

## RESEARCH ARTICLE

# Associations between age of menarche, early sexual debut and high-risk sexual behaviour among urban Tanzanian schoolgirls: A cross-sectional study

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## Abstract

**Objectives:** This cross-sectional survey aimed to explore associations between age of menarche, early sexual debut and high-risk sexual behaviour among urban Tanzanian schoolgirls.

**Methods:** Secondary schoolgirls aged 17–18 years from Mwanza, Tanzania, participated in structured face-to-face questionnaire-based interviews, conducted by nurses and clinicians. Age of menarche was evaluated in categories of 11–12, 13–14, 15–16 or  $\geq 17$  years. Primary outcome measures were self-reported early sexual debut (first vaginal sex at  $< 16$  years) and high-risk sexual behaviour, including non-use of condoms, having sex for gifts/money, having older sexual partners and/or other risky behaviours.

**Results:** Of 401 girls enrolled, 174 (43.4%) reported prior vaginal sex. Prevalence of early sexual debut was 14.2% but pressured/forced sex and risky sexual behaviours were common. Adjusted for potential confounding, younger age at menarche was associated with early sexual debut (adjusted odds ratio for linear trend: 1.88 per category, 95% confidence interval: 1.21–2.92,  $p = 0.005$ ). This association remained after excluding girls with first sex at  $< 8$  years or experiencing pressure or force at first sex. Further, adjusted for potential confounding (including ever experiencing forced sex), early sexual debut was associated with high-risk sexual behaviour (adjusted odds ratio: 2.85, 95% confidence interval: 1.38–5.88,  $p = 0.004$ ).

**Conclusions:** Among urban Tanzanian school girls, younger age of menarche was associated with early sexual debut, and early sexual debut was associated with high-risk sexual behaviour. Researchers and public health professionals developing and delivering interventions aimed at preventing adverse sexual health outcomes should consider the impact of these early biological and sexual exposures.

## KEYWORDS

adolescent girls, menarche, sexual and reproductive health, sexual behaviour, sexual debut, sub-Saharan Africa, urban

## INTRODUCTION

Adolescent girls in Sub-Saharan Africa are disproportionately affected by human immunodeficiency virus (HIV) and

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other sexually transmitted infections (STIs), early pregnancy and marriage, gender-based violence and forced sex [1]. In the past two decades, early age of sexual debut (albeit with varying definitions of 'early') has been increasingly recognised as an important risk factor for these and other adverse sexual health outcomes among adolescents and young adults [2, 3]. Early sexual debut among males and females has also been linked to risky sexual behaviours such as non- or inconsistent condom use, having multiple sexual partners and/or a high rate of partner change, having casual or older sexual partners and having transactional sex [3–7]. It is thus plausible that the observed associations between early first sex and the above adverse sexual health outcomes are mediated through high-risk sexual behaviour; though other mechanisms, such as biological susceptibility to HIV and other STIs, have also been proposed [2].

Early pubertal development, typically using age of menarche as a proxy marker in girls, has consistently been found to be associated with early sexual debut, as well as teenage pregnancy and STIs in high income countries and some low- and middle-income countries [8–11]. However, a paucity of recent evidence from Sub-Saharan Africa limits our understanding of these associations in this region [11]. Most relevant studies from Sub-Saharan Africa were conducted over two decades ago, and recent declines in age of menarche (attributed to improved socioeconomic, health and nutritional status), increases in age of sexual debut (attributed to improved socioeconomic status and retention in school) and changes in sociocultural traditions and practices may restrict their relevance today.

Increasing our understanding of typical first sexual behaviours among adolescent females in Sub-Saharan Africa, and evaluating associations between pubertal development, sexual debut and sexual behaviour, may shed light on the pathways contributing to different sexual health outcomes, which is key to developing informed interventions. Sexual behaviours have changed over time, and it is important to document which factors are associated with this. This study therefore examined whether age of menarche (a proxy for pubertal development) is associated with early sexual debut (defined here as first vaginal sex at <16 years old), and whether early sexual debut is associated with high-risk sexual behaviour, among urban Tanzanian schoolgirls.

## METHODS

We conducted a cross-sectional, questionnaire-based survey of 401 Tanzanian schoolgirls aged 17–18 years between November 2013 and June 2014 as part of the 'Reproductive Health in Adolescents in Sub-Saharan Africa' (RHASA) study [12–14]. The primary objectives of the RHASA study were to assess the acceptability of procedures for research on reproductive health and to characterise the vaginal microbiome in adolescent girls in Tanzania [12–14]. The study was approved in 2013 by the Lake-Zone Institutional Review Board (IRB) in Mwanza (ref: MR/53/100/86), the Tanzanian National Ethics Committee (EC) of the Medical

Research Coordinating Committee at the National Institute for Medical Research (ref: NIMR/HQ/R.8a/Vol.IX/1544), the IRB of the Antwerp Institute of Tropical Medicine (ref: 867/13), and the EC of the Antwerp University Teaching Hospital (ref: 13/14/147).

## Study setting and population

Participants were from urban Mwanza, north-west Tanzania, which has a population of over one million people [15]. Free schooling is offered for all children in Tanzania and reported literacy rates in Mwanza city are almost 92% (though considerably lower in older adults) [16]. North-west Tanzania has a high incidence and prevalence of STIs such as HIV, syphilis, chlamydia, gonorrhoea, Herpes simplex virus type 2 and Human papillomavirus [17–19].

Girls were eligible to take part in the RHASA study if they were aged 17–18 years, resident in Mwanza, attending a government secondary day school, planning to remain in the study area for at least 1 month post-enrolment and able and willing to provide informed consent/assent (with a parent or guardian if <18 years) [12–14].

## Participant recruitment and data collection

RHASA study procedures have been described previously [12–14]. In brief, 26 secondary schools in Mwanza city with ≥25 female attendees in the target age range were invited to take part, and 24 schools agreed. Potentially eligible female pupils and their parents/guardians were invited to school meetings where they were informed about the study. Girls aged 18 years who were interested in joining the study were asked to provide informed consent. Where girls were aged 17 years, parents/guardians were asked for informed consent and girls for assent. The informed consent/assent included information about the sensitive questions that would be asked.

Data were collected from participating girls on sexual behaviours, STI symptoms and sanitary and hygiene practices through structured face-to-face interviews using a standardised, pre-tested questionnaire. Interviews were conducted by nurses or clinical officers who were trained and experienced in asking adolescent schoolgirls about sensitive topics. Interviews were conducted in a private location, and staff always sought to create an open and non-judgemental environment. The questionnaire was designed in a way that it would put girls at ease and make them feel free in talking to the interviewer about themselves and their homes before questions were asked about sexual behaviour. Before moving onto questions about sexual behaviour, girls were gently informed by the interviewer that: [a] we know that some girls of their age are already having sex and others are not, and either case is ok; [b] we just want to hear the truth about young peoples' experiences; [c] the discussion is confidential; and [d] girls could take as much time as they needed to answer the questions.

Some questions asked about whether girls had experienced pressure or force to have sex, which had the potential

to cause distress for some participants. For these questions, girls were gently probed in order to understand how they felt about having sex at that time and whether they felt any pressure or force from the person that they had sex with or someone else, and their answers were coded accordingly. Nurse counsellors were available to participants should they experience any distress due to the topics discussed, and to provide advice on support options available to girls should abuse be suspected or reported.

## Data management and analyses

Survey data were collected onto paper questionnaires and double-entered into OpenClinica (Azaka Research, United States of America) [12–14]. Data were analysed using STATA version 15.0. Socio-demographic and behavioural characteristics of all participants were tabulated. As some girls had not passed menarche or sexual debut at the time of the survey, median ages of menarche and first sex were estimated using Kaplan Meier (KM) methods. Based on previous data on the median age of first sex in Tanzanian girls [20, 21], and consistent with other studies in Sub-Saharan Africa [22, 23], early sexual debut was defined as first vaginal sex at <16 years of age.

## Evaluation of the association between age of menarche and early sexual debut

Logistic regression was used to estimate crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) for the association between age of menarche and early sexual debut. Age of menarche was evaluated as an ordinal variable in categories of 11–12, 13–14, 15–16 or  $\geq 17$  years. Girls who had not yet passed menarche at the time of the survey were included in the  $\geq 17$ -year group. Deprivation score, a previously described measure of socioeconomic status (SES) [13], was considered an a priori confounder.

The multivariable model was built iteratively, first including age at menarche and deprivation score. Other potential confounders were then added stepwise, considering evidence of and biological rationale for confounding. These variables were retained in the model if there was evidence of an association with both the exposure (age of menarche) and outcome of interest (early sexual debut) in univariate analyses and/or their inclusion in the multivariable model altered the OR for the main exposure-outcome association by >5%. The likelihood-ratio test (LRT) was used to test for departure from linearity for age at menarche (as an ordinal variable).

We considered it plausible that girls who had menarche at a younger age may have been pressured or forced to have sex earlier. Thus, in a sensitivity analysis, we excluded girls who reported pressure or force at first sex so that we could evaluate whether younger age of menarche was associated with reportedly consensual early sexual debut. In this sensitivity analysis, we also excluded girls who reported sexual debut at <8 years, who likely experienced first sex before the onset of puberty.

## Evaluation of the association between early sexual debut and high-risk sexual behaviour

Among girls who reported ever having vaginal sex, logistic regression was used to evaluate whether early sexual debut was associated with high-risk sexual behaviour. Sexual behaviour risk was evaluated based on girls' answers to seven sexual behaviour questions that have known associations with adverse sexual outcomes such as STIs and unplanned pregnancy [2, 6, 7, 24]. These questions related to: [a] having >1 lifetime sexual partner; [b] ever having sex in exchange for gifts or money; [c] ever having sex after drinking alcohol or taking drugs; [d] the first or most recent sexual relationship being a casual relationship (i.e. not with a husband, fiancé or boyfriend); [e] the first or most recent sexual partner being  $\geq 5$  years older; [f] the first or most recent sexual partner having concurrent sexual relationships; and [g] rarely or never using condoms with the first or most recent sexual partner. Each behaviour was given a value of 1 if reported or 0 if not reported. Answers of 'do not know' or 'cannot remember' were given a value of 0 (i.e. considered lower risk). Answer values were summed to create a risk score ranging from 0–7, which was then dichotomised at the median value as 'high-risk' (score  $\geq 2$ ) versus 'low risk' (score <2) for use in analyses.

The multivariable logistic regression model was built iteratively, as above, including early sexual debut and potential confounders, considering evidence of and biological rationale for confounding. Again, potential confounders were retained in the model if there was evidence of an association with both the exposure (early sexual debut) and outcome of interest (high-risk sexual behaviour) in univariate analyses and/or their inclusion in the multivariable model altered the OR for the main exposure-outcome association by >5%. One participant was excluded from analyses because she had missing values for all of the contributing variables.

In a sensitivity analysis, answers of 'do not know' or 'cannot remember' to the seven questions contributing to the sexual behaviour risk score were coded as 1, assuming in this scenario that reduced awareness of these behaviours was likely to be associated with higher sexual risk.

## RESULTS

Of 1210 age-eligible girls registered at the included schools, 802 were successfully contacted and their parents invited to school meetings; 439 parents attended the meetings, and consent/assent was obtained for 401 girls to participate in the study.

Characteristics of the 401 survey participants are presented in Table 1. All but four girls had passed menarche between the ages of 11 and 17 years. The KM median age of menarche was 14 years (95% CI: 14–15 years). In total, 174 (43.4%) girls reported ever having vaginal sex. Only 10 and 2 girls reported ever having oral and anal sex, respectively; and these behaviours were only reported by girls who

**TABLE 1** Participant demographics, characteristics and sexual behaviour

| Variable   | Categories                          | N (%)      |            |
|--|-------------------------------------|------------|------------|
| <i>Among all survey participants</i>                           |                                     | 401        |            |
| Age at enrolment (years)                                       | 17                                  | 223 (55.6) |            |
|  | 18                                  | 178 (44.4) |            |
| Secondary school form  | 1–2                                 | 74 (18.5)  |            |
|  | 3                                   | 236 (58.9) |            |
|  | 4                                   | 91 (22.7)  |            |
|  | Protestant                          | 52 (13.0)  |            |
| Religion   | Catholic                            | 192 (47.9) |            |
|  | Other Christian                     | 96 (23.9)  |            |
|  | Muslim                              | 54 (13.5)  |            |
|  | Other                               | 7 (1.8)    |            |
|  | Tribe                               | Msukuma    | 176 (43.9) |
| Mjita  |                                     | 32 (8.0)   |            |
| Mkara/Mkerewe  |                                     | 22 (5.5)   |            |
| Mkuria/Mshashi   |                                     | 22 (5.5)   |            |
| Mhaya  |                                     | 21 (5.2)   |            |
| Other  |                                     | 128 (31.9) |            |
| Number of people in household                                  |                                     | ≤4         | 74 (18.5)  |
|  |                                     | 5–6        | 123 (30.7) |
|  | ≥7                                  | 204 (50.9) |            |
| Lives with mother and/or father                                | Yes                                 | 279 (69.6) |            |
|  | No                                  | 122 (30.4) |            |
| Night away in past 3 months                                    | Yes                                 | 46 (11.5)  |            |
|  | No                                  | 355 (88.5) |            |
| Deprivation score  | 1 (least deprived)                  | 24 (6.0)   |            |
|  | 2                                   | 170 (42.4) |            |
|  | 3                                   | 192 (47.9) |            |
|  | 4 (most deprived)                   | 15 (3.7)   |            |
|  | Ever drinks alcohol                 | Yes        | 11 (2.7)   |
| Age at menarche (years)  | No                                  | 390 (97.3) |            |
|  | 11–12                               | 29 (7.2)   |            |
|  | 13–14                               | 184 (45.9) |            |
|  | 15–16                               | 167 (41.7) |            |
|  | ≥17                                 | 16 (4.0)   |            |
|  | Not passed menarche                 | 4 (1.0)    |            |
| Menstrual sanitation method                                    | Missing                             | 1 (0.3)    |            |
|  | Sanitary pads (±cloth and/or pants) | 213 (53.1) |            |
|  | Cloth and/or pants only             | 184 (45.9) |            |
|  | Not applicable                      | 4 (1.0)    |            |
| Ever cleans intra-vaginally                                    | Yes                                 | 60 (15.0)  |            |
|  | No                                  | 341 (85.0) |            |
| Circumcised  | Yes                                 | 5 (1.3)    |            |
|  | No                                  | 396 (98.8) |            |
| Ever had vaginal sex   | Yes                                 | 174 (43.4) |            |
|  | No                                  | 227 (56.6) |            |
| Among participants reporting previous vaginal sex <sup>a</sup> |                                     | 174        |            |

(Continues)

**TABLE 1** (Continued)

| Variable                                    | Categories  | N (%)      |
|---|-------------|------------|
| Age at first sex (years)                    | ≤11         | 5 (2.9)    |
|   | 12–13       | 7 (4.0)    |
|   | 14–15       | 45 (25.9)  |
|   | 16–17       | 106 (60.9) |
| Number of lifetime sexual partners          | 18          | 11 (6.3)   |
|   | 1           | 128 (73.6) |
| Used a condom at first sex                  | ≥2          | 46 (26.4)  |
|   | Yes         | 77 (44.3)  |
|   | No          | 95 (54.6)  |
| Pressure or force at first sex <sup>b</sup> | Do not know | 2 (1.2)    |
|   | Yes         | 47 (27.0)  |
|   | No          | 127 (73.0) |
| Ever forced to have sex                     | Yes         | 24 (13.8)  |
|   | No          | 150 (86.2) |
| Ever had sex for gifts/money                | Yes         | 14 (8.1)   |
|   | No          | 160 (92.0) |
| Ever had sex after alcohol/drug-use         | Yes         | 1 (0.6)    |
|   | No          | 173 (99.4) |
| Ever had sex whilst menstruating            | Yes         | 6 (3.5)    |
|   | No          | 168 (96.6) |

<sup>a</sup>All variables below this sub-heading refer to vaginal sex.<sup>b</sup>Girls' answers were coded as 'yes' if they reported that they wanted to wait to have sex but felt pressure to have sex at that time, or if they did not want to have sex but were forced to.

also reported previous vaginal sex. The KM median age of first vaginal sex among all girls was ≥18 years.

Most girls (73.6%) who had passed sexual debut had only had one sexual partner at the time that the survey was conducted. However, data on girls' first relationships suggest that early risky sexual behaviours were common, including having a casual relationship (27.0%), having a partner who was ≥5 years older (15.5%), having a partner with known concurrent sexual relationships (19.5%) and rarely or never using condoms (58.1%) (Table 2). Forty-seven (27.0%) of the girls who had passed sexual debut said that they felt pressured ( $n = 25$ ) or were forced ( $n = 22$ ) to have sex the first time that they had sex. First sexual partners of these girls were boyfriends ( $n = 26$ , 55.3%), friends ( $n = 7$ , 14.9%), people they recognised from the community ( $n = 6$ , 12.8%), complete strangers ( $n = 4$ , 8.5%), relatives ( $n = 2$ , 4.3%) or a teacher ( $n = 1$ , 2.1%). In one case, details on the sexual partner were missing.

### Association between age of menarche and early sexual debut

Two of the 401 survey participants were excluded from this analysis; one because age of menarche was unknown, and the other because first sex occurred as a result of sexual

**TABLE 2** First and most recent sexual relationships among girls with previous vaginal sex

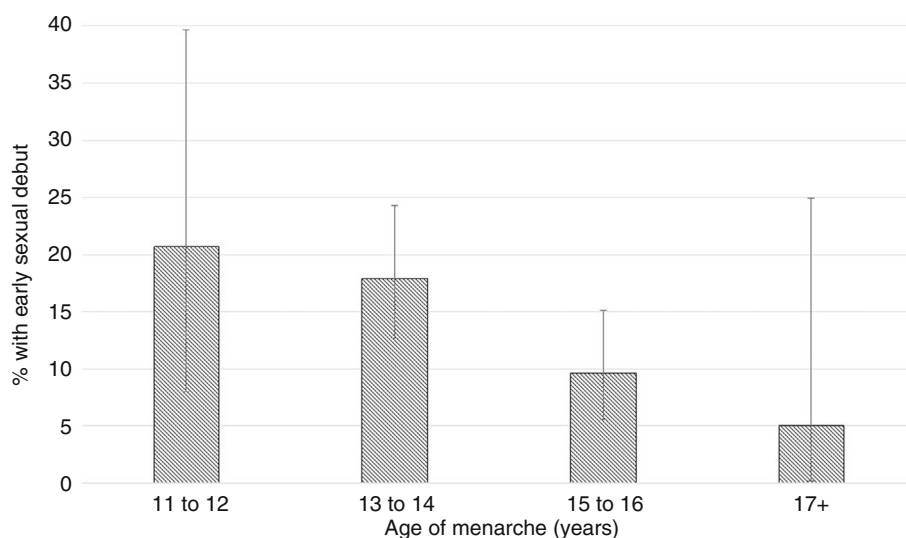
| Variable <sup>a</sup>                              | Categories                   | First relationship, N (%) <sup>b</sup> | Most recent relationship, N (%) <sup>b</sup> |
|--|------------------------------|--|--|
| Total  | –                            | 174                                    | 46   |
| Relationship to sexual partner                     | Boyfriend                    | 126 (72.4)                             | 40 (87.0)                                    |
|  | Friend                       | 31 (17.8)                              | 3 (6.5)                                      |
|  | Other <sup>c</sup>           | 16 (9.2)                               | 3 (6.5)                                      |
|  | Missing                      | 1 (0.6)                                | –  |
| Age difference with sexual partner                 | Same age ( $\pm 1$ year)     | 49 (28.2)                              | 10 (21.7)                                    |
|  | Partner 2–4 years older      | 74 (42.5)                              | 22 (47.8)                                    |
|  | Partner $\geq 5$ years older | 27 (15.5)                              | 9 (19.6)                                     |
|  | Do not know                  | 23 (13.2)                              | 5 (10.9)                                     |
| Number times had sex with sexual partner           | Once                         | 82 (47.1)                              | 7 (15.2)                                     |
|  | 2–3 times                    | 55 (31.6)                              | 23 (50.0)                                    |
|  | $\geq 4$ times               | 32 (18.4)                              | 16 (34.8)                                    |
|  | Do not remember              | 4 (2.3)                                | –  |
|  | Missing <sup>d</sup>         | 1 (0.6)                                | –  |
| Sexual partner had concurrent sexual relationships | Yes                          | 34 (19.5)                              | 15 (32.6)                                    |
|  | No                           | 64 (36.8)                              | 8 (17.4)                                     |
|  | Do not know                  | 75 (43.1)                              | 23 (50.0)                                    |
|  | Missing <sup>d</sup>         | 1 (0.6)                                | –  |
| Frequency of condom use with sexual partner        | Always/Most of the time      | 69 (39.7)                              | 18 (39.1)                                    |
|  | Rarely/never                 | 101 (58.1)                             | 28 (60.9)                                    |
|  | Cannot remember              | 3 (1.7)                                | –  |
|  | Missing <sup>d</sup>         | 1 (0.6)                                | –  |

<sup>a</sup>All variables refer to vaginal sex.

<sup>b</sup>Data are shown for first relationships for all 174 girls who reported ever having sex, and for most recent relationships for 46 girls who reported having  $>1$  lifetime partner.

<sup>c</sup>Other partners reported by girls included a relative, someone that the girl recognised from the community, or a complete stranger.

<sup>d</sup>Missing results are all from one girl who experienced sexual abuse at just 3 years old.

**FIGURE 1** Proportion of girls with early sexual debut by age of menarche. Error bars show 95% confidence intervals.

abuse when aged 3 years old. Fifty-five (13.8%) of the 399 girls included in the analysis reported having first sex at  $<16$  years. In the crude analysis, there was strong evidence

that the odds of early first sex increased with younger age of menarche (OR for linear trend: 1.73, 95% CI: 1.14–2.62,  $p = 0.009$ ; Figure 1), and the association remained after



**TABLE 3** Odds ratios for the effect of age of menarche and other participant characteristics and behaviour on sexual debut at <16 years

| Variable                             | Category           | N with sexual debut at <16 y/total N (%) | Crude-OR (95%CI)  | LRT <i>p</i> -value | Adjusted-OR (95%CI) <sup>a</sup> | LRT <i>p</i> -value |
|--------------------------------------|--------------------|--|-------------------|---------------------|----------------------------------|---------------------|
| Age of menarche (years) <sup>b</sup> | ≥17                | 1/20 (5.0)                               | 1.73 (1.14–2.62)  | 0.009               | 1.88 (1.21–2.92)                 | 0.005               |
|                                      | 15–16              | 16/167 (9.6)                             |                   |                     |                                  |                     |
|                                      | 13–14              | 32/183 (17.5)                            |                   |                     |                                  |                     |
|                                      | <13                | 6/29 (20.7)                              |                   |                     |                                  |                     |
| Age at enrolment (years)             | 17                 | 37/222 (16.7)                            | 1                 | 0.058               | 1                                | 0.108               |
|                                      | 18                 | 18/177 (10.2)                            | 0.57 (0.31–1.03)  |                     | 0.60 (0.32–1.13)                 |                     |
| Secondary school form                | 1–2                | 11/74 (14.9)                             | 1                 | 0.448               | 1                                | 0.241               |
|                                      | 3                  | 35/234 (15.0)                            | 1.01 (0.48–2.10)  |                     | 1.17 (0.55–2.48)                 |                     |
|                                      | 4                  | 9/91 (9.8)                               | 0.63 (0.25–1.61)  |                     | 0.59 (0.22–1.59)                 |                     |
| Religion <sup>c</sup>                | Catholic           | 28/191 (14.7)                            | 1                 | 0.790               | 1                                | 0.801               |
|                                      | Other Christian    | 18/147 (12.2)                            | 0.81 (0.43–1.53)  |                     | 0.85 (0.44–1.63)                 |                     |
|                                      | Muslim, other      | 9/61 (14.8)                              | 1.01 (0.45–2.27)  |                     | 1.12 (0.48–2.60)                 |                     |
| Tribe <sup>c</sup>                   | Sukuma             | 22/176 (12.5)                            | 1                 | 0.507               | 1                                | 0.571               |
|                                      | Non-Sukuma         | 33/223 (14.8)                            | 1.22 (0.68–2.17)  |                     | 1.19 (0.65–2.16)                 |                     |
| Number of people in household        | ≤4                 | 7/73 (9.6)                               | 1                 | 0.319               | 1                                | 0.526               |
|                                      | 5–6                | 21/123 (17.1)                            | 1.94 (0.78–4.82)  |                     | 1.69 (0.66–4.28)                 |                     |
|                                      | ≥7                 | 27/203 (13.3)                            | 1.45 (0.60–3.48)  |                     | 1.39 (0.57–3.41)                 |                     |
| Lives with mother and/or father      | No                 | 19/122 (15.6)                            | 1                 | 0.496               | 1                                | 0.524               |
|                                      | Yes                | 36/277 (13.0)                            | 0.81 (0.44–1.48)  |                     | 0.81 (0.43–1.54)                 |                     |
| Night away in past 3 months          | No                 | 48/353 (13.6)                            | 1                 | 0.767               | 1                                | 0.671               |
|                                      | Yes                | 7/46 (15.2)                              | 1.14 (0.48–2.70)  |                     | 1.22 (0.50–2.99)                 |                     |
| Deprivation score                    | 1 (least deprived) | 2/24 (8.3)                               | 1                 | 0.719               | 1                                | 0.457               |
|                                      | 2                  | 25/169 (14.8)                            | 1.91 (0.42–8.63)  |                     | 1.99 (0.43–9.26)                 |                     |
|                                      | 3                  | 25/191 (13.1)                            | 1.66 (0.37–7.58)  |                     | 1.73 (0.37–7.99)                 |                     |
|                                      | 4 (most deprived)  | 3/15 (20.0)                              | 2.75 (0.40–18.80) |                     | 4.71 (0.65–34.34)                |                     |
| Ever drinks alcohol                  | No                 | 53/388 (13.7)                            | 1                 | 0.680               | 1                                | 0.540               |
|                                      | Yes                | 2/11 (18.2)                              | 1.40 (0.30–6.68)  |                     | 1.69 (0.34–8.44)                 |                     |

Abbreviations: CI, confidence interval; LRT, likelihood ratio test; N, number; OR, odds ratio.

<sup>a</sup>Results are from a multivariable model including age of menarche, age at enrolment, secondary school form and deprivation score ( $n = 399$ ).

<sup>b</sup>There was no evidence for a departure from linearity in the association between age of menarche and early sexual debut ( $p = 0.74$ ), so the ordinal variable of age of menarche (in categories of 11–12, 13–14, 15–16 and ≥17 years) was fit as a linear term.

<sup>c</sup>Religion and tribe were re-categorised for multivariable analyses as shown in the table.

adjusting for potential confounding effects of age at enrolment, secondary school form and deprivation score (adjusted OR for linear trend: 1.88, 95% CI: 1.21–2.91,  $p = 0.005$ ; Table 3). In the sensitivity analysis, excluding two girls with first sex at 7 years old and 45 girls who reported pressure or force at first sex, the adjusted OR for linear trend increased to 2.44 (95% CI: 1.41–4.20,  $p = 0.001$ ).

### Association between early sexual debut and high-risk sexual behaviour

One of the 174 girls reporting prior vaginal sex was excluded from this analysis because sexual behaviour data were missing. This was the same girl who was excluded from the

analysis above because first sex occurred as a result of sexual abuse at just 3 years old. Of the 173 girls included in the analysis, 56 (32.4%) had first sex at <16 years. Early sexual debut appeared to be associated with the following individual sexual behaviours: having >1 lifetime sexual partner; the first or last sexual partner being ≥5 years older; the first or last sexual partner having concurrent relationships; the first or last sexual relationship being a casual relationship; and rarely or never using condoms in the first or last sexual relationship (Table S1).

Sexual risk score ranged from 0 to 6, and the distribution of girls across scores was as follows: 0 = 23.1%, 1 = 31.8%, 2 = 19.1%, 3 = 15.6%, 4 = 8.1%, 5 = 1.7%, 6 = 0.6%. Figure S1 shows the distribution of sexual risk scores by age of sexual debut (<16 vs. ≥16 years). Overall, the median

**TABLE 4** Odds ratios for the effect of early sexual debut and other participant characteristics and behaviour on high-risk sexual behaviour

| Variable                        | Category           | N with high-risk behaviour/total (%) | Crude-OR (95% CI) | LRT <i>p</i> value | Adjusted-OR (95% CI) <sup>a</sup> | LRT <i>p</i> value |
|---------------------------------|--------------------|--------------------------------------|-------------------|--------------------|-----------------------------------|--------------------|
| Age of sexual debut (years)     | ≥16                | 45/117 (38.5)                        | 1                 | 0.011              | 1                                 | 0.004              |
|                                 | <16                | 33/56 (58.9)                         | 2.30 (1.20–4.40)  |                    | 2.85 (1.38–5.88)                  |                    |
| Age at enrolment (years)        | 17                 | 36/84 (42.9)                         | 1                 | 0.567              | 1                                 | 0.282              |
|                                 | 18                 | 42/89 (47.2)                         | 1.19 (0.65–2.17)  |                    | 1.45 (0.74–2.86)                  |                    |
| Secondary school form           | 1–2                | 12/24 (50.0)                         | 1                 | 0.173              | 1                                 | 0.162              |
|                                 | 3                  | 42/106 (39.6)                        | 0.66 (0.27–1.60)  |                    | 0.70 (0.27–1.78)                  |                    |
|                                 | 4                  | 24/43 (55.8)                         | 1.26 (0.46–3.44)  |                    | 1.45 (0.49–4.36)                  |                    |
| Religion <sup>b</sup>           | Catholic           | 44/92 (47.8)                         | 1                 | 0.302              | 1                                 | 0.207              |
|                                 | Other Christian    | 27/58 (46.6)                         | 0.95 (0.49–1.84)  |                    | 0.96 (0.48–1.94)                  |                    |
|                                 | Muslim, other      | 7/23 (30.4)                          | 0.48 (0.18–1.27)  |                    | 0.41 (0.14–1.16)                  |                    |
| Tribe <sup>b</sup>              | Sukuma             | 33/74 (44.6)                         | 1                 | 0.910              | 1                                 | 0.998              |
|                                 | Non-Sukuma         | 45/99 (45.5)                         | 1.04 (0.57–1.90)  |                    | 1.00 (0.52–1.94)                  |                    |
| Number of people in household   | ≤4                 | 18/36 (50.0)                         | 1                 | 0.419              | 1                                 | 0.352              |
|                                 | 5–6                | 23/60 (38.3)                         | 0.62 (0.27–1.43)  |                    | 0.54 (0.22–1.32)                  |                    |
|                                 | ≥7                 | 37/77 (48.1)                         | 0.93 (0.42–2.04)  |                    | 0.79 (0.34–1.84)                  |                    |
| Lives with mother and/or father | No                 | 25/55 (45.5)                         | 1                 | 0.947              | 1                                 | 0.823              |
|                                 | Yes                | 53/118 (44.9)                        | 0.98 (0.51–1.86)  |                    | 0.92 (0.46–1.85)                  |                    |
| Night away in past 3 months     | No                 | 67/148 (45.3)                        | 1                 | 0.906              | 1                                 | 0.994              |
|                                 | Yes                | 11/25 (44.0)                         | 0.95 (0.40–2.23)  |                    | 1.00 (0.40–2.49)                  |                    |
| Deprivation score <sup>c</sup>  | 1 (least deprived) | 0/8 (0.0)                            | 1.79 (1.10–2.90)  | 0.016              | 1.73 (1.04–2.89)                  | 0.033              |
|                                 | 2                  | 35/78 (44.9)                         |                   |                    |                                   |                    |
|                                 | 3                  | 37/80 (46.3)                         |                   |                    |                                   |                    |
|                                 | 4 (most deprived)  | 6/7 (85.1)                           |                   |                    |                                   |                    |
| Ever drinks alcohol             | No                 | 76/168 (45.2)                        | 1                 | 0.816              | 1                                 | 0.608              |
|                                 | Yes                | 2/5 (40.0)                           | 0.81 (0.13–4.95)  |                    | 0.60 (0.09–4.21)                  |                    |
| Age of menarche                 | ≥17                | 2/5 (40.0)                           | 1                 | 0.563              | 1                                 | 0.752              |
|                                 | 15–16              | 27/69 (39.1)                         | 0.96 (0.15–6.15)  |                    | 1.22 (0.18–8.36)                  |                    |
|                                 | 13–14              | 39/82 (47.6)                         | 1.36 (0.22–8.57)  |                    | 1.43 (0.20–9.98)                  |                    |
|                                 | <13                | 9/16 (56.3)                          | 1.93 (0.25–14.89) |                    | 2.34 (0.26–20.91)                 |                    |
| Pressure or force at first sex  | No                 | 54/127 (42.5)                        | 1                 | 0.260              | 1                                 | 0.993              |
|                                 | Yes                | 24/46 (52.2)                         | 1.47 (0.75–2.90)  |                    | 1.00 (0.42–2.37)                  |                    |
| Ever forced to have sex         | No                 | 63/150 (42.0)                        | 1                 | 0.037              | 1                                 | 0.127              |
|                                 | Yes                | 15/23 (65.2)                         | 2.59 (1.03–6.48)  |                    | 2.12 (0.80–5.67)                  |                    |

Abbreviations: CI, confidence interval; LRT, likelihood ratio test; N, number; OR, odds ratio.

<sup>a</sup>Results are from a multivariable model including early sexual debut, age at enrolment, secondary school form, number of people in household and ever experiencing forced sex among 173 survey participants who reported previous vaginal sex.

<sup>b</sup>Religion and tribe were re-categorised for multivariable analyses as shown in the table.

<sup>c</sup>The ordinal variable of deprivation score was fit as a linear term.

score was 1, and 78 girls (45.1%) were categorised as having high-risk sexual behaviour (risk score ≥2). In the crude analysis, the odds of high-risk sexual behaviour were over two times higher in girls with sexual debut at <16 years compared with ≥16 years (OR: 2.30, 95% CI: 1.20–4.40, *p* = 0.011) (Table 4). There was also evidence for increased odds of high-risk sexual behaviour in girls who had ever been forced to have sex. After adjusting for potential confounding effects of age at enrolment,

secondary school form, number of people residing in household and ever being forced to have sex, the odds of high-risk sexual behaviour were almost three-times higher in girls who had sexual debut at <16 compared with ≥16 years of age (OR: 2.85, 95% CI: 1.38–5.88, *p* = 0.004).

In a sensitivity analysis, where responses of ‘do not know’ or ‘cannot remember’ to the behaviour questions contributing to the sexual risk score were given a score of

1, the median sexual risk score was 2 and a score of  $\geq 3$  was considered 'high-risk'. After adjusting for the same potential confounders as in the main analysis above, the odds of high-risk sexual behaviour were over 3.5-times higher in girls who had sexual debut at  $<16$  compared with  $\geq 16$  years of age (OR: 3.52, 95% CI: 1.61–7.66,  $p = 0.001$ ).

## DISCUSSION

Less than 15% of urban Tanzanian schoolgirls in this study reported having first sex at  $<16$  years, and the median reported age of sexual debut ( $\geq 18$  years) was higher than in previous studies in the region [20, 25–27]. However, among sexually active girls, the youngest age of 'consensual' sex reported was just 7 years old (though the ability of a 7-year-old to consent to sex is highly questionable) and risky sexual behaviours were common. Consistent with earlier studies from Sub-Saharan Africa [22, 28, 29], we found robust evidence for an association between younger age of menarche and early sexual debut. Furthermore, our analyses found strong evidence for an association between early sexual debut and high-risk sexual behaviour.

Interestingly, we did not observe an association between age of menarche and high-risk sexual behaviour. However, the sample size for this evaluation was much smaller than the sample size for the evaluation of age of menarche and early sexual debut. The odds ratios for the effect of age of menarche on high-risk sexual behaviour did appear to increase with younger age of menarche, but confidence intervals surrounding the estimates were very wide.

We hypothesised that the physiological changes occurring during puberty (rather than menarche itself) were associated with age of sexual debut in this population. Pubertal development typically starts at 8–13 years in girls, and the first stages of puberty usually precede menarche by approximately 2.5 years [30]. Early puberty may lead to early first sex because hormonal changes make girls interested in sexual activity at a younger age and because the associated bodily changes make them more attractive to males. In some local cultures, menarche itself is seen as a marker of womanhood, after which girls are expected to enter into relationships or marriage [31, 32]. However, no girls in this study were married and there was no effect of tribe or religion on the association between menarche and sexual debut. We considered it possible that pressure or force at first sex may mediate the relationship between early puberty and early sexual debut in this population. However, the association between age of menarche and early sexual debut observed in our study was even stronger after excluding girls reporting pressure or force at first sex (though under-reporting of coercion cannot be ruled out).

The observed association between early first sex and high-risk sexual behaviour in our study may reflect a lack of maturity, with girls who initiated sex at a younger age being less aware of potential consequences, less able to make sensible judgements and decisions, or less able to negotiate with

their sexual partners (particularly with older partners). Males may also be more likely to take advantage of younger girls. Forced sex was more common in girls with first sex at  $<16$  compared with  $\geq 16$  years and was associated with high-risk sexual behaviour. Nonetheless, after controlling for ever experiencing forced sex, an association between early sexual debut and high-risk sexual behaviour was slightly increased. Of note, we also observed a strong association between deprivation score and high-risk sexual behaviour, with the most deprived girls reporting higher risk behaviour.

Our results among Tanzanian schoolgirls were consistent with earlier studies from Sub-Saharan Africa, which found an increased risk of having multiple sexual partners, older first sexual partners or non-condom use with earlier sexual debut [6, 7, 33]. However, our primary outcome measure encompassed a range of sexual risk-taking behaviours, giving a broader picture of risk rather than focusing on individual factors. Notably, our sexual behaviour 'score' assumes equal weighting of the contributing behaviour variables, which may be an over-simplification. Also, girls were only asked about their first and last sexual relationships so we cannot confirm presence or absence of risk-taking sexual behaviour in interim relationships. However, only 10 girls reported more than two relationships, all of whom were categorised as having high-risk sexual behaviour. Thus, their outcome category would not have changed by including data on interim relationships.

Girls in this study were still in school at age 17–18 years. Whilst schooling is free for all children in Tanzania, an estimated one-third of children in Tanzania have left school by the age of 15 years, with girls typically leaving school before boys [34]. Many of the girls aged 17 and 18 years who were identified in the RHASA study as being recorded on the school registers were actually no longer attending school. Girls who are able to stay in school may not need to work and may be of higher SES, have a more structured family and have greater parental involvement compared with those who leave [34]. Lower education level and SES, absenteeism from school, and lack of parental engagement and involvement have all been linked to earlier sexual debut [25]. Furthermore, until recently, schoolgirls in Tanzania who became pregnant were forced to leave school [35]. Thus, our study population may, on average, start sex at an older age, be less sexually active and have less risk-taking behaviour than other populations of 17–18-year-old Tanzanian girls.

There are some limitations of our study. Selection bias may have arisen because of the low response rate of parents and girls in the participating schools; only 55% of parents invited to school meetings about the study attended. Nonetheless, the average age of menarche in this study and our previously published STI prevalence estimates from the same study population did not differ considerably from other adolescent populations in Tanzania and Sub-Saharan Africa [12–14, 36, 37]. Furthermore, selection bias arising from a lower response rate would likely have a greater impact when measuring the prevalence of an outcome than when examining associations (as was done in this study).



There are some limitations of using questionnaires for collecting data on sensitive topics from adolescent females, as previously reported [38]. Information bias may have arisen because girls with earlier first sex might be more likely to over-report age of sexual debut or under-report high-risk sexual behaviour. Whilst measures were taken in the survey to limit the risk of social desirability bias and promote accurate reporting, our previously reported laboratory data from the same study showed that 7% of girls reporting no previous vaginal sex had an STI, suggesting under-reporting of sexual activity [13]. Finally, whilst we controlled for potential confounders of the associations between age of menarche, early sexual debut and high-risk sexual behaviour, variables such as SES can be difficult to measure, so residual confounding is possible.

## CONCLUSIONS

Among urban Tanzanian schoolgirls, this study provided evidence that younger age of menarche is associated with early sexual debut, and that early sexual debut is associated with high-risk sexual behaviour in adolescence. It is widely recognised that the risks of STI acquisition and other negative sexual health outcomes are particularly high around the time of, and in the years following, sexual debut; many interventions aimed at risk-reduction have focused on the corresponding age groups. However, for many girls, predisposition to sexual health risks may start much earlier. Globally, the average age of menarche is decreasing, and it is important that we understand the potential implications this has for sexual behaviours and associated sexual health risks. However, at the same time, average age of sexual debut is increasing as socio-economic status and retention in school improve, and we must be alert to the possibility that the relationship between ages of menarche and sexual debut may change with time. Nonetheless, some girls are still commencing sex at a very early age, even before adolescence, and coerced or forced sex among young girls in Sub-Saharan Africa is common. Recognition and protection of these vulnerable groups should be a priority.

## ACKNOWLEDGEMENTS

We are grateful to the nurses, clinical officers and tracing teams who conducted the fieldwork for this survey, and to the data team for their contribution to data entry and management. We give particular thanks to the girls who gave up their time to participate in the study and the parents who supported their participation.

## FUNDING INFORMATION

This work was supported by the European and Developing Countries Clinical Trials Partnership (project code: SP.2011.41304.066). Suzanna Francis (G1002369), Kathy J. Baisley, and Richard J. Hayes (G0700837) received salary support through MRC/DFID. The funding agencies were not involved in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

Anonymised study data may be made available upon reasonable request by email to the corresponding author, and upon approval by all authors.

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## SUPPORTING INFORMATION

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

**How to cite this article:** Whitworth HS, Baisley KJ, Nnko S, Irani J, Aguirre-Beltran A, Changalucha J, et al. Associations between age of menarche, early sexual debut and high-risk sexual behaviour among urban Tanzanian schoolgirls: A cross-sectional study. *Trop Med Int Health*. 2023;28(3):237–46. <https://doi.org/10.1111/tmi.13858>