the longer the marriage, the lower the marital quality, possibly as a result of increased boredom and/or reduced compatibility with spouses (*Hypothesis 4*). Second, we expect this relationship to be stronger (i.e. worse marital quality) for refugees who married before

³ Marriage order (i.e., first vs. higher-order union) is another factor that has been discussed in the literature. However, we are concerned with a population of young people in a context where divorce and re-marriage remain relatively rare events. In our sample, only 2% ($n=20$) of respondents reported being in a second marriage and none in a higher-order one. Therefore, we do not discuss this factor in depth.

being displaced to Jordan, whose unions have been exposed to further stressors (*Hypothesis 5*).

Research in Western contexts has also consistently found a negative association between parenthood and marital quality, attributing the result to reductions in shared leisure, intimacy, and time spouses dedicate to care for one another after babies are born (Twenge et al., 2003). The arrival and presence of children can also increase marital conflict as spouses adjust to parenting responsibilities (Nomaguchi & Milkie, 2003). In non-Western, more “collectivist” and “family-oriented” cultures, however, there are reasons to expect the opposite. For example, the high level of involvement that extended family members have in child care in these settings can buffer stress due to parenthood (Allendorf & Ghimire, 2013; Moghadam, 2004). In many Middle Eastern societies, reproduction within marriage continues to have a high social value and is often perceived as cementing the union and an indicator of marriage success (Sabour Esmaili & Schoebi, 2017). Accordingly, we expect that the presence of children in Jordanian and Syrian families represents less of a disruption to couple relationship quality than what is observed in Western settings and to have little or no influence on marital quality (*Hypothesis 6*).

Gender

The role of gender in marriage outcomes has been studied extensively. In terms of marital quality and satisfaction, on average, men report more positive outcomes than their female spouses both in Western settings (Umberson et al., 2005; VanLaningham et al., 2001) and in several LMICs (Allendorf & Ghimire, 2013; Pimentel, 2000). This gender gap is often explained by the different social expectations placed on men and women within marriage. In specific, scholars argue that social gender roles create more demanding and less rewarding expectations for wives than for husbands (e.g., women may face greater expectations to care for and support their husbands, do more to maintain the relationship and the household intact, even if they are working) (Wilcox & Nock, 2006). Social expectations, particularly in conservative societies, may also make women more likely to rely on their marital role for self-validation and to have greater expectations for intimacy and emotional support than their male spouses (Williams, 1988). Such gendered expectations around marital roles are still very much present in Middle Eastern societies. Therefore, we hypothesise that marital quality will be lower for women than men among both Jordanians and Syrians (*Hypothesis 7*).

Table 1 summarises all our hypotheses.

Data and measures

The 2020–2021 survey of young people in Jordan

Data for this study come from the Survey of Young People in Jordan (SYPJ), which was conducted in 2020–2021 with the sponsorship of UNICEF Jordan (OAMDI, 2022). The SYPJ is a nationally representative survey of Jordanian and Syrian young people (aged 16–30) that was administered to all age-eligible people identified in households invited to be interviewed. Households were selected using a random, stratified, multi-stage cluster sampling design (see Assaad et al. (2021) for details on sampling methodologies).

Table 1 Hypotheses for factors influencing marital quality

	Expected relationship with marital quality
<i>Union formation characteristics</i>	
(1) Spouse choice	Ambiguous, but stronger for women of both nationalities
(2) Consanguinity	Positive, especially for Syrian women
(3) Age at marriage	Negative, especially for marriages contracted before age 18 and Syrian women
<i>Marriage-specific characteristics</i>	
(4) Marital duration	Negative
(5) Married prior to displacement	Negative (applicable to Syrians only)
(6) Presence of children	Ambiguous, and potentially null
<i>Individual-level characteristics</i>	
(7) Gender	Negative for both Syrian and Jordanian women

Overall, surveys were conducted with 4538 young people residing in 2854 households. For this study, the analytical sample is restricted to the $N=984$ respondents who were married at survey time and who responded to the series of questions on marital quality.⁴

Measures

Marital quality

The SYPJ contained six questions on aspects of marital quality that respondents could answer on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Respondents were asked whether they feel that they:

- 1) Have an equal role in decision-making
- 2) Understand each other well
- 3) Discuss disagreements
- 4) Argue often
- 5) Their spouse is disrespectful towards them.
- 6) Their spouse treats them harshly.⁵

For comparability and ease of interpretation, we reverse-coded items (4–6) so that greater values imply better outcomes in all instances (e.g., higher values imply couples not arguing often).⁶

We use the six items together and separately to examine spousal relationships in our sample. We begin by following the standard approach adopted in sociological research on marital quality, which understands and measures the concept as a latent construct. Depending on the context, prior literature found this latent variable to be defined by either uni- or multi-dimensional scales, measured with one or multiple items (e.g.,

⁴ $n=132$ respondents who reported being contractually married were not asked questions on marital quality and were thus excluded from the sample. Couples who are contractually married typically do not yet co-reside and thus many of the marital quality questions do not apply to their situation.

⁵ The exact wording of the latter question (“My husband/wife treats me harshly”), in Arabic, was “يتحدثونني/يتحدثونني قاسياً/يتحدثونني قاسياً”. While the question was intended to capture instances of domestic violence, we are aware that it may be an imperfect proxy because the wording does not necessarily imply violence and abuse.

⁶ We imputed responses using the modal response for 2 observations that had missing values on 1+ marital quality questions.

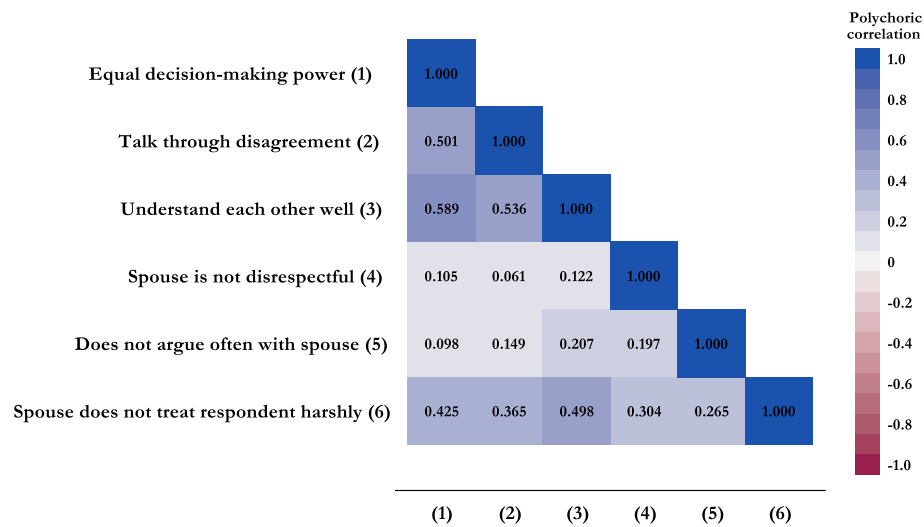


Fig. 1 Polychoric correlations for items measuring dimensions of marital quality

Allendorf & Ghimire, 2013; Glenn et al., 2010). Given the minimal research on marital quality in Jordan and the MENA, we use exploratory factor analysis (EFA) to identify potential underlying dimensions and operationalise its measurement. This approach allows us to conduct exploratory work without assuming the number of latent dimensions of marital quality and/or giving ex ante weights to certain items.

Specifically, we employ a polychoric correlation matrix that takes into account the ordinal nature of the marital quality items (Kolenikov & Angeles, 2009). The matrix of such correlation coefficients for the whole sample is presented in Fig. 1 (Supplementary Material Figure A1 presents matrices for each nationality sub-group). Using this matrix, the EFA identified one underlying construct of marital quality (eigenvalue: 1.855, ordinal $\alpha=0.77$), with satisfactory loadings (i.e. factor loadings >0.6) for items (1–3) and (6) (Finch, 2020). We excluded items with low factor loadings (<0.2) from the construction of the final factor. Overall, our umbrella factor for marital quality identified via EFA comprises elements of equality, respect and interpersonal communication and explains 53% of the items’ shared variance.

In addition to examining marital quality as a latent construct, we built ordinal measures for each marital quality outcome.⁷ We do so to avoid loss of information and because examining single items can be informative of specific behaviours and relationship processes, especially given the absence of a consistent definition, measurement and operationalisation of marital quality in MENA and elsewhere (Bradbury et al., 2000; Fincham & Rogge, 2010).

⁷ As alternative strategies, we also estimated logistic regressions using simple binary indicators differentiating between “strongly agree/agree” vs. “neutral/disagree/strongly disagree” and ordinal logistic regression with a three-level categorical dependent variable (“strongly agree/agree”, “neutral”, “disagree/strongly disagree”). Results remained qualitatively identical.

Independent variables

Union formation characteristics. Our variables related to how the marriage came about consist of marriage arrangements, age at marriage and consanguinity. Marriage arrangement describes the extent to which the respondent reported participating in the choice of her/his spouse. It is coded as a categorical variable differentiating between (i) self-arranged marriages, i.e. where the respondent chose her/his spouse independently; (ii) jointly arranged marriages, i.e. where the respondent selected the spouse together with family members; and (iii) arranged marriages if spouse choice was exclusively made by the respondent's family.

We examine age at marriage both as a continuous indicator and a three-level variable capturing whether the marriage happened (i) before age 16, (ii) between 16 and 17 and (iii) 18+. ⁸ Consanguinity is measured with a binary variable for whether the respondent reported being related by blood to her/his spouse.

Marriage-specific characteristics. We measure marital duration as the difference between the reported date (month/year) of the current marriage and the date of the interview. ⁹ For the sub-sample of Syrian refugees, we use retrospective data on migration to build an additional variable for whether the marriage took place before or after they arrived as displaced in Jordan. As to the presence of children, we create a continuous indicator for the number of children ever born alive to female respondents. This information was only available and included in analyses of the female sample.

Individual- and household-level characteristics. In addition to a binary indicator for gender, we build socio-economic indicators for employment status (participated in paid labour activities in the past week), residence type (urban vs. rural or camp setting), educational level (less than basic, basic (10th grade), secondary and higher) and household wealth. This latter variable is a wealth index measure based on quintiles similar to the ones used by the Demographic and Health Survey Program (2023). We do not include age at the time of the survey because it is highly correlated with marital duration.

Methods

We use linear regression models to examine the predictors of marital quality for the factor identified through EFA and ordinal logistic models for each single marital quality item. We conduct the analyses on samples of Syrians and Jordanians separately, proceeding in a stepwise manner. First, we investigate baseline (i.e. unadjusted) relationships between marital quality measures and each indicator of (i) union formation characteristics and (ii) marriage-specific characteristics. Second, we analyse whether these relationships persist once we adjust for individual- and household-level factors. Third, we estimate full models with all covariates. Fourth, we interact union formation characteristics with respondents' gender to examine whether the influence of a given characteristic

⁸ We are not able to examine spousal age gaps in our sample. While age information was collected from all household members, it was not possible in all cases to identify respondents' spouses (and therefore their ages) through linkage with the household roster, particularly in extended families. We therefore would have lost a substantial (and biased) proportion of our already small analytical sample.

⁹ It is important to highlight here that marital duration cannot be distinguished from marriage cohort due to the cross-sectional nature of the data. Hence, any potential relationship between marital duration and marital quality may actually be the result of belonging to specific marriage cohorts. Moreover, age at survey is also highly related to marital duration. Thus, we cannot disentangle the specific influence of marital duration, marriage cohort, and age at the time of survey.

(e.g., consanguinity) matters differently for marital quality outcomes of men and women of a given nationality. Finally, we restrict our samples to female respondents to examine group-specific predictors and their interactions.

To ease interpretation, we show the results of ordinal logistic models using exponentiated coefficients (odds ratios, OR). For the measure of marital quality constructed with EFA, we multiplied the raw factor by 10 and standardised it so that coefficients are not affected by leading zeros and can be interpreted in terms of increase/decrease in standard deviations. Positive coefficients in all models indicate better marital quality. All coefficients are weighted using weights accounting for survey design (OAMDI et al., 2022).

Results

Sample characteristics

Table 2 shows basic descriptive statistics of the samples of young married Syrian refugees ($n = 565$) and Jordanians ($n = 419$). Due to women's younger average age at marriage among both Syrians and Jordanians, the majority of the analytical sample comprised women (74%). On average, respondents' age is 25 years. Syrians have much lower educational attainment, are poorer and less urbanised (due to camp residence) than Jordanians. Very few young women work (<4%), and the employment rate among Syrian men is considerably lower (48%) than among Jordanian men (73%). Among Syrians, 38% of married women and 52% of married men were living in refugee camps at the time of the survey. This is considerably higher than the proportion of camp residents in the youth population overall (about 20%) and may reflect younger ages at marriage among youth in camps.

Union formation characteristics

About a quarter of respondents report being in a family-arranged marriage. The largest proportion of family-arranged marriages is among Syrian women (32%), followed by Jordanian women (26%). The latter also have the highest prevalence of consanguineous union (nearly 67%), followed by Syrian men (62%). Notably, consanguinity is common throughout the sample, at 62% of respondents. Female Syrian refugee youth have the lowest average age at marriage (17.5 years old), noting that our data are subject to right-censoring because they capture youth during the key ages of transition to marriage. Marriage before age 18 is very rare among male Syrian youth and was not reported by any male Jordanian. By contrast, almost a quarter of married female Jordanian youth (23%) and over half of married female Syrian youth (57%) married before age 18.

Reflecting their earlier ages at marriage and correspondingly longer marriage duration, 48% of female Syrian refugee youth had married prior to displacement but only 18% of the married Syrian men. It is also important to note that, among Syrian refugees, there are significant differences in all union formation characteristics between those who married before and after migrating to Jordan (Table A1). These differences likely reflect the age composition of the two groups.

Since most cross-group differences appear in the variable capturing involvement in spouse selection, in Fig. 2 we visually explore other union formation characteristics (age at marriage, early marriage and consanguinity) by marriage arrangement type for each gender-nationality group. Across all groups, typically respondents in

Table 2 Sample descriptive statistics, SYPJ 2020–21

	Syrian women	Syrian men	Jordanian women	Jordanian men	Total
	Percent/mean (sd)	Percent/mean (sd)	Percent/mean (sd)	Percent/mean (sd)	Percent/mean (sd)
<i>Individual and household characteristics</i>					
Age	23.5 (4.07)	25.1 (3.)	25.6 (3.4)	26.6 (2.6)	24.8 (3.7)
Education					
Less than basic	41.5%	50.9%	8.3%	13.3%	29.5%
Basic	37.1%	33.9%	21.1%	28.9%	30.4%
Secondary	19.3%	13.6%	44.1%	43.4%	28.7%
Higher education	2.1%	1.7%	26.5%	14.5%	11.4%
Currently working	1.8%	48.0%	3.9%	73.5%	16.8%
Residence location					
Urban	61.6%	48.0%	81.6%	92.8%	68.6%
Rural/camps	38.4%	51.9%	18.5%	7.2%	31.4%
Household wealth					
Poorest	27.8%	25.9%	10.42%	9.64%	20.0%
Poor	28.4%	33.3%	6.85%	7.23%	20.1%
Middle	26.0%	23.7%	12.2%	14.5%	19.9%
Rich	15.5%	15.3%	25.6%	28.9%	20.0%
Richest	2.3%	1.7%	44.9%	39.8%	19.9%
<i>Union formation and marriage-specific characteristics</i>					
Marriage arrangements					
Self-arranged	55.9%	74.6%	61.0%	84.3%	63.4%
Family arranged	32.2%	16.9%	26.5%	10.8%	25.7%
Jointly arranged	11.9%	8.5%	12.5%	4.8%	10.9%
Age at marriage	17.5 (2.4)	21.4 (2.4)	19.9 (3.1)	23.8 (2.5)	19.5 (3.3)
Married before age 18	56.7%	3.4%	22.6%	0.0%	30.7%
Consanguinity	58.1%	62.1%	66.7%	59.0%	62%
Children ever born	2.3 (1.6)		2.0 (1.3)		2.2 (1.5)
Marital duration (years)	6.0 (3.9)	3.6 (2.7)	5.7 (3.6)	2.9 (2.3)	5.3 (3.7)
Married before displacement to Jordan	47.6%	17.5%			21.7%
Observations	388	177	336	83	984

Source: SYPJ (2020–21)

family-arranged marriages appear to have married earlier, particularly among Jordanian women ($p=0.001$). We find no significant differences in consanguinity by the marriage arrangement type across all groups, except a moderate association for Syrian men ($p=0.03$). In other words, consanguinity and arranged marriage in this population are not synonymous, primarily because consanguinity rates are so high overall.

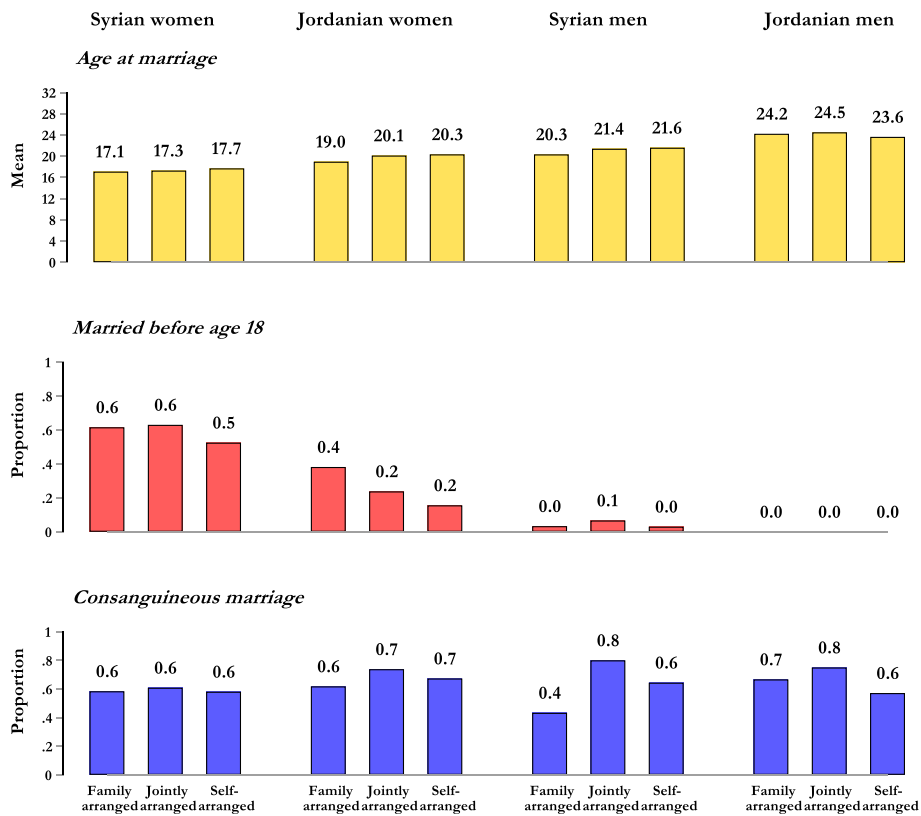


Fig. 2 Distribution of union formation characteristics by marriage arrangement. Source: SYPJ (2020–21). Note that proportions for Jordanian men in particular should be taken with care due to small sample size

Predictors of marital quality

We present the results of linear regression models using the latent measure of marital quality identified through EFA for Syrians (Table 3) and Jordanians (Table 4). In both tables, first, we show the relationships between each union formation/marriage-specific characteristic and marital quality, adjusting for socio-demographic and economic factors, including gender, and a full model including all predictors.¹⁰ In the last two columns, we restrict the samples to women and further examine the interaction between age at marriage and marriage arrangement type.

Three main observations appear salient. First, contrary to our hypotheses, we observe null associations between the latent construct of marital quality and consanguinity (*Hypothesis 2*) as well as between marital quality and marriage-specific characteristics (*Hypotheses 4, 6*). Among Syrians, we also do not find evidence of differences in marital quality between respondents who married before/after being displaced to Jordan (*Hypothesis 5*). However, among both Syrians and Jordanians, estimates point to a negative association between the type of marriage arrangement and marital quality. Specifically, young Syrians and Jordanians whose marriages were family-arranged report significantly lower marital quality (nearly a sixth and one-half of a standard deviation

¹⁰ Bivariate relationships are shown in Tables A2, A3 in the Supplementary Material.

Table 3 Adjusted linear regression models of the standardised dimension of marital quality, Syrians

	Marital quality (factor)								
	All respondents						Female sample		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Marriage arrangement (ref: Self-arranged)									
Family arranged	− 0.149+						− 0.168 ⁺	− 0.198*	− 1.877*
	[0.100]						[0.083]	[0.146]	[0.846]
Jointly arranged	0.167						0.174	0.032	− 1.768
	[0.177]						[0.178]	[0.195]	[1.098]
Age at marriage (ref: 18+)									
Before age 16		− 0.288*						− 0.248*	
		[0.191]						[0.108]	
Between age 16–17		0.022						0.065	
		[0.161]						[0.201]	
Age at marriage (continuous)			0.013				0.005		− 0.002
			[0.020]				[0.020]		[0.025]
Consanguineous marriage				− 0.008			− 0.007	− 0.033	0.038
				[0.088]			[0.091]	[0.110]	[0.129]
Marital duration in years					− 0.011		− 0.023	− 0.014	− 0.003
					[0.016]		[0.022]	[0.035]	[0.026]
Marriage timing (ref: Before displacement)									
Married after displacement to Jordan						− 0.002	− 0.099	− 0.105	
						[0.102]	[0.141]	[0.206]	
Number of children								− 0.011	− 0.032
								[0.050]	[0.052]
Marriage arrangement × age at marriage									

Table 3 (continued)

	Marital quality (factor)								
	All respondents							Female sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Family arranged × age at marriage									0.095*
									[0.047]
Jointly arranged × age at marriage									0.103 ⁺
									[0.059]
Gender (ref: Male)									
Female	− 0.178 ⁺	− 0.166 ⁺	− 0.167	− 0.205*	− 0.196 ⁺	− 0.204 ⁺	− 0.146*		
	[0.113]	[0.129]	[0.127]	[0.104]	[0.106]	[0.108]	[0.104]		
Constant	0.186 ⁺	− 0.182	− 0.130	0.144	0.198	0.136	0.255	− 0.007	0.220
	[0.112]	[0.199]	[0.426]	[0.110]	[0.125]	[0.112]	[0.440]	[0.308]	[0.513]
R-squared	0.196	0.198	0.187	0.186	0.188	0.189	0.206	0.315	0.306
Obs	565	565	565	565	565	565	565	388	388

Source: SYPJ (2020–21). Estimates from linear regression models. Positive coefficients indicate better marital quality. Standard errors in brackets. All models control for respondent's region of residence (Centre, North, South), education, residence type (urban, rural/camps), wealth and employment status

⁺ $p < 0.1$,

* $p < 0.05$

Table 4 Adjusted linear regression models of the standardised dimension of marital quality, Jordanians

	Marital quality (factor)							
	All respondents						Female sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Marriage arrangement (ref: Self-arranged)								
Family arranged	- 0.510**					- 0.497**	- 0.641**	- 1.287
	[0.178]					[0.181]	[0.195]	[0.984]
Jointly arranged	- 0.037					0.017	- 0.264	- 0.561
	[0.236]					[0.232]	[0.195]	[1.882]
Age at marriage (ref: 18+)								
Before age 16		- 0.859*					- 0.641	
		[0.432]					[0.195]	
Between age 16–17		0.195					- 0.264	
		[0.230]					[0.195]	
Age at marriage (continuous)			0.057*			0.065+		0.059
			[0.026]			[0.037]		[0.047]
Consanguineous marriage				0.120		0.042	0.007	0.030
				[0.169]		[0.168]	[0.169]	[0.177]
Marital duration in years					- 0.013	0.023	0.055	0.058
					[0.024]	[0.032]	[0.048]	[0.050]
Number of children							- 0.076	- 0.077
							[0.134]	[0.132]
Marriage arrangement x age at marriage								
Family arranged x age at marriage								0.032
								[0.047]
Jointly arranged x age at marriage								0.019
								[0.089]
Gender (ref: Male)								
Female	- 0.03	- 0.098	0.021	- 0.208	- 0.112	0.065		
	[0.254]	[0.271]	[0.281]	[0.245]	[0.260]	[0.286]		
Constant	- 0.143	- 0.854	- 1.276	- 0.138	- 0.054	- 1.588	- 0.575	- 1.201
	[0.528]	[0.683]	[0.811]	[0.539]	[0.537]	[1.054]	[0.721]	[1.182]
R-squared	0.155	0.141	0.133	0.118	0.117	0.172	0.248	0.250
Obs	419	419	419	419	419	419	336	336

Source: SYPJ (2020–21). Estimates from linear regression models. Positive coefficients indicate better marital quality. Standard errors in brackets. All models control for respondent’s region of residence (Centre, North, South), education, residence type (urban, rural/camps), wealth and employment status

+ $p < 0.1$
 * $p < 0.05$
 ** $p < 0.01$
 *** $p < 0.001$

lower, respectively) than those who chose their spouses autonomously. The strength and magnitude of the coefficients are larger among Jordanians (Table 4, Cols. 1, 6), but in both nationality groups, marital arrangement is particularly predictive of marital quality for women. This is in line with our expectation (*Hypothesis 1*) that involvement in union

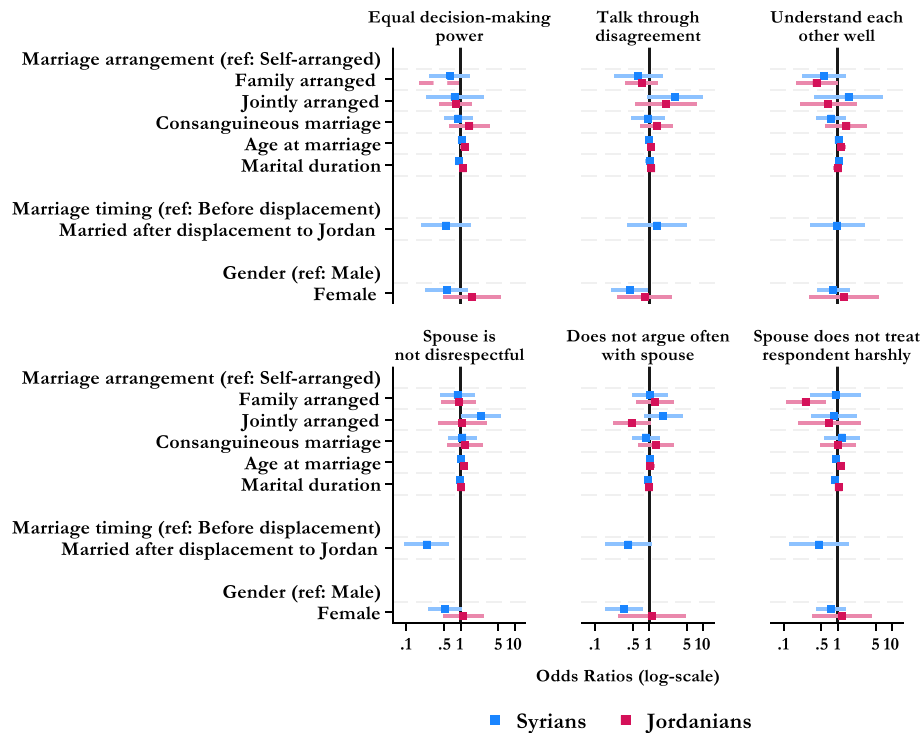


Fig. 3 Adjusted ordinal logistic regression models of marital quality items. Note that proportions for Jordanian men in particular should be taken with care due to small sample size. Ordinal logistic regression models. The squares represent odds ratio of a given outcome associated with a given variable. Error bars represent 95% confidence intervals. The dashed line corresponds to an odds ratio of 1. Full tabular results associated with each model in exponentiated form are in Tables A6, A7, Cols. 1–6 (Supplementary Material)

formation is associated with marital quality outcomes, and more strongly so among women.

Second, we find some evidence that marrying early, particularly before age 16, is associated with lower-quality spousal relationships, especially among Syrian women (*Hypothesis 3*). For this group, we further observe a significant interaction effect between age at marriage and marital arrangement, whereby increasing age at marriage moderates the negative influence of being in a family-arranged marriage (Table 3, Col. 9). No other interaction across union formation and marriage-specific characteristics was related to marital quality.

Third, we find that overall, among Syrians, women experience lower marital quality than men, a pattern does not emerge among Jordanians (*Hypothesis 7*). The specific associations between union formation characteristics and marital quality, however, generally do not depend on gender (Tables A4, A5),

As to other potential predictors, marital quality is not associated with factors found to be important in other LMICs, such as education (e.g., Allendorf & Ghimire, 2013). Only among Syrians, highly educated respondents report higher marital quality than refugees with less than basic levels of education, but this is likely due to both small cells and the high selectivity of this group (not shown). Finally, it is important to highlight that the R-square values from multivariate models show that, all together, these characteristics account for 20–30% of the variation in the dimensions of marital quality. That is, a large

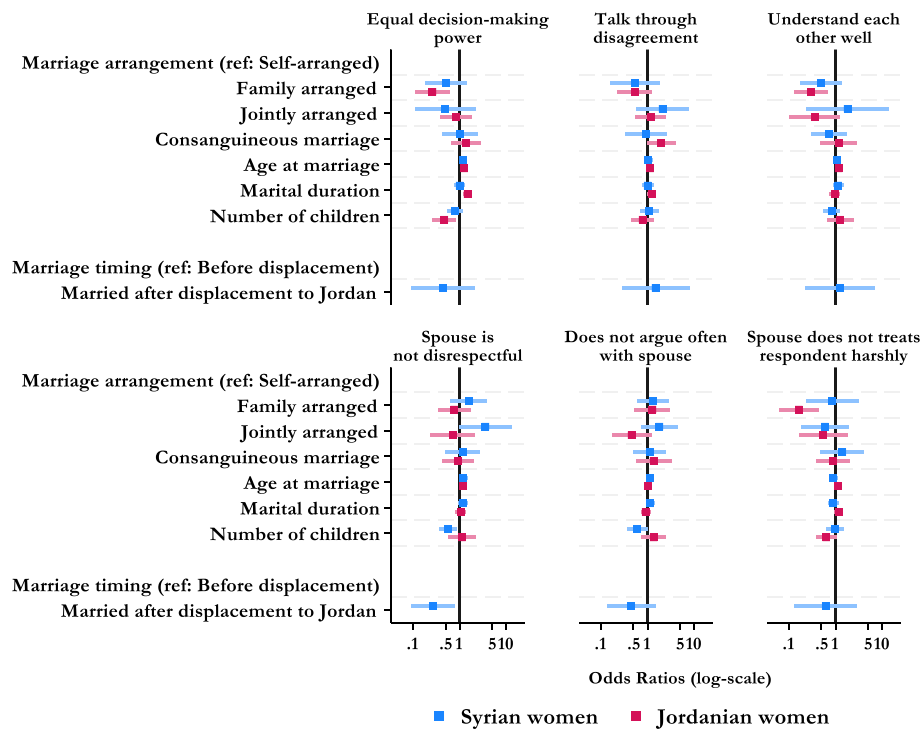


Fig. 4 Adjusted ordinal logistic regression models of marital quality items, female samples. Ordinal logistic regression models. The squares represent odds ratio of a given outcome associated with a given variable. Error bars represent 95% confidence intervals. The dashed line corresponds to an odds ratio of 1. Full tabular results associated with each model in exponentiated form are in Tables A6-A7, Cols. 7–12 (Supplementary Material).

share of the variation in the latent construct of marital quality remains unexplained, especially among Jordanians.

Ordinal logistic models

We next describe whether and how union formation processes and other factors may influence specific dimensions of marital quality for each nationality sub-group.

The ordinal logistic model estimates suggest that the negative influence of arranged marriages on marital quality is driven by two items: equality in decision-making and interpersonal communication (understanding each other well) (Fig. 3). As previously noted, the relationships are stronger and larger in magnitude for Jordanians. Among this group, youths in self-arranged unions are also more likely to agree that their spouse does not treat them harshly compared to those in arranged marriages (Col. 6 in Table A6).

As to other union formation characteristics, consanguinity as well as a continuous indicator for age at marriage are not associated with any specific marital quality item. However, when we examined relationships using a categorical indicator for marriage “before age 16”, “between 16 and 17” and “after age 18”, we found that the odds that both Syrians and Jordanians report having equal decision-making power with their spouses declines with younger age at marriage (not shown).

Notably, we now find that Syrians who married after being displaced to Jordan are more likely to feel disrespected by their spouses and to argue often with them (Fig. 3, Cols. 4–5, Table A6), i.e. with the two items that did not correlate well with the latent construct used earlier. Therefore, at least for these two items, the relationship works in the opposite direction from the one we hypothesised and does not change when we exclude marital duration from the model (not shown). Again, in contrast to Jordanians, for whom there are no significant gender differences, Syrian women report lower marital quality than Syrian men across most items (Table A6). In addition, for Syrian women having more children appears detrimental to marital quality, and again particularly with regard to feeling respected and the frequency of arguing with husbands (Fig. 4, Cols. 10–11, Table A6).

Discussion and conclusion

Marital quality is an fundamental aspect of family life with consequences for individual health, well-being and resilience (Bradbury et al., 2000). Because of its importance, the drivers of satisfactory marital life have been studied extensively in various settings, but not in the MENA region and/or in populations affected by conflict and insecurity. In this study, we leveraged unique representative data on Syrian refugees in Jordan to examine the interplay between displacement, union formation characteristics and marital quality and, more broadly, to investigate the predictors of marital quality among youth in the MENA region.

Our main finding is that among displaced Syrian youth in Jordan, the level of individual involvement in spouse selection operates as the strongest determinant of marital quality: arranged marriages are associated with lower marital quality overall, especially for women. The same pattern is observed among Jordanians. These results are in line with findings from the few other studies assessing the connection between spouse choice and marital quality in LMICs (Allendorf & Ghimire, 2013; Olcay Imamoglu et al., 2019). They are also consistent with research showing that, alongside the persistence of more customary practices, union formation dynamics among young people—and men in particular—in LMICs reflect some adoption of more Westernised patterns and ideals (Allendorf, 2017; Allendorf & Ghimire, 2013). Therefore, taken together, our results extend the small pool of evidence on the benefits of self-choice marriages even in contexts where these are not necessarily normative. These benefits are particularly apparent for wives, who at the same time are less likely than men to participate in the selection of their spouse.

A second important and related finding is that, for displaced Syrian women, it is not just the level of individual involvement in spouse selection, but its combination with age at marriage that appears to be most detrimental to satisfactory marital relationships. That is, for Syrian women, marital quality is lowest when arranged marriages happen at a young age. Although care must be taken in interpreting this result due to a limited sample with an over-representation of early unions, this finding speaks to the importance of autonomy in decisions about when and whom to marry, particularly among girls and women. Early marriage is not the same as forced marriage, and the qualitative literature on early marriage among Syrian refugee girls points

to the fact that girls themselves sometimes see marriage as an escape from difficult economic or household circumstances within their natal families (e.g., Al Akash & Chalmiers, 2021). Yet there are also many cases in which girls do not want to marry early (or marry a particular person early) and our findings suggest that these may be the cases in which marital quality suffers the most, with likely implications for other aspects of well-being.

More generally, we find that among Syrian refugees, women tend to experience lower marital quality than men—a pattern that is not observed among Jordanians. Among Syrian women, we further find that those with children and those who formed their unions after being displaced to Jordan are more likely to report negative marital dynamics. The latter finding agrees with much of the literature in Western contexts suggesting that parenthood may lead couples to experience greater conflict (Bradbury et al., 2000; Nomaguchi & Milkie, 2003). However, we do not find similar patterns among Jordanian women. Unfortunately, the lack of previous literature on marital quality in this context makes it difficult to draw conclusions about the reasons for this difference between the populations. It is possible that the findings among Syrians are an indication of specific displacement-related stressors, such as economic strain and limited network support, that make the presence of children in the household a source of marital conflict. Similarly, displacement-related precarity and the disruption of social ties may have led to lower-quality matches in the marriage market following displacement. At the same time, less conflict in unions formed before displacement may be a reflection of heightened bonding in couples that shared the traumatic experience of displacement (Shamai et al., 2018) or a shared process of adjustment of expectations as the family adapts to a new context. Future research using longitudinal data should further explore the dynamics of marital quality among displaced Syrians in relation to such contextual factors.

Our findings indicate that other union formation characteristics, such as consanguinity, as well as marriage-specific factors typically correlated with marital quality in other contexts, such as marital duration (Allendorf & Ghimire, 2013; Olcay Imamoğlu et al., 2019) have little to no overall association with marital quality. The relationship between these characteristics and marital quality also does not seem to depend on marital arrangement, since we find no evidence of an interaction between involvement in spouse choice and marital duration or consanguinity. This result again may be indicative of the positive relational aspects of self-arranged marriages, regardless of duration or kinship ties between spouses (Xiaohe & Whyte, 1990). However, it is important to note that our descriptive analyses suggest that a large proportion of both Syrian and Jordanian youth—including those who self-arrange their marriages—keep practising consanguinity. The continued prevalence of consanguineous marriages among young people suggests that they and/or their families see benefits to this form of union formation (Al Akash & Chalmiers, 2021). In addition, although our data do not permit us to distinguish between marital duration, marriage cohort, and age at survey time, at least for Jordanian women, consanguinity and marital duration appear to be beneficial to equality in decision-making.

As observed in other non-Western contexts (e.g., Allendorf & Ghimire, 2013), across the sub-populations of Syrian refugee and Jordanian youth, most variation in marital quality remains unexplained. This may be due, in part, to survey-specific limitations, including

small samples for some categories and/or issues of measurement. Given the minimal prior research on marital quality in the MENA region, it is possible that survey instruments did not adequately capture important aspects of marital quality in this context. Another limitation of our analysis and ability to explain differences in marital quality is the potential for selection bias on who makes up our sample. Since divorce rates in this context are very low, we do not expect selection due to the exclusion of marriages that ended in divorce (or death) before the time of the survey to appreciably bias our results. However, we cannot rule out that unmeasured characteristics associated with marital quality and other union formation characteristics, including involvement in marriage decision-making, may be influencing our estimates. Since we observe youth during the key ages of marriage in the Jordanian context, those who married younger are over-represented in our analytical sample. Young people who marry later in the transition to adulthood may experience different union formation patterns and relationship quality. Due to the cross-sectional nature of our data and the lack of other studies with which we could compare our results, we are also unable to determine the degree to which marital quality among Syrian youth is shaped by displacement-related factors.

Nevertheless, this study presented some indicative findings about important relationships between displacement, union formation and marital quality in the MENA—a region of the world where conflict, crises and insecurity often interact with marriage markets and family dynamics (Sieverding et al., 2020). We hope that our results encourage further research into how conflict, displacement and insecurity influence not only patterns of family formation, but also family life after marriage in MENA and globally. A more holistic view of the dynamics of marriage and family life in conflict-affected populations is important not only for understanding demographic trends, but also for understanding the many other aspects of well-being that are shaped in the family sphere.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s41118-024-00219-y>.

Supplementary Material 1.

Author contributions

Orsola Torrissi: conceptualisation, formal analysis, methodology, writing—original draft, writing—review and editing. Maia Sieverding: conceptualisation, methodology, writing—original draft, writing—review and editing.

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Data availability

Cleaned data for the study are available from the corresponding author or, alternatively, can be downloaded in raw format from the following link: <https://www.erfdataportal.com/index.php/catalog/241>.

Declarations

Competing interests

The authors confirm that this manuscript is original, and is not currently being considered for publication elsewhere. Its content is solely the responsibility of the author. The author declares no financial or non-financial conflicts of interest associated with this study.

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