RESEARCH ARTICLE

REVISED Shifting dynamics: Changes in the relationship between total fertility rate and contraceptive prevalence rate in Jordan between 2012 and 2017 [version 2; peer review: 3 approved, 1 not approved]

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Abstract

Background: Between the two most recent Population and Family Health Surveys, Jordan saw a dramatic decline in the Total Fertility Rate (TFR) from 3.5 to 2.7 in 5.5 years. Over the same period, modern contraceptive use also declined, from 61.2% to 51.8% among married women. This decrease in both TFR and the contraceptive prevalence rate (CPR) diverges from the typical relationship seen between these two factors whereby historically as CPR increases, TFR decreases. This paper explores this unique pattern using multiple methodologies.

Methods: First, we validate the survey data using nationally collected data on fertility and contraceptive distribution. Second, we look to changes that have historically influenced changes in CPR and TFR, including changes in ideal family size and wanted fertility rates. Third, we explore proximate determinants and other influences on fertility and changes in contraception, examining the changes in the method mix and unmet need; marriage patterns, including the demographics of the married population, spousal separation, and time since last sex; postpartum insusceptibility; infecundity, both primary and secondary; and abortion, to see if any have shifted significantly enough to allow for fertility to decline with less contraceptive use.

Results: We find that the decline in fertility in Jordan was driven by a reduction in mistimed or unwanted pregnancies and there was a significant increase in the share of reproductive aged women who are infecund. We also concluded that the changes in fertility and contraceptive use are driven by changes in Jordanian nationals, not by the growing Syrian refugee population.

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Any reports and responses or comments on the article can be found at the end of the article.

Conclusions: Jordan is not the only country to be experiencing a shift in the typical relationship between CPR and TFR. Results can inform both future approaches for family planning programs and our expectations regarding what kind of change our family planning investments might buy.

Keywords

Fertility, Contraception, Jordan

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REVISED Amendments from Version 1

We have expanded our discussion on the multiple countries which show discordant changes in TFR and CPR. Additionally, we have included confidence intervals in our discussion of TFR.

Any further responses from the reviewers can be found at the end of the article

Background

In most countries, total fertility rate (TFR) and contraceptive prevalence rate (CPR) change over time in a predictable relationship wherein CPR increases while TFR declines. This pattern is consistent with both the demographic transition theory¹ and proximate determinants of fertility². Until recently, Jordan has followed this typical pattern. However, between the two most recent Jordan Population and Family Health Surveys (JPFHS), rather than the CPR increasing and the TFR decreasing, Jordan saw a decline in both CPR among married women (from 61.2% to 51.8%) and TFR (from 3.5 to 2.7) over the period of just 5.5 years. Was this significant shift due to data errors? If not, what changed to influence TFR and CPR in this unexpected way?

This paper aims to explore several potential factors that may have influenced this pattern change and provide further analysis of the recent past, current, and potential future trends of fertility and family planning (FP) in Jordan. We start by validating the 2017 JPFHS data for fertility and FP by comparing them to service statistics collected by Jordan's Department of Statistics and Ministry of Health. We then explore typical factors that may be responsible for the shift that might explain this new CPR/TFR pattern, including the ideal family size, wanted total fertility rates, unintended pregnancies and method mix.

Jordan's unique country context as a middle-income country in the Middle East means that the specific factors contributing to its CPR and TFR pattern may not be directly comparable to other low-and middle-income countries. However, Jordan is not the only country in which we are seeing shifts to the typical relationship between TFR and CPR. India, Indonesia, Maldives, Nepal and Pakistan³ have also experienced a decrease in TFR coupled with a decrease in mCPR between their two most recent DHSs⁴. All six countries are middle-income countries and

Jordan is the only country not located in South Asia or Southeast Asia. Every country except Pakistan has a TFR below 3.0 and appears to be reaching the later stages of the demographic transition. One DHS further analysis on fertility in Nepal. The authors examine the decline in total fertility between 2006 and 2016 through the proximate determinants of fertility, with the addition of a spousal separation index. They conclude that spousal separation played a major role in the fertility decline, followed by changing marriage patterns and abortion⁵.

Expanding our understanding of these new and unexpected patterns can inform both future approaches for (FP) programs and our expectations regarding what kind of change our FP investments might buy that will benefit other countries seeing similar changing patterns. We hope that the approaches used in this paper to analyze JPFHS and national health management and information system data and to coordinate those findings with country context and FP programming efforts may provide discussion and learning opportunities for global FP teams.

Background on family planning in Jordan

Jordan's FP program is stewarded by the Ministry of Health (MOH) and includes long standing services in the public and private sectors which offer widespread access to contraception across the country. Approximately 49% of FP services are supported the by the MOH, which in addition to MOH facilities, includes Royal Medical Services and public university facilities⁶. The remaining 51% of FP services are provided by the private sector which includes private clinics, hospitals, and pharmacies, the United Nations Relief and Works Agency (UNWRA) and NGOs⁶. There is no emergency contraceptive product available in the public or private sector and abortion is illegal except to save the life of the mother or to preserve her physical health^{7,8}. To address high rates of unmet need for FP and overcome the stagnation of contraceptive use, the MOH has supported efforts to shift social norms regarding FP use and family size and improve the availability and quality of FP services⁹. In addition to programmatic efforts to influence demand and use of FP services; major recent changes in the

¹ Kirk, D. 1996. "Demographic transition theory." *Population Studies* 50 (3) : 361–387. <https://doi.org/10.1080/0032472031000149536>.

² Bongaarts, J. 1978. "A framework for analyzing the proximate determinants of fertility." *Population Development and Review* 4 (1):105–132. <https://doi.org/10.2307/1972149>.

³ 2017–18 National figures excluded Gilgit Baltistan, which was included in the 2012–13 estimates, so trend analysis between the two estimates should be interpreted with caution.

⁴ ICF. 2012. The DHS Program STATcompiler. Funded by USAID. <https://www.statcompiler.com/en/>.

⁵ Dev Pant, P., J Prasad Pandey & K. Bietsch. 2019. Unmet need for family planning and fertility in Nepal: levels, trends and determinants. DHS Further Analysis Reports No. 119. Rockville, Maryland, USA: ICF International. <https://dhsprogram.com/pubs/pdf/FA119/FA119.pdf>.

⁶ Department of Statistics (DOS) and ICF. 2019. *Jordan Population and Family Health Survey 2017–2018*. Amman, Jordan, and Rockville, Maryland, USA: DOS and ICF. <https://www.dhsprogram.com/pubs/pdf/FR346/FR346.pdf>.

⁷ El Mowafi, I. & A. Foster. 2020. "Emergency contraception in Jordan: Assessing retail pharmacists' awareness, opinions, and perceptions of need." *Contraception* 101 (4): 261–265. <https://doi.org/10.1016/j.contraception.2019.10.002>.

⁸ Singh, S, L. Remez, G. Sedgh, L. Kwok & T. Onda. 2017. "Abortion worldwide 2017: uneven progress and unequal access." https://www.guttmacher.org/sites/default/files/report_pdf/abortion-worldwide-2017.pdf.

⁹ Institute for Reproductive Health. 2016. *Final Report: Jordan Family Planning Assessment*. FACT Project. Washington, D.C.: Institute for Reproductive Health, Georgetown University. http://irh.org/wp-content/uploads/2016/05/USAID_FP_assessment_2016_IRH_FINAL_REPORT.pdf.

Jordanian socio-economic environment have likely influenced fertility and contraceptive use outcomes¹⁰.

Since 2011, Jordan has received hundreds of thousands of Syrian refugees - with estimates ranging from 650,000 to 1.2 million refugees over the course of six years¹⁰. Of the registered Syrian refugees, an estimated 80 percent live within Jordanian towns and cities and utilize national and local services for daily life¹¹. Providing support to the refugees put additional strain on limited national resources, which resulted in challenges to fully fund and address critical health issues¹⁰. The impact of the regional conflicts and refugee settlements has had a substantial economic impact on Jordanians, due to increased costs of food, goods, and rent alongside continued high rates of unemployment and underemployment¹².

Recent changes in family planning and total fertility rate

In the past, the relationship between TFR and CPR in Jordan followed the typical pattern, with TFR declining as CPR increased, as can be seen in [Table 1](#) which shows Jordan's TFR, CPR, modern CPR (mCPR), and traditional CPR (tCPR) from the JPFHS from 1990 to 2018. Between 1990 and 2002 Jordan's TFR fell by almost 2 children per woman (from 5.6 to 3.7), then over the next decade (2002–2012) TFR remained fairly level, ranging from a high of 3.8 to a low of 3.5. At the same time that fertility was rapidly declining (1990–2002), total CPR increased from 40% to 56% for married women and during the 10-year stall in fertility decline, CPR increased by only

5%. Traditional methods make up a large share of the method mix in Jordan and have fluctuated in use over time. Between the 2012 and 2017–18 surveys, TFR began to decline again, by 0.8 children per woman, while at the same time CPR declined from 61% to 52% of married women. Declines of 5% each were seen in both mCPR and tCPR.

Methods

Validating survey results from the 2017–18 JPFHS

We seek to validate that the changes seen in the 2017 JPFHS data are a true reflection of fertility and contraceptive use in Jordan, and not the result of data collection error. This validation is done internally, using previous JPFHS rounds, and externally using nationally collected data from the 2015 Census, birth registrations, and contraception distribution recorded by the Ministry of Health. Analysis is conducted using R version 3.6.1¹³.

The JPFHS is a nationally representative survey which aims to provide estimates of basic demographic and health indicators. Implemented by the Jordan Department of Statistics (DOS) with assistance from ICF through the Demographic and Health Survey (DHS) Program, the 2017–18 JPFHS is the seventh DHS to be conducted in Jordan⁶. It is designed to be representative of the country as a whole, of urban and rural areas separately, of the three regions of Jordan, its 12 administrative governorates, and of its three national groups (Jordanians, Syrians and other nationalities)¹¹. The sampling frame is based on Jordan's Population and Housing Census frame for 2015 and the sampling design is a stratified two-stage cluster design¹¹.

Internal validation of the JPFHS. One hypothesis for the reported rapid decline in TFR is that a problem with data collection in the most recent survey resulted in an undercounting of births. This kind of error can occur if enumerators do

¹⁰ Alshoubaki, W. & M. Harris. 2018. "The impact of Syrian refugees on Jordan: a framework for analysis." *Journal of International Studies* 11 (2): 154–179. <https://doi.org/10.14254/2071-8330.2018/11-2/11>.

¹¹ World Food Program USA. 2019. *10 facts about the Syrian refugee crisis in Jordan*. World Food Program USA. <https://www.wfpusa.org/articles/10-facts-about-the-syrian-refugee-crisis-in-jordan/#>.

¹² World Bank. 2019. *Jordan*. <http://pubdocs.worldbank.org/en/837261553672494334/jordan-MEU-April-2019-Eng.pdf>.

¹³ RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL <http://www.rstudio.com/>

Table 1. Trends in fertility (with confidence intervals) and contraceptive use in Jordan Population and Family Health Surveys 1990 through 2017–18.

Survey	Total fertility rate 15–49	Married women currently using any method of contraception	Married women currently using any modern method of contraception	Married women currently using any traditional or folk method
2017–18 JPFHS	2.7 (2.66–2.80)	51.8	37.4	14.4
2012 JPFHS	3.5 (3.42–3.60)	61.2	42.3	18.9
2009 JPFHS	3.8 (3.75–3.95)	59.3	42.0	17.2
2007 JPFHS	3.6 (3.50–3.68)	57.1	41.9	15.2
2002 JPFHS	3.7 (3.54–3.79)	55.8	41.2	14.6
1997 JPFHS	4.4 (4.20–4.50)	52.6	37.7	14.9
1990 JPFHS	5.6 (5.41–5.74)	40.0	26.9	13.1

not collect full birth histories¹⁴. Other data quality issues that may contribute to an underestimation of TFR include misreporting of date of birth, sampling errors, selection bias, and other factors, such as an underestimation of ever-married women or misreporting of women's age. To check for errors in the 2017 JPFHS, annual TFRs were constructed from the last three surveys to confirm that TFRs from the same year in multiple surveys overlap. Annual age specific fertility rates were also calculated for the 2017 survey.

To internally validate contraceptive use, we examined the contraceptive calendar collected by the JPFHS for 72 months before the survey. We constructed monthly CPR and mCPR for married women, aged 15–44, from the 2017 JPFHS contraceptive calendar. Because we only know marital status at time of the survey and date of first marriage, we excluded monthly observations from women prior to their first marriage. It is possible some women were formerly married and then remarried at some point in the calendar, but we were unable to distinguish these periods. We excluded women over 45 because we do not have women 45–49 in earlier years of the calendar and by the time of interview, they would have been above the age of 50 and excluded from the survey. We aimed to use the contraceptive calendar to see if the difference between the current use measure from the previous survey and the monthly measure from the calendar for the same time period was similar. However, our results revealed inaccuracies in the contraceptive calendar data, so it could not be used to validate contraceptive use. Due to concerns regarding the accuracy of the contraceptive calendar data, results from this analysis are not presented in the body of the text but can be found in *Extended data*, Appendix 1¹⁵.

External validation of the JPFHS. To externally validate fertility rates in the JPFHS, data from the 2015 census¹⁶ provided by the Civil Status and Passport Department was used to calculate TFR for Jordanian women living in Jordan. We also estimated the crude birth rates (CBR) and general fertility rate (GFR) from 2007 to 2018 using publicly available birth and population data from Jordan's DOS¹⁷. The DOS uses this data to calculate annual estimates (for the whole population and for women of reproductive age). The population data is released as end year populations. From the DOS's annual estimates, we estimated the person-years lived annually for the entire population and women of reproductive age to use as the denominators for CBR and GFR. We assumed constant exponential growth throughout the year and estimated the growth rate using

$P2 = P1 * \exp(\text{rate} * \text{time})$. We then estimated the mid-year population using this growth rate. We assumed the mid-year population was equivalent to the person-years lived in the period.

To externally validate the trend in contraceptive use between JPFHS surveys, we construct an annual estimated modern use (EMU) value using data from the Ministry of Health Contraceptive Logistic Management Information System. EMU is a measure developed by the [Track20](#) project as part of the monitoring process supporting the FP2020 global initiative to facilitate annual estimates of modern contraceptive use based on service statistics. The tool used to generate the EMU value uses government data on contraceptive distribution, making several adjustments for long term methods distributed in years prior that may still be in use in the current year, method discontinuation, and lack of data from certain private sources (especially pharmacies and shops)¹⁷. Data from 2005 to 2018 for commodities distributed to clients, commodities distributed to facilities, and FP visits were all available for the majority of public sector and minority of private sector distribution. These variables are collected to monitor the distribution and dispensing of FP commodities and to report to the MOH indicators related to couple years of protection (CYP) and FP visits. Each facility receiving commodities from the MOH must report to the central MOH at the end of each month in paper format. Staff at the central level enter the data into the logistics information system. This system generates indicators including those related to stockouts. In order to use the EMU to validate the latest JPFHS mCPR estimate, we run the Family Planning Estimation Tool (FPET) with the EMU value calculated from commodities to clients data (which allows FPET to consider the service statistics data in its estimate calculations) and excluded the 2017 survey. The FPET is part of joint work by Track20, the United Nations Population Division, and UMass Amherst to estimate and project likely paths of CPR, mCPR and unmet need. It is the official tool used in tracking progress for the FP2020 Global Initiative¹⁸.

Exploring influencing factors on TFR and CPR

There are several factors that have historically been found to influence TFR and CPR. Using descriptive statistics, we explore these factors as the potential source of the change in Jordan.

Changes in population distribution. One area for exploration is whether changes seen between 2012 and 2017 are driven by shifts in population distribution, notably changes in nationality. To look at this we constructed TFRs separately for Jordanians and Syrians in 2012 and 2017. Both JPFHS rounds only interviewed ever married women but TFR requires data from all women to be calculated. The JPFHS provides an all women adjustment weight for these calculations; however, subpopulation estimates require special attention¹⁹. In 2017,

¹⁴ Schoumaker, B. 2014. *Quality and consistency of DHS fertility estimates, 1990 to 2012*. DHS Methodological Reports No. 12. Rockville, Maryland, USA: ICF International. <https://dhsprogram.com/publications/publication-mr12-methodological-reports.cfm>.

¹⁵ Kristin Bietsch. (2020, September 29). kristinbietsch/JordanFertilityFP: Release for Gates 092920 (Version V2.4). Zenodo. <http://doi.org/10.5281/zenodo.4058480>

¹⁶ Department of Statistics (DOS). n.d. *Population and housing 2015*. http://dosweb.dos.gov.jo/censuses/population_housing/census2015/

¹⁷ Department of Statistics (DOS). n.d. *Population*. <http://dosweb.dos.gov.jo/population/>

¹⁸ New, JR & L. Alkema. 2015. *Family planning estimation tool (FPET)*. <http://fpet.track20.org/>.

¹⁹ DHS Program. n.d. "Guide to DHS Statistics DHS-7." DHS Program. https://dhsprogram.com/Data/Guide-to-DHS-Statistics/Analyzing_DHS_Data.htm.

the JPFHS provided a special all-women factor for tabulations based on nationality, allowing for TFR calculations by nationality. The 2012 survey does not provide such a weight. To compare TFRs by nationality between surveys, we used an alternative approach: because non-marital childbearing is uncommon in Jordan, we used information from the household registers to estimate the population of never married women of reproductive age. Assuming never married women have not had children, we added these women to the ever-married women sample to form an all women sample. We also made an assumption regarding age. Century month codes for women's date of birth and date of interview are used to construct TFR, but the household roster only provides full years of age. We assumed that on average, women are halfway through a single year age group.

Changes in fertility intentions. We look at changes in wanted TFR (WTFR) and unmet need. Ideal number of children is calculated by asking women if they could go back in time before having children and choose how many children they would have, what would be the number of children they choose. WTFR is calculated in the same manner as the TFR, but only includes live births that were at or below the ideal family size of the respondent at the time of conception. Mathematically, WTFR must always be smaller than TFR, while this is not the case for ideal number of children, which can exceed TFR.

Unmet need is a measure of women who are fecund and currently trying to avoid pregnancy but are not currently using a contraceptive method, or who are pregnant or postpartum infecund and did not want to become pregnant at the time of their most recent pregnancy. The DHS algorithm for unmet need is used in this study and can be found on the DHS website²⁰.

Proximate determinants of fertility. We explore determinants of fertility to understand how fertility is able to decline in Jordan given the observed decline in contraceptive use. To begin our analysis of fertility change, we calculate the proximate determinants of fertility, as described by Bongaarts². With the JPFHS data, we calculate the index of proportion married, index of contraception, and index of lactational infecundability. Due to a lack of JPFHS and national data on abortion, it was not possible to calculate the index of abortion, but theories regarding the impact of abortion on fertility are discussed in a later section.

We also conduct analysis for other factors which may limit fertility that are in line with Bongaart's framework². Additional factors included changes in the method mix; marriage patterns, including the demographics of the married population, spousal separation, and time since last sex; postpartum insusceptibility; infecundity, both primary and secondary; and abortion.

Method mix If the method mix changes so that the contraceptives used are more effective (result in fewer pregnancies from method failures), then it would be possible to experience declines in TFR with declines in CPR. We look at the method mix overtime to see if changes in method efficacy are enough to offset declines in overall method use.

Marriage and exposure to risk of pregnancy The JPFHS only interviews ever married women. For a greater understanding of the demographic structure of the married population, we calculate marriage by age for all women in the households interviewed by the JPFHS. Information about these women is provided by one household member who completes the household roster. Information includes age, sex, marital status, and nationality. For demographics of currently married women, we look at the women's questionnaire to find information on time since first marriage, spousal separation, and time since last sex.

Infecundity To compare levels of infecundability, we look at primary sterility (the percent of ever married women aged 45–49 with no children) and the proportion of infecund/menopausal married women as categorized by the definition of unmet need (married five or more years ago, had no children in past five years, never used contraception and said “can't get pregnant” when asked whether they wanted future children). And increase in infecundity will result in fewer births and more women of reproductive age without a need for, and therefore less likely to use, contraception.

Abortion Both the 2012 and 2017 JPFHS record pregnancies and pregnancy outcomes as part of the contraceptive calendar. Pregnancy outcomes are recorded as births or terminations. For the most recent termination in the calendar, women were asked to identify the type of terminations (miscarriages, abortions, or stillbirths). As we do not expect the miscarriage rate to change over time, we look at women who had a pregnancy end in the calendar (either through birth or termination) to estimate if abortion increased between surveys.

Results

Validating survey results from the 2017–18 JPFHS

Internal validation of the JPFHS. As shown in Figure 1, we find no evidence to support the hypothesis that the reported rapid decline in TFR is due to an undercounting of births or other data quality issue in the most recent survey. As can be seen below, except for the 2007 value calculated from the 2017 survey, the TFRs are consistent. Looking at TFRs from the 2017 survey, fertility decline began around 2010 (though the older surveys show a decline from at least 2007), and a major decline in TFR happened between 2013 and 2014; there was a small bounce back in 2015, but then a decline in 2016 to the same level as 2014.

Figure 2 shows that the drop from 2013–14 happened for the three highest fertility age groups- women ages 20–34. The drop in the three groups in 2014 is followed by one year of growth or stagnation, then a decline between 2015 and 2016 for the four age groups with the highest age specific fertility rates. There does not appear to be a data quality issue in

²⁰ <https://www.dhsprogram.com/topics/Unmet-Need.cfm#:~:text=What%20is%20unmet%20need%3F,and%20has%20changed%20over%20time.>

Figure 1. Annual total fertility rate, estimated using birth histories from the 2009, 2012 and 2017 Jordan Population and Family Health Survey.

Figure 2. Age-specific fertility rates by year, 2017 Jordan Population and Family Health Survey.

underreporting of births in the 2017 JPFHS in comparison to earlier surveys. Fertility was falling by 2010, and may have started earlier, with a rapid decline between 2013 and 2014.

External validation of the JPFHS. The national TFR for Jordanian women, which was calculated from the 2015 census, is presented in Figure 3. We can see that the TFR increased

between 2006 and 2007, then started declining (as was also seen when looking at the 2009 and 2012 JPFHS), with a stall between 2009 and 2010. After 2010, it continuously declined, reaching about three children per woman three years prior to the last survey. The fertility rates calculated from census data confirm the rapid drop of TFR as seen in the JPFHS over the last five years.

Figure 3. Annual national total fertility rate from 2015 census data.

To look at more recent declines, we calculate annual estimates for CBR and GFR (Table 2) and see continuous monotonic declines for both measures from 2007 to 2016, with the largest declines between 2012–2013. There are small increases in CBR and GFR between 2016 and 2017, though in 2018 the CBR and GFR declined to the same level as 2016.

Annual TFRs, CBRs, and GFRs constructed from census and annual registered births show similar trends of fertility decline over the last decade as the JPFHS.

Turning to contraceptive use, Figure 4 shows married women mCPR from the JPFHS, modeled contraceptive trends using results from FPET using survey data (not taking into account service statistics), as well as EMU calculated for commodities to clients data, commodities to facilities data, and FP visits data. Note that EMU does not necessarily have the same absolute level of mCPR as survey data but is examined for comparable trends. We see that all three sources of service provision data show dramatic declines, even larger than survey data (which may mean women are shifting to methods not recorded in the MOH data, such as methods from pharmacies^{6,21,22} or traditional methods). The largest declines occurred after 2012. The three types of data are consistent in their trends.

The EMUs show adjusted CYPs with a denominator of women of reproductive age. If we look at the CYPs without adjustment (Figure 5), we see almost flat distribution in all three datasets. Over the same period, the number of women of reproductive age grew by 73%. A similar number of contraceptive

Table 2. Annual crude birth rate and general fertility rate in Jordan, 2007–2018.

Year	Crude birth rate	General fertility rate
2007	30.8	120.7
2008	29.3	114.7
2009	28.1	110.3
2010	27.9	109.3
2011	26.1	103.9
2012	24.7	99.9
2013	22.9	92.9
2014	22.4	90.5
2015	21.6	87.4
2016	20.4	82.7
2017	21.3	86.2
2018	20.4	82.7

commodities, delivered to a growing population, results in a decline of mCPR.

We ran the FPET model with EMU data, excluding the 2017 JPFHS to see if FPET would predict the decline in mCPR recorded in 2017 JPFHS. The model predicts a mCPR of 39.7%, with an 80% confidence interval of 33.2% to 46.0% (shown in Figure 6), the JPFHS 2017 estimate of mCPR for married women is 37.4%, within the confidence interval and close to the mean. By including the EMU data, FPET is able to accurately predict the decline in mCPR for married women, leading us to our

²¹ Department of Statistics and ICF. 2013. *Jordan Population and Family Health Survey 2012*. Calverton, Maryland, USA: Department of Statistics and ICF International.

²² The percent of modern method users who received their method from a pharmacy increased from 7.4% in 2012 to 15.1% in 2017.

Figure 4. Trends in modern contraceptive prevalence rate and estimated modern use.

Figure 5. Trends in couples' use of protection.

conclusion that service statistics data, collected continuously by the government, supports the decline in mCPR found in the latest JPFHS.

The changes seen between the 2012 and 2017 JPFHS show declines in both TFR and contraceptive use. One possible explanation of these declines are biases in survey results. Our analyses find government sources of data, including census results, birth registries, and MOH FP service statistics mirror trends seen in the JPFHS. Since the results do not appear to be caused by errors in data collection, we turn to potential demographic explanations, which would allow TFR and CPR to decline at the same time.

Exploring influencing factors on TFR and CPR

To understand the declining fertility and contraceptive use, we look more closely at other factors such as women's ability to become pregnant and use of fertility control methods that are not reported in the national service statistics.

Changes in population distribution. After confirming the decline in the TFR above, we examine the declines in the TFR and changes in fertility intentions between 2012 and 2017. When possible, we look at changes by nationality, as Jordan has seen a change in its population distribution between the two surveys due to an influx in Syrian refugees. The 2012 Women Recode file from JPFHS does not include nationality. Nationality was

Figure 6. Modern contraceptive prevalence.

determined here by the information provided in the Person Recode, which is matched with individuals in the Women Recode. In 2012, Jordanian nationals were 93.0% of ever married women interviewed while 2.9% were Syrian. In 2017, the Jordanian population was 86.9% of ever married women, and the share of Syrians rose to 8.6%. The remainder of the population in both surveys is categorized into Egyptian, Iraqi, other Arab Nationalities, and non-Arab nationalities. Because of their small sample sizes, we include these non-Syrian populations in total numbers, but not in breakdowns by nationality.

Table 3 shows TFRs from both the published reports and using our method of calculating TFR. When data exist in both areas it matches very closely (the largest difference is 0.1 for Syrians in 2017). Overall, there was a 0.8 child decline in TFR between 2012 and 2017. The Jordanian population also saw a 0.8 child decline in TFR, and its TFR in both surveys is only 0.1 lower than the national. Syrians saw a large decline in TFR (though it should be noted their population in 2012 was small, therefore there is much larger uncertainty in the estimates) of 1.3 children per woman. The Syrian TFR is 2 children higher than the national TFR. Both groups experienced large declines in TFR over the period, with Jordanian TFR near the national level.

Table 4 shows the age-specific fertility rates (ASFRs) for Jordanians are lower than for Syrian in 2017 (constructed using the all women weight adjustment). Syrian ASFR peaks between

Table 3. Total fertility rates (with confidence intervals) by nationality, JPFHS 2012 and JPFHS 2017.

	Published 2012	Using never married women from household roster 2012	Published 2017	Using never married women from household roster 2017
National	3.5 (3.42-3.60)	3.5 (3.37-3.55)	2.7 (2.66-2.80)	2.7 (2.67-2.81)
Jordanian		3.4 (3.30-3.48)	2.6 (2.56-2.71)	2.6 (2.56-2.72)
Syrian		6.1 (5.26-7.01)	4.7 (4.36-4.96)	4.8 (4.47-5.10)

Table 4. Distribution of ASFRs (with confidence intervals) by nationality, JPFHS 2017.

Age Group	Jordanians	Syrians	National
15–19	17.2 (14.83-19.52)	133.3 (115.49-151.20)	26.9 (24.26-29.64)
20–24	103.9 (97.73-110.06)	247.5 (218.20-276.90)	109.5 (103.69-115.31)
25–29	153.0 (144.90-161.06)	216.4 (187.85-244.94)	156.1 (148.55-163.63)
30–34	136.7 (128.65-144.83)	188.7 (160.00-217.34)	137.1 (129.56-144.54)
35–39	89.7 (83.03-96.40)	85.3 (63.48-107.02)	87.8 (81.62-93.95)
40–44	24.9 (21.22-28.65)	53.5 (36.03-70.97)	26.9 (23.30-30.54)
45–49	1.4 (0.38-2.41)	7.5 (-2.11-17.18)	1.6 (0.56-2.63)
TFR	2.6 (2.56-2.71)	4.7 (4.36-4.96)	2.7 (2.66-2.80)

the ages of 20–24, while the highest ASFR for Jordanians is 25–29.

Changes in fertility intentions. Another possible explanation for declines in TFR is that the ideal family size is decreasing, which would motivate women to have fewer pregnancies and a lower fertility rate. If we look at ideal number of children in both 2012 and 2017, for the whole nation, Jordanians, and Syrians, the median and modal ideal number of children for currently married women is four. There is no significant change over time nationally in the mean ideal number of children (3.9 in 2012, 3.8 in 2017), which leads to the question: why would TFR experience a large decline between surveys when women's desired number of children did not? This is especially interesting given that the ideal number of children is higher than the TFR.

If we look at wanted TFR instead of the ideal number of children, as Table 5 shows, in 2012 there was a one-child difference between TFR and WTFR, and in 2017 this was reduced to half a child. This leads us to conclude that a major contribution to the decline in TFR between 2012 and 2017 (0.5 children out of a decline of 0.8 children per women) was a decline in births that were above individual women's ideal number of children. In the context of women not exceeding their ideal

number of children, this is a success. While the ideal number of children has not changed, the women individually exceeding their ideal number has declined, however this also implies that many women have fewer than their ideal number of children.

There is a significant decline in the percent of current pregnancies that are reported as mistimed or unwanted from the 2012 to 2017 JPFHS. In 2012, 28.8% of currently pregnant women report their birth as mistimed or unwanted, this number halved to 14.2% in 2017. There is also a decline from 29.5% to 15.5% in the percent of women who reported their last birth as mistimed or unwanted.

The decline in the gap between WTFR and TFR, as well as the decline in the percent of pregnancies and births reported as unwanted or mistimed indicates that a large majority of the TFR decline was caused by a reduction in unwanted or mistimed fertility and took place in the absence of changes in the ideal family size. However, since there was not an increase in contraceptive use or an increase in more effective methods of contraception, the means of reducing unwanted fertility remains unexplained. Next, we turn to the desire for future births for more clues into the decline.

Desire for future births Figure 7 shows the percent of currently married women who desire to limit their future births plotted against their current parity. We see that for most parities, the largest change happened between the 2009 and 2012 surveys. This finding, combined with the decline in the gap between WTFR and TFR, as seen in Table 5, suggests that desire to limit had increased by 2012, but the actual avoidance of future births was seen in the following years (the WTFR and TFR are calculated for the 3 years prior to the 2017 survey). The only parity in 2017 with a sizable increase in the desire to

Table 5. Unintended pregnancies and mistimed or unwanted births.

	JPFHS 2012	JPFHS 2017
Wanted TFR	2.5	2.2
TFR	3.5	2.7

Figure 7. Desire to limit by parity.

limit is parity 3. If more of these women do limit future births, TFR may continue to decline.

If we look at distribution of currently married women from the 2012 and 2017 surveys, we find more uncertainty about future childbearing: in 2017, 7.1% of women are undecided if they would like to have another child, compared to 2.2% in 2012 (Table 6).

The increase in the percent of married women who are undecided about having another child, coupled with a fertility rate lower than ideal family size suggests potential uncertainty about the future, which is causing women (or couples) to restrict childbearing during the time of the survey period. The decline in fertility is mainly caused by a reduction in unintended pregnancies and births, suggesting couples have more motivation to avoid these births. It is not yet known whether this is postponement in fertility, or if women will remain at the new, lower fertility rate into the future.

Unmet need Unmet need for contraception increased by 2.5 percentage points from 2012 to 2017, as seen in Table 7, a statistically significant increase, although that increase was much smaller than the decrease in contraceptive use. While the government service statistics showed a steady distribution of contraception (which would lead to a decline in CPR given rising numbers of women of reproductive age), the rise in unmet

need is not enough to account for this entire decline. Both Jordanians and Syrians experienced increases in unmet need between surveys, though only the Jordanian change was statistically significant. In 2012, Syrians had statistically higher unmet need than Jordanians, in 2017 the difference was no longer statistically significant.

Proximate determinants of fertility. The results of our initial analysis around factors that are typically seen to influence TFR and CPR provide some insights into movement of one factor, but do not fully explain why in Jordan both TFR and CPR have declined together. This leads us to explore possible explanations related to proximate determinants of fertility, the results of which are presented below.

The index of proportion married, index of contraception, and index of lactational infecundability are presented in Table 8. The data used to calculate the indices are available in *Extended data*, Appendix 3¹⁵.

Given a total fecundity of 15.3 (the average total fecundity used by Bongaarts²), we predict a fertility rate of 3.3 in 2012, and 3.7 in 2017–18, with the main driver of change the increase in the index of contraception. There is a slight decrease in the index of marriage and no change in the index of postpartum infecundity. Given that the predicted fertility rate in 2012 is higher than the observed fertility rate, it is

Table 6. Fertility intention of married women.

Among Currently Married Women	JPFHS 2012	JPFHS 2017
Want Another Child	41.8	36.9
Undecided	2.2	7.1
Want No More Children	50.5	47.7
Sterilized (Respondent or Partner)	2.3	1.5
Declared Infecund	3.2	6.9

Table 7. Unmet need among married women.

Year	National	Jordanian	Syrian
JPFHS 2012	11.7	11.5	17.9
JPFHS 2017	14.2	13.6	18.6

Table 8. Proximate determinants for fertility.

Survey Year	Index of Marriage (Cm)	Index of Contraception (Cc)	Index of postpartum infecundity (Ci)	Total Fecundity	Cm*Cc*Ci	Predicted Fertility Rate (No Abortion)	Observed fertility
JPFHS 2012	0.479	0.482	0.926	15.3	0.214	3.3	3.5
JPFHS 2017	0.472	0.550	0.926	15.3	0.241	3.7	2.7

likely the total fecundity is higher than 15.3 in Jordan. In 2017, a predicted fertility rate one child per woman higher than the observed fertility rate signifies that the three fertility inhibiting factors included in this analysis of the proximate determinants do not fully capture all fertility limiting factors. If the only other limiting factor of fertility in 2017 was abortion, the total abortion rate would need to be 1.6 abortions per woman (Calculated using the index of induced abortion necessary for $TFR = Tf * Cc * Ci * Cm * Ca$, with $Ca = TFR / [TFR + (0.4 * [1 + \% \text{ of women using contraception}] * TAR)]$), however, there are other factors which may lower fertility.

Temporal measurement effects One possible explanation for declines in TFR and CPR simultaneously is a temporal measurement issue. The fertility rate is measured over the 3 years prior to the survey, while contraceptive use is a current status measure from the time of the survey. Therefore, theoretically, contraceptive use could have been high for several years before the survey, leading to declines in the number of births, and contraceptive use might have fallen immediately before the survey. However, given the steady declines in the EMU calculated from government provided service statistics data, contraceptive use has been steadily declining for some time in Jordan. Nationally, CPR declined by 9.3 percentage points between 2012 and 2017. For native Jordanians, the decline was 8.5% (statistically significant), and 11.0% for Syrians (not statistically significant).

Method Mix While CPR declined by 9.3 percentage points between 2012 and 2017 (as seen in Figure 8), only three individual methods changed by more than a percentage point each. Male condom use declined from 7.5% to 4.8% among married women (statistically significant), while periodic abstinence declined from 3.4% to 1.2% (statistically significant), and withdrawal from 13.6% to 12.1% (marginally significant). One would suspect that given the declines were concentrated in less effective methods, the average contraceptive effectiveness (which accounts for the method mix and failure rates) would increase, but we find only a slight increase in effectiveness from 90% to 91%, not enough to offset the 10-percentage point decline in CPR.

We also looked at use of emergency contraception (EC) in Jordan. If women do not consider EC a method they “currently use,” it may be underreported in the 2017 JPFHS, and if women are switching to EC from other methods, this underreporting may help to explain why we see a decline in CPR accompanied by a decline in TFR.

Only one woman reported being a current EC user at the time of the survey (and she also reported being a pill user). Only four instances of EC use were reported in the contraceptive calendar- all by one woman in four continuous months, a potential data error. Reports of low EC use is not surprising, given that

Figure 8. Contraceptive use by method.

no EC brands are registered in Jordan²³. However, knowledge of EC has risen from 15.3% of married women in 2012 to 27.3% in 2017, an increase which is statistically significant. 22.5% of married men had knowledge of EC in 2017 (men were not interviewed in 2012). One hypothesis for EC knowledge being so high without a dedicated product in country is the off-label use of hormonal contraceptive pills. Though pharmacists in Jordan are not found to be well informed on EC⁶ women may obtain guidance from providers on using the Yuzpe method²⁴ and/or use information from the internet to help them use oral contraceptive pills for EC. There is no national tracking of off label use of oral contraception as an EC method and women may underreport in the JPFHS by reporting EC use as oral contraceptive pill use.

Marriage and exposure to risk of pregnancy Overall, 56.0% of women of reproductive age in the households interviewed by JPFHS were currently married in the 2017–18 survey, compared to 54.2% in 2012, though this increase is not statistically significant. The mean age of married women rose from 34.4 to 34.7, the largest change by age group was 45–49-year-old women, who increased as a share of married women from 12.8 to 15.8% (a statistically significant increase). At the same time, Table 9 shows that more women were likely to have been married for under two years in 2017 compared to 2012, 8.9% compared to 6.9% (statistically significant), while the percent who had been married for 2–4 years declined from 13.0% in 2012 to 11.7% in 2017–18 (not statistically significant). This postponement in marriage and change in marital distribution may explain some of the reasons for the drop in current contraceptive use. The higher proportion of women of reproductive age that were recently married could impact the contraceptive rate, because they may want to have their first child soon and may not have been using contraceptives during the period of the survey (less than 1% of nulliparous women reported using modern contraception in either the 2012 or 2017 JPFHS). Also, these women would not have been

married during a large part of the 3-year windows used to construct total fertility rates.

Figure 9 illustrates the changing population structure of women of reproductive age by age and ethnicity. The top left corner shows the age distribution of all women of reproductive age in the country, we see that there are fewer younger women and more older women in Jordan in 2017 compared to 2012. This change is mainly driven by change among native Jordanians. The Syrian population, especially in 2017, is skewed younger than the population overall. Looking at the percent married by age and ethnicity, we see very little changes for Jordanian women and non-Jordanian, non-Syrian women. Syrian women among the younger ages are much more likely to be married than other women. Overall, 39% of 15–19-year-old Syrians were married in 2017, compared to 4.9% of Jordanians and 6.9% of other nationalities. Between the two surveys, there was over a doubling of Syrian women as a share of married women, from 3.0% to 7.8%. The overall increase in the population of Syrians led to an increase in the percent married among 15–19-year-old women to grow from 6.2% in 2012 to 7.6% in 2017–18, though overall the share of the married population who were aged 15–19 only increased from 2.5% to 2.6% (neither is a statistically significant change).

If more married women are not living with their husbands this could explain both a decrease in contraceptive use (as they are less likely to be at risk of pregnancy) and decrease in fertility. Table 10 shows that in 2012, 2.9% of currently married women were not living with their husband, in 2017 the percent rose to 4.5%, a 50% increase (and statistically significant), though still a small proportion of the population. Syrian women were more likely to not live with their husbands than Jordanians in both surveys. Changes by nationality were not statistically different between the two surveys.

Decreased coital frequency could also lower both CPR and TFR; the JPFHS does not measure coital frequency but does measure time since last sexual experience. Table 11 shows that in 2012, 89.2% of married women had sex in the last 4 weeks, this share increased to 90.6% in 2017, a statistically insignificant change. Both Jordanians and Syrians experienced statistically significant increases in the percent of married women having sex in the last 4 weeks.

Overall, there has been a slight increase in spousal separation and no change in recent sexual activity among married women. In both surveys, women who live with their husbands are statistically more likely to use contraception, therefore, a decline in cohabitation among married women may lead to a decline in contraceptive use (and an increase in unmet need), though this would only explain a small portion of the overall decline. The increase in the share of newly married women could also decrease contraceptive use since contraceptive use between marriage and first birth is uncommon.

Infecundity Primary sterility declined slightly between 2012 and 2017, from 7.4% for ever married women to 6.2% (a non-statistically significant change). Secondary sterility, or

Table 9. Time since first marriage among currently married women.

Time since first marriage	2012 JPFHS	2017 JPFHS
Under 2 Years	6.88	8.85
2–4 Years	12.95	11.65
5–9 Years	20.63	19.78
10–14 Years	17.25	17.19
Over 15 Years	42.30	42.52

²³ International Consortium for Emergency Contraception. *EC status and availability: Jordan*. <https://www.cecinfo.org/country-by-country-information/status-availability-database/countries/jordan/>.

²⁴ Yuzpe, A & W. J. Lancee. 1977. "Ethinylestradiol and dl-norgestrel as a postcoital contraceptive." *Fertility and Sterility* 28 (9): 932–936. [https://doi.org/10.1016/S0015-0282\(16\)42793-7](https://doi.org/10.1016/S0015-0282(16)42793-7).

Figure 9. Age and marriage by ethnicity, 2012 and 2017-18 JPFHS.

Table 10. Percent of married women living with husband.

Year	National	Jordanian	Syrian
2012 JPFHS	97.1	97.5	86.9
2017 JPFHS	95.5	96.8	90.9

Table 11. Percent of married women who had sex in last 4 weeks.

Year	National	Jordanian	Syrian
2012 JPFHS	89.2	90.1	74.4
2017 JPFHS	90.6	91.9	86.8

the percent of women defined as infecund, rose from 8.7% in 2012 to 14.5% in 2017 (a statistically significant increase). [Figure 10](#) shows infecundity rose in all but the youngest age

group. The largest increases are seen among 40 to 44-year-old women (increase in 8.0 percentage points and statistically significant) and 30-34-year-old women (7.1 percentage points and statistically significant). The higher share of women at older ages in the population, as discussed above, increased the population level infecundity as well. Some sections of the definition of infecund are self-reported, but many others are calculated using past contraceptive use and reproductive occurrences - a large increase in the percent of women who are infecund may account for a sizeable share in the decrease of CPR (especially considering the biggest declines were in coitus dependent methods such as condoms and withdrawal) as well as declines in fertility rates. Women who are infecund may choose to not use contraception because of their lower risk of conception. Note that by definition women who are using contraception cannot be defined as infecund based on the unmet need algorithm. Therefore, it is possible that some women who are infecund or menopausal are not reported as such because they do not know their status and are currently using contraception, and the decline in contraceptive use could have unmasked a larger share of the infecund population. Public health practitioners in Jordan have identified the high

Figure 10. Infecund/menopausal by age, 2012 and 2017-18 JPFHS.

prevalence of smoking, both cigarettes and traditional “shisha” pipes²⁵ (12%) and overweight/obesity²⁶ (54%) as possible reasons for increases in delayed fertility or infecundity.

Abortion Table 12 shows that there was a large increase in the percent of currently married women who reported no pregnancy outcome in the calendar (either were not pregnant in the calendar or were only pregnant at the end of the calendar/time of interview). The percent of women whose most recent outcome was a birth declined, as did the percent that had a miscarriage or stillbirth, only abortion slightly rose. The large decline in fertility makes it difficult to compare changes between other outcomes.

Table 13 shows the distribution of pregnancy outcomes (women with no pregnancy outcomes in the calendar are removed) and finds that the percent of pregnancies ending in abortion is small, only 1.2% in 2012, and 2.0% in 2017, a statistically significant increase. The increase in pregnancies ending in

Table 12. Pregnancy outcomes from calendar data.

Of Currently Married Women: Most Recent Pregnancy Event Outcome	2012 JPFHS	2017 JPFHS
No pregnancy outcome in calendar	31.1	42.8
Birth	59.5	51.0
Miscarriage	8.3	4.9
Abortion	0.8	1.1
Stillbirth	0.4	0.2

Table 13. Pregnancy outcomes from calendar data of those who had a pregnancy in the calendar.

Of Currently Married Women with Pregnancy Outcome in Calendar: Most Recent Pregnancy Event Outcome	2012 JPFHS	2017 JPFHS
Birth	86.3	89.2
Miscarriage	12.0	8.5
Abortion	1.2	2.0
Stillbirth	0.6	0.4

²⁵ Reproductive Facts. *Smoking and infertility*. Birmingham, Alabama, USA: American Society of Reproductive Medicine. https://www.reproductivefacts.org/globalassets/rf/news-and-publications/bookletsfact-sheets/english-fact-sheets-and-info-booklets/smoking_and_infertility_factsheet.pdf.

²⁶ Dag, Z.O. & B. Dilbaz. 2015. “Impact of obesity on infertility in women.” *Turkish-German Gynecological Association* 16 (2): 111–117. <https://doi.org/10.5152/jtgga.2015.15232>.

abortion may signal an overall increase in the trend, however the level is notably low. Abortion is only legal in Jordan to save the life of a woman or preserve physical health²⁷. Globally, abortion is under-reported, especially in countries with restrictive policies or where it is socially stigmatized²⁸. However, given an estimated 22% of pregnancies end in abortion in Western Asia²⁹, it is very likely that abortions are more than 2% of all pregnancies and underreported in the calendar. Additionally, the large decline in miscarriages, from 12.0% in 2012 to 8.5% in 2017 is noteworthy, especially without significant public health interventions designed specifically to reduce miscarriage. While the level is close to the global average of 10% of recognized pregnancies to end in miscarriage³⁰, there does not appear to be an obvious reason for such a large decline in the trend. Consanguinity has declined in Jordan over time, though evidence of consanguinities effect of pregnancy loss is mixed^{31–34}. Both the low reported levels of abortions and decline in miscarriage signal inconsistencies in calendar data. Further inconsistencies in the calendar, regarding contraceptive use over time are shown in *Extended data*, Appendix 1¹⁵. While abortion may be allowing for a simultaneous decline in CPR and TFR, we are unable to substantiate this hypothesis with the available data.

Discussion

The changes between 2012 and 2017 JPFHS provide national FP policy makers and program managers with a conundrum - how can the TFR decline when contraceptive use also declines?

What do such changes mean for the national FP program? The analysis in this paper shows that there is not a simple answer to this question and that many factors beyond the traditional elements of FP programming influence the outcomes. When examining the data by nationality, changes in the native Jordanian population mirror changes in the national numbers, even with the changes in population composition, which indicates that the influx of Syrian and other refugees in recent years is not a significant contributing factor to this new pattern.

Several fertility inhibiting changes could have allowed fertility and contraceptive use to decline simultaneously. Primarily, the increase in infecundity, seen across most age groups, could lower both fertility rates and contraceptive use rates. Given that declines in contraception were mostly driven by declines in coitus dependent methods adds further weight to the knowledge of subfecundity among the population. While there are issues with direct measurement of both EC use and abortion, the data signals that there may be changes in use of both that could help reduce fertility, but not increase the CPR (especially if women do not consider EC a method they are “currently” using). For EC, the increase in knowledge without the availability of a branded EC on the market suggests there may be use off label use of oral contraceptives. There appear to be inconsistencies throughout the contraceptive calendar, but we do see a significant, though small, increase in the percent of pregnancies ending in abortions.

The rise in share of recently married women of reproductive age (intending to get pregnant soon), an increase in proportion of women of reproductive age in the 45–49 age group (increasing the overall rate of infecundity), and a general increase in infecundity across all age groups results in a decreased need for contraception. Despite a decline in the overall need for contraception, unmet need for contraception among women who were not infecund or trying to become pregnant increased substantially within a short period of time, meaning that a significant group of women who did not want to become pregnant were not using contraception. However, the increase in unmet need was not as large as the decline in CPR.

Possibly due to a challenging economic climate and potential shifts in social norms, increasing numbers of Jordanian women are considering having no children at all, or are considering having no more children or are uncertain about their plans to have additional children, yet there has been an overall decline in the use of modern and traditional contraceptive methods. This is countered by the fact that the desired number of children is still approximately four and has not changed since 2012. This information presents a picture of a complex economic and socio-cultural environment that is impacting women's choices and practices regarding fertility and contraceptive use, suggesting that women (and couples) are having fewer children than they would ideally want and those who have their ideal number of children are less likely to exceed this number.

²⁷ United Nations, Department of Economic and Social Affairs, Population Division. 2014. *Abortion policies and reproductive health around the world*. New York, New York, USA: United Nations. <https://www.un.org/en/development/desa/population/publications/pdf/policy/AbortionPoliciesReproductiveHealth.pdf>.

²⁸ Moseson, H., M. Massaquoi, C. Dehlendorf, L. Bawo, B. Dahn, Y. Zoila, E. Vittinghoff, R. A. Hiatt, C. Gerds. 2015. “Reducing under-reporting of stigmatized health events using the List Experiment: results from a randomized, population-based study of abortion in Liberia.” *International Journal of Epidemiology* 44 (6): 1951–1958. <https://academic.oup.com/ije/article/44/6/1951/2572557>.

²⁹ Guttmacher. 2017. *Abortion in Asia*. New York, New York, USA: Guttmacher. https://www.guttmacher.org/sites/default/files/factsheet/ib_www-asia_0.pdf

³⁰ The American College of Obstetricians and Gynecologists. 2015. *Early Pregnancy Loss*. Washington, DC, USA: American College of Obstetricians and Gynecologists. <https://www.acog.org/clinical/clinical-guidance/practice-bulletin/articles/2018/11/early-pregnancy-loss>.

³¹ Assaf, S., M. Khawaja, J. Dejong, Z. Mahfoud, K. Yunis. 2009. “Consanguinity and reproductive wastage in the Palestinian Territories.” *Paediatric and Perinatal Epidemiology* 23 (2). <https://doi.org/10.1111/j.1365-3016.2008.00988.x>.

³² Gowri, V., A. M. Udayakumar, W. Biso, Y. Al Farsi, K. Rao. 2011. “Recurrent early pregnancy loss and consanguinity in Omani couples.” *Acta Obstetrica et Gynecologica Scandinavica* 90 (10): 1167–1169. <https://doi.org/10.1111/j.1600-0412.2011.01200.x>.

³³ Al Husain, M. & M. Al Bunyan. 1996. “Consanguineous marriages in a Saudi population and the effect of inbreeding on prenatal and postnatal mortality.” *Annals of Tropical Paediatrics: International Child Health* 17 (2): 155–160. <https://doi.org/10.1080/02724936.1997.11747879>.

³⁴ Saad, F. A. & E. Jauniaux. 2002. “Recurrent early pregnancy loss and consanguinity.” *Reproductive BioMedicine Online* 5 (2): 167–170. [https://doi.org/10.1016/S1472-6483\(10\)61620-3](https://doi.org/10.1016/S1472-6483(10)61620-3).

Conclusion and recommendations for programming

Continued monitoring of FP services, contraceptive uptake, and rates of infecundity are needed to determine whether the 2017 JPFHS outcomes are short term, or if they represent a trend that will last for several years. To help ensure that Jordanian women can achieve their desired fertility and optimal family size, programmatic interventions to strengthen both FP services and demand creation along with further research and attention on women's infecundity are needed.

Although Jordan has been able to reduce its TFR without commensurate increases in contraceptive use; it is not clear that those declines can be sustained without increases in FP use over time. To help women achieve their fertility intentions, national efforts to improve use of voluntary FP should be strengthened. Part of those efforts should include the application of a life cycle approach to Jordanian women's reproductive needs and services, including the flexibility to support women's changing FP needs from the time they marry and desire to have children to later years when they may wish to limit fertility. Also critical in this programming is the analysis and planning for women coming into and out of infecundity - whether due to postpartum amenorrhea or subfecundity that may be associated with health or environmental factors. Further analysis of the factors driving the high rates of infecundity found in the survey should be conducted and clinical support provided to women experiencing infertility so that they can achieve their desired fertility.

In addition to continuing national efforts to improve the quality of FP services, the expansion of the contraceptive method mix may help to attract new or discontinued FP users³⁵. The introduction of a hormonal intrauterine device in the public sector and EC for both public and private sector may fill gaps in the existing method mix and efforts to reposition underutilized contraceptive methods such as injectables, implants, and sterilization, may also help to increase women's use of contraception. Given the historically high use of withdrawal in Jordan, it may be useful for FP programmers to conduct research on improving efficacy and counseling to enable couples to increase effectiveness of their chosen method. With the high availability of cell phones and internet access in Jordan FP programmers should consider providing counseling to women on the use of branded internet apps to support fertility awareness methods such as the standard days and two-day methods.

To dispel myths and misconceptions and to improve support for FP use, social and behavior change interventions should be developed for segmented groups of potential contraceptive users and their influencers. These efforts can utilize women's changing desires regarding fertility to influence perceptions and use of FP for the long term, which may help drive a sustained change in the TFR.

To spur the growth of contraceptive use, the MOH should focus on improving the quality of FP services along the continuum of care. Choice of contraceptive methods, information given to clients, technical competence, interpersonal relations, follow-up-continuity mechanisms, and appropriate constellation of services are the main determinants of quality FP services³⁶. The quality components of FP services are expected to impact not only the choice of appropriate method but also the future behavior of the user in terms of continuation, discontinuation, or switching. The improved quality of FP services at service delivery points (including reducing provider bias, ensuring adequate method mix with special focus on long acting methods, and elimination of stock-outs), coupled with ceasing missed opportunities such as raising awareness at the community level, are core programmatic strategies to increase use of modern contraceptives in Jordan.

Data availability

Underlying data

Jordan's Demographic and Health Surveys are available in the MEASURE DHS repository (<http://www.measuredhs.com>). Access to the dataset requires registration and is granted to those that wish to use the data for legitimate research purposes. A guide for how to apply for dataset access is available at: <https://dhsprogram.com/data/Access-Instructions.cfm>.

Jordan's annual estimates of population and birth are available for the Jordanian Department of Statistics at <http://dosweb.dos.gov.jo/population/>.

Jordanian census data used to calculate Total Fertility Rates and Ministry of Health data used to calculate Estimated Modern Use were directly provided to the authors and are not openly available. If individuals would like to enquire about accessing this data, please write to Malak Al Ouri at alouri_malak@hotmail.com.

Extended data

Zenodo: kristinbietsch/JordanFertilityFP: Release for Gates 092920. <https://doi.org/10.5281/zenodo.4058480>¹⁵.

File 'Jordan TFR CPR Extended Data.docx' contains the following extended data:

- Appendix 1: Analysis of contraceptive calendar data.
- Appendix 2: Algorithm for calculating Unmet Need.
- Appendix 3: Proximate Determinants of Fertility Data.

Extended data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

Software availability

R code for all analysis is available at: <https://github.com/kristinbietsch/JordanFertilityFP/releases/tag/V2.4>.

Archived source code at time of publication: <https://doi.org/10.5281/zenodo.4058480>¹⁵.

License: MIT License.

³⁵ Ross, J. & Stover, J. 2013. "Use of modern contraception increases when more methods become available: analysis of evidence from 1982–2009." *Global Health: Science and Practice* 1 (2): 203–2012. <https://doi.org/10.9745/GHSP-D-13-00010>.

³⁶ Bruce, J. 1990. "Fundamentals of quality of care: a simple framework." *Studies in Family Planning* 21(2): 61–90. <https://doi.org/10.2307/1966660>

Open Peer Review

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Sara Riese

ICF International, Fairfax, VA, USA

Thank you to the authors for considering my comments and modifying the article. With these additions, I believe that this paper should be accepted for indexing. Although it does not identify a clear answer to the overall research question, it does explore and rule out many of the potential explanations. In this way, it is a contribution to the literature to provide a framework for analysis for unexpected and unexplained patterns in survey results. Both the specific effort to understand these issues in the Jordan survey, as well as the framework for analysis, are valuable and worthy of indexing.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Implementation science, quality of care, reproductive health, equity

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 15 July 2021

<https://doi.org/10.21956/gatesopenres.14551.r30767>

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Lindsay Mallick

University of Maryland School of Public Health, College Park, MD, USA

Thank you for the opportunity to review this manuscript. This manuscript provides an incredibly

comprehensive examination of factors that may explain the fertility related paradox in Jordan: that the total fertility rate has declined while contraceptive use has also declined in tandem. Although no one clear answer emerged as a result of this analysis, several important conclusions can still be drawn from analysis, for example, that these trends are not the results of major data quality issues. As researchers and stakeholders continue to explore and monitor these trends, this paper serves as an important contribution to the literature and guide for further research. As this paper has already undergone several revisions, I only have minor comments that could be addressed to improve the quality overall.

The more substantial suggestions I have are:

- The various rates examined in the study are not well-defined. I suggest adding a text box or table, even as appendix, to define and describe the calculation of these rates.
- There were many different explanatory factors examined; however, not all were justified, described, or explained. Especially for exploring influencing factors on TFR/CPR section, as well as for examining ASFR, it would be helpful to connect each of these avenues of exploration to a specific hypothesis. Ordinarily this would be appropriate for the introduction, but as there were so many aspects studied in this analysis, some context in the methods section would be helpful. E.g., you do this for proximate determinants, but not population distribution or changes in fertility intentions.
- Although there do seem to be some explanations and the resulting estimates seem to be at least partially explained (EC under reported, marriage distribution change, marital separation, infecundity, possibly abortion). Is it not possible that the confluence of multiple, partial factors have contributed and together results in these more substantial trends?
- You note on p. 11 “the means of reducing unwanted fertility remains unexplained”; however, your analysis does uncover some potential explanations. In the results and discussion, you review these factors separately, but I think it would be important to note that there may not be one sole factor that contributes to this situation in Jordan; rather, a combination of many factors. Further, one potential factor that was not discussed—even as a data limitation or area for future research—is teasing out the contribution and role of male infertility. How might that play a role in your analysis and findings?
- I have some issues with the conclusion and recommendations. First, promoting an increase in contraceptive use and improved quality of care are not relevant to this paper. I believe the first two paragraphs of the conclusion are enough and the rest could be cut. However, if they are kept, I suggest connecting the recommendations listed more strongly with meeting women’s fertility desires; although I don’t believe this was the intent of the authors, this conclusion could otherwise be read as promoting family planning for population control.

Minor comments:

- In the background section you mention service statistics but not CRVS and census data, which were also used.
- In the background section, you mention the impetus for the investigation is to direct future investments in family planning; however, this manuscript goes beyond that and helps to

improve our understanding of population dynamics.

- For external validation using census data, how complete is birth and population data? In some countries, civil registrations and vital statistics systems are not fully functioning and don't capture records for the total population.
- In the methods section (under external validation), consider describing FPET, maybe with a bit more detail, before you discuss how you input EMU. It's important to know that survey data feed into FPET, to give context to why you left out 2017 (described in results but should be moved to methods). Also, spell out UMass.
- I suggest adding notes on figures to spell out acronyms for readers who are unfamiliar; Figure 6 should include what the pinkish purple and lavender purple bars are.
- For figure 6, the black dots are service statistics - is that EMU calculated from service statistics? Is the most recent point reflecting EMU is close to 20%? That may be helpful to describe.
- Define TAR acronym.
- When describing results examining method mix, first describe the current method mix overall (what are the dominant method(s) before describing changes.)
- The DHS Program is no longer MEASURE DHS, note new web address. Also, the 't' in the DHS Program is also capitalized (in 2nd paragraph of methods).

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Reproductive, maternal, and newborn health; quality of care,

specifically quality of care for family planning

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 28 June 2021

<https://doi.org/10.21956/gatesopenres.14551.r30730>

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Thomas W. Pullum

Demographic and Health Surveys, ICF, Rockville, MD, USA

The authors have applied a wide range of strategies to explain the unexpected pattern of decline in CPR and decline in TFR between the two most recent DHS surveys in Jordan. They have successfully eliminated some potential explanations and have identified many other potential explanations that cannot be tested with the available data. The fact that the authors have not been able to account for the unexpected pattern does not invalidate the effort.

Since the release of the 2017-18 survey, the staff of DHS have independently applied many of the approaches used by Bietsch *et al.* We have been particularly concerned with possible incompatibility of the sampling frames for the two surveys, possible irregularities during fieldwork, and other evidence of data quality issues. We have been unable to identify any serious problems. However, the search continues. If there are problems with the data, we definitely do not want them to recur in the next survey.

If the unexpected pattern does not arise from data quality flaws, then it must be due to the kinds of factors Bietsch *et al.* explore, such as compositional change between the surveys, the asynchronicity of recent fertility and current use, changes in the method mix or use-effectiveness, a systematic pattern of under-reporting of contraceptive use or of other pregnancy terminations, etc. Thus far, none of those potential explanations appears to be sufficient.

Eventually—at the latest, after the next survey—there will be a reconciliation of the inter-related trajectories of fertility intentions, contraceptive use, and fertility in Jordan, overall and in sub-populations. Until then, it is important to have a published record of the efforts to understand the puzzle, even if they are not completely successful.

Page 2, column 2, line 4: “One DHS further analysis on fertility in Nepal.” This fragment needs to be fixed. I will not refer to other editing issues, but there are several.

For more than ten years, the URL www.measuredhs.com has been automatically redirected to www.dhsprogram.com. MEASURE DHS is an obsolete label for The DHS Program.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Demographic methods, analysis of demographic survey data

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 16 June 2021

<https://doi.org/10.21956/gatesopenres.14551.r30744>

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Issa Masarweh

Arab Institute for Training and Research in Statistics, Amman, Jordan

After reviewing the new version of the research “Shifting dynamics: Changes in the relationship between total fertility rate and contraceptive prevalence rate in Jordan”, I believe that the authors have not addressed the many concerns/comments I raised earlier.

The authors challenged a well-established and strong association between TFR and CPR but could not provide sound and convincing evidences on their thesis of “Shifting Dynamics” in this association.

Thus, I reaffirm the status of “Not Approved”.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Version 1

Reviewer Report 10 November 2020

<https://doi.org/10.21956/gatesopenres.14393.r29824>

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Sara Riese

ICF International, Fairfax, VA, USA

The article offers an analysis that attempts to understand and identify the inconsistency in the declining TFR alongside a declining CPR in the most recent Jordan PFHS. The paper looks at this question in two ways: first by attempting to validate the TFR and CPR data from the Jordan PFHS, and second by exploring factors traditionally associated with TFR and CPR, including Bongaarts' proximate determinants of fertility.

In the data validation section, while the Schoumaker 2014 Methodological Report is cited and possible issues around birth history collection are mentioned, there are a number of other possible data quality issues highlighted in from that report which would have been good to

mention in this paper, for example sample design and quality of age reporting. While I don't necessarily know if these would clearly identify issues that would clarify the TFR/CPR trends in this case, when conducting data quality checks, they would have been informative to mention and/or explore. A more thorough discussion of these issues would be valuable, especially given the lack of any other significant explanation.

In addition, when presenting point estimates for TFR, it would be appropriate to include the CIs.

Finally, in the introduction section, the authors state that Jordan is not the only country where there are shifts to the typical relationship between TFR and CPR. It would have been helpful to have some discussion of other examples of this situation and whether or not explanations have been identified in those cases.

In general, the study is a clear contribution to the literature as it attempts to systematically approach this counter-intuitive finding of decreasing TFR and CPR. The authors have done well in their presentation of the results and discussion of the inconclusive findings. My "partly" responses on the study design and statistical analysis questions reflect that I believe this study would benefit from a more thorough discussion or exploration of the potential data quality issues around TFR estimates, as well as a discussion of other country cases. The "partly" response on the underlying source data is a reflection of the fact that the Jordanian census data is not openly available to the public.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Implementation science, quality of care, reproductive health, equity

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 07 Jun 2021

Kristin Bietsch, Avenir Health, Glastonbury, USA

The authors are very grateful for Dr. Riese's careful and constructive comments. Our responses are as follows:

We have included additional examples of data quality issues that may contribute to an underestimation of TFR, and feel that our analysis constructing TFRs from the last three surveys assesses the presence of these data quality concerns. If any of the data quality issues mentioned in Schoumaker 2014 were present in any of the surveys, we would expect the TFR estimates from that survey to appear as outliers, but our analysis shows that the TFRs calculated from each survey are consistent.

We have included CIs for all the tables and figures that present TFR (Table 1, Figure 1, Figure 2, Table 3 and Table 4).

We expanded this section of the introduction to include a list of countries where there were shifts in the typical relationship between TFR and CPR (which we identified using STATcompiler), and did a literature search to try to identify whether explanations have been identified in these cases. We identified one study of fertility in Nepal.

We thank Dr. Riese for reviewing our paper and for her valuable feedback. We hope the changes we made to the paper have sufficiently addressed her concerns.

Competing Interests: No competing interests were disclosed.

Reviewer Report 29 October 2020

<https://doi.org/10.21956/gatesopenres.14393.r29827>

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Issa Masarweh

Arab Institute for Training and Research in Statistics, Amman, Jordan

Comments on my answer to Question 4: The statistical methods used were inappropriate and the authors resorted to data analysis outside the survey to show that Jordan has experienced a shift in the typical relationship between CPR and TFR rather than data errors.

Early Questioning of 2017/18 DHS Data?

Long before releasing JPFHS 2017/18 (DHS) main report, Jordan Department of Statistics (the survey owner) organized a meeting attended by a large number of stakeholders representing GOs, NGOs, academicians and donor agencies working in Jordan to discuss the prelim results of

the survey. Many of the attendees have then raised questions about the survey TFR result (2.6 for the Jordanian sample and 2.7 for the national sample) and believed it to be inconsistent with all direct or intermediate variables affecting fertility.

The Department of Civil Status and Passport (in charge of Jordan vital register) published in its annual report of 2017 a TFR of 3.1 births per Jordanian woman (above JPFHS 2017/18 figure of 2.6) and a CBR of 24.2 births per 1000 compared to 21.6 (the survey figure).

Post 2017/18 DHS of Release of Results:

TFR in two governorates of the North and South Region of Jordan is inconsistent with their mCPR and unmet need for FP. The formers have a high TFR (3.5 each) but the highest mCPR (42.5 and 41.1%) and the lowest unmet need (10.5 and 9.9 %) among all governorates of Jordan; while the South region has a TFR of 2.6 below the national TFR (2.7) but has the lowest mCPR (33.6%) among the three regions of Jordan (the lowest mCPR was 24.7% in the southern governorate of Ma'an).

Multi-Method for Evaluating 2017 TFR Figure:

To verify the questionable 2017/2018 DHS TFR of 2.6 for Jordanian woman, I carried out an evaluation employing the following 8 methods (results are shown later in this report):

1. Cross-tab the 2012 and 2017/18 fertility variables against their correlates to assess the changes that took place; the inter-survey results were inconsistent.
2. Considering the 2015 Census fertility figure.
3. Calculating the proximate determinants of fertility indexes for 2012 and 2017/2018.
4. Estimating CPR and mCPR required for having a TFR of 2.6.
5. Running a regression of TFR against mCPR using the 7 DHSs 1990-2017 figures.
6. Recalculating 2017 TFR using the 2017/18 proximate determinants of fertility figures.
7. Estimating 2017 TFR from data on births by age of mother from recent Jordan vital statistics record.
8. Calculating CYP from Jordan FP Contraceptive Logistics System data for the years 2012-2018.

Below are the changes in the direct factors affecting TFR between 2012 and 2017/18 Survey which indicate that TFR should have been rising rather than declining:

- % of ever-married WRA increased by 2 percentage points.
- % of currently married WRA increased by 1.5 percentage points.
- % of currently WRA who are sexually active increased by 3 percentage points.
- % currently pregnant increased from 5.5% to 5.9%;
- % started childbearing at age 15-17 increased from 2.9% to 3.1%.
- mCPR decreased by 4 percentage points;
- Unmet need for using contraceptives increased by 2 percentage points;
- Median age at F.S increased by 0.3 years;
- % of non-user of FP methods among currently married WRA who don't intend to use contraceptives increased by 15 percentage points;
- % of ever-married WRA who didn't discuss FP with health professionals in the last 12 months increased by 4 percentage points;
- Childless women 45-49 years (proxy of sterility) decreased by 2 percentage points;

- C-S deliveries decreased by 1.4 percentage points (means shorter pregnancy interval);
- Couple years of protection CYP (proxy of modern contraceptives users) based on Jordan MoH FP Logistic System decreased from 229,000 to 224,000 between 2012 and 2017.

Estimated TFR for 2017 based on:

1. Bongaarts five proximate determinants of fertility - TFR is 3.24 births per women (not 2.6);
2. Direct estimate using published data for 2017 by the Department of Civil Status and Passport yielded a figure of 3.56 birth per woman (not 2.6);
3. TFR figure from 2015 Census data is 3.4 (3.38) births per woman and it is impossible for TFR to decline to 2.6 or 2.7 in two years;
4. The empirical relationship between TFR and the proximate determinants of fertility; in order to have a TFR of 2.6, mCPR should have been 46% in 2017 and not 38% as 2017 JPFH has shown;
5. Two indirect methods for estimating TFR for 2017, I got the following results:
 - Rele method – 3.15 births per women.
 - Using the survey reported ASFRs, number of WRA, mid-year total population and number of Jordanian annual births, TFR was 3.56 births per woman (same as the figure derived from the direct method).

One Possible Partial Explanation of the Rapid Fertility Decline 2012-2017 is the age structure of survey sample:

Jordan 2017 DHS interviewed a lower proportion of younger women and higher proportion of older Jordanian women of reproductive age compared with the 2012 DHS. This may partially explain the very low TFR resulted from later survey data.

JPFHS 2017/2018 compared with 2012 JPFHS interviewed lower proportion of younger women (< 30 years) – 27.8 % vs. 30.7% who are more fecund and also want to have more children; and higher proportion of older women (35.1% vs. 32.7%) who are less fecund (40-49 years) and probably achieved their desired number of children.

My Conclusions:

The authors' arguments refute the well-established empirical findings in the literature regarding the inhibiting effect of contraceptives use on TFR; beside the impact of other proximate/direct variables. The findings presented in the article do not provide compelling evidence that the inter-survey decline in Jordan TFR is real and a result of shifting pattern.

To avoid pregnancy, fecund women should refrain from sexual intercourse and/or use a contraceptive method. Accepting the authors' inference that TFR may rapidly decline, the case of Jordan (other things being equal) without a decline in sexual exposure and significant increase in modern contraceptive use will give a false recommendation or approach to FP program managers and decision makers for not investing in FP services.

Data errors in the later survey is not ruled out and it has been noticed by ICFI during the data collecting stage. Jordan fertility is still stalling; a trend witnessed in other countries.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

No

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Demographic analysis, analysis of fertility related data and formulation of population policy.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 07 Jun 2021

Kristin Bietsch, Avenir Health, Glastonbury, USA

The authors greatly respect Dr. Masarweh and are honored that he agreed to review the paper. We appreciate that he took the time to check other sources to prepare his review. We have acknowledged many of the trends Dr. Masarweh detailed in his review in our paper and agree that these trends should point to an increase in TFR. Interestingly, this is not what we have found in the JPFHS, which we validated internally and externally (using the 2015 census and annual birth numbers from the Jordanian Department of Statistics). The counter-intuitive trends between TFR and mCPR are what prompted this analysis. We stand by our analysis and have explored many of the proximate determinants of fertility as well as other potential changes to fertility with the DHS data.

We agree that contraception is an important element of any family planning program and that maintaining the apparent low fertility will require continued strong efforts toward increased family planning use. In our conclusions and recommendations section we emphasize the importance of a continued focus on family planning programs, including improving quality, expanding the method mix and dispelling myths and misconceptions to help women achieve their fertility intentions.

Competing Interests: None