

THEORY AND METHODS

Validity of age at menarche self-reported in adulthood

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Objective: To test the validity of age at menarche self-reported in adulthood and examine whether socioeconomic position, education, experience of gynaecological events and psychological symptoms influence the accuracy of recall.

Design: Prospective birth cohort study.

Setting: England, Scotland and Wales.

Participants: 1050 women from the Medical Research Council National Survey of Health and Development, with two measures of age at menarche, one recorded in adolescence and the other self-reported at age 48 years.

Results: By calculating the limits of agreement, κ statistic and Pearson's correlation coefficients (r), we found that the validity of age at menarche self-reported in middle age compared with that recorded in adolescence was moderate ($\kappa=0.35$, $r=0.66$, $n=1050$). Validity was improved by categorising age at menarche into three groups: early, normal and late ($\kappa=0.43$). Agreement was influenced by educational level and having had a stillbirth or miscarriage.

Conclusions: The level of validity shown in this study throws some doubt on whether it is justifiable to use age at menarche self-reported in middle age. It is likely to introduce error and bias, and researchers should be aware of these limitations and use such measures with caution.

Menarche heralds the beginning of a females's reproductive life and its timing is an indicator of the start of regular exposure to endogenous oestrogen and other hormones. Age at menarche is predicted by several factors, including childhood growth and weight,^{1,2} and has been found to be associated with a range of diseases in adulthood, including breast cancer,³ endometrial cancer,⁴ depression⁵ and rheumatoid arthritis.⁶ It is therefore a clinically relevant and widely used measure in epidemiological and anthropological studies, considered as an outcome, predictor, confounder, effect modifier or mediator.

The growth of interest in a life-course approach to adult health⁷ means that studies which were not initiated until study participants were already adults, or were historical cohorts that have been revitalised after a period without data collection, often rely on participants recall of a range of earlier life factors. These retrospective measures need to be validated, as they may be more prone to measurement errors and bias than measures collected prospectively.

Previous studies that have assessed the validity of age at menarche recalled in adulthood have had small sample sizes (current studies include between 43⁸ and 368⁹ women), may not be generalisable as they use either unrepresentative study populations¹⁰ or have a follow-up of <34%¹¹ and have not investigated the characteristics that might account for variation in accuracy of recall.

The Medical Research Council National Survey of Health and Development (MRC NSHD) has information on age at menarche from two data collection points, one in adolescence and the other in middle age; hence, it presents an opportunity to examine the validity of age at menarche self-reported in middle age and to investigate whether a range of factors may influence this.

METHODS

The MRC NSHD is a socially stratified cohort of 2547 women and 2815 men who have been followed up regularly since their birth in March 1946.¹²

During medical examinations carried out when the members of the cohort were aged 14–15 years, school doctors established whether the female members had started their periods and if so, the month and year of onset. If they had not reached menarche by the time of interview, this was recorded. In 1994, all female members, then aged 48 years were asked in a postal questionnaire for their age at menarche in years ("How old were you when you had your first menstrual period?").

By 1994, 154 (6.0%) of the original female cohort members had died, 232 (9.1%) were abroad and not contacted, 296 (11.6%) had previously refused to participate in the study and 87 (3.4%) were untraced. Of the remaining 1778 women, 946 had both measures of age at menarche recorded, and 104 had reported an age at menarche at age 48 years and were known not to have reached menarche by age 14–15 years. The data on these 1050 women (41.2% of the original cohort and 57.8% of the cohort who were examined at age 14–15 years) were used to assess the validity of the measure of age at menarche self-reported in middle age. All analyses used age at menarche in completed years since a more accurate timing was not available for self-reports in middle age.

Factors that could influence the validity of recalled age at menarche were examined. These included social class in childhood and in adulthood, and educational attainment, all collected prospectively. Father's occupational social class at participant's age 11 years (or at age 15 or 4 years if missing at age 11 years ($n=68$)) and own occupational social class at age 53 years (or at age 43, 36, 26 or 20 years if missing at 53 years ($n=174$)) were both classified according to the Registrar General's classification and grouped into three categories: I or II (professional or managerial/technical); III (non-manual) or III (manual, skilled); IV or V (partly skilled or unskilled). Educational level achieved by age 26 years was grouped into five categories: degree or higher; advanced secondary qualifications (A levels or equivalent, generally

Abbreviation: MRC NSHD, Medical Research Council National Survey of Health and Development

Table 1 Cross-tabulation of reported age at menarche (in years) ascertained during adolescence and in middle age in the Medical Research Council National Survey of Health and Development cohort (n = 1050)

Age at menarche (years), recorded at age 48 years	Age at menarche (years), recorded at age 14–15 years							Not yet reached	Total
	9	10	11	12	13	14	14		
9	1 (14.3)*	0 (0)	4 (2.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5
10	2 (28.6)	10 (43.5)*	16 (11.4)	14 (4.7)	9 (2.5)	1 (0.8)	0 (0)	0 (0)	52
11	2 (28.6)	7 (30.4)	80 (56.7)*	85 (28.2)	36 (10.1)	1 (0.8)	0 (0)	0 (0)	211
12	2 (28.6)	3 (13.0)	27 (19.2)	113 (37.5)*	67 (18.9)	3 (2.5)	1 (1.0)	1 (1.0)	216
13	0 (0)	1 (4.3)	12 (8.5)	60 (19.9)	146 (41.1)*	31 (26.1)	9 (8.7)	9 (8.7)	259
14	0 (0)	0 (0)	2 (1.4)	21 (7.0)	79 (22.3)	62 (52.1)*	26 (25.0)	26 (25.0)	190
15	0 (0)	1 (4.3)	0 (0)	7 (2.3)	14 (3.9)	20 (16.8)	39 (37.5)	39 (37.5)	81
16	0 (0)	1 (4.3)	0 (0)	1 (0.3)	4 (1.1)	1 (0.8)	20 (19.2)	20 (19.2)	27
17	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (5.8)	6 (5.8)	6
18	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.0)	1 (1.0)	1
19	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1.9)	2 (1.9)	2
Total	7 (100)	23 (100)	141 (100)	301 (100)	355 (100)	119 (100)	104 (100)	104 (100)	1050

*The two measures are in agreement.
Values are n (%).

taken at age 18 years); ordinary secondary qualifications (O levels or equivalent, generally taken at age 16 years); below secondary qualifications; and no qualifications. To assess the effect of having experienced a gynaecological “event”, hysterectomy and oophorectomy status and experience of a stillbirth or miscarriage were used. Hysterectomy and oophorectomy status were ascertained from information provided by women at data collections across middle age. As age at menarche was recalled at age 48 years, three categories of hysterectomy and oophorectomy status were created: no hysterectomy or oophorectomy; hysterectomy and/or oophorectomy before age 48 years; and hysterectomy and/or oophorectomy at or after age 48 years. During a home visit at age 43 years, women were asked whether they had ever experienced a stillbirth or miscarriage and this was coded as a binary variable. Finally, to assess the effect of psychological distress on agreement, a 12-point scale¹³ was used, based on four psychological symptoms (anxiety/depression, irritability, tearfulness and panic) reported by women for the previous 12 months in the postal questionnaire at age 48 years. The choice of symptoms was based on a factor analysis of 20 common health symptoms, and the score reflected how bothersome each was in everyday life: had not had symptoms (score 0), had symptoms but not bothered (score 1), bothered a little (score 2) and bothered a lot (score 3).¹³

By using data on the 946 women who had reached menarche by the time of their interview in adolescence, 95% limits of agreement¹⁴ and Pearson’s correlation coefficient were calculated. The difference between the two measures of age at menarche was calculated and these differences were plotted against the mean of the two measures to check that there was no relationship between them. After also checking that the differences were normally distributed, the mean and standard deviation (SD) were used to calculate the 95% limits of agreement—that is, mean difference (1.96 SD). In further analyses, including the 104 women who had not reached menarche by the time of their interview in adolescence (n = 1050), age at menarche was considered in individual years up to and including age 13 years, with menarche reported at age 14 years or above grouped. These two measures of age at menarche were cross-tabulated, a κ statistic was used to assess the level of agreement and Pearson’s correlation coefficient was calculated. To examine whether categorising age at menarche improves validity, age at menarche was categorised into three groups: early menarche (≤ 11 years), normal menarche (12–13 years)

and late menarche (≥ 14 years). The two categorical measures of age at menarche were cross-tabulated and agreement was assessed using κ . Logistic regression was used to examine whether there was an association between agreement (yes or no) between the two categorical measures of age at menarche and childhood and adult social class, education, gynaecological events and psychological symptoms. All data were analysed using Stata V.8.2.

Relevant ethics committee approval was obtained for this study.

RESULTS

Of the 946 women with a valid age at menarche at both measurement points, 412 (43.6%) had recalled exactly the same age at menarche (in years) at age 48 years as had been recorded during the medical examination at age 14–15 years (table 1). Overall, 195 (20.6%) women had recalled their age at menarche in middle age only 1 year higher than that recorded in adolescence, and a further 199 (21.0%) women had recalled their age at menarche 1 year younger, suggesting that there was no systematic under-reporting or over-reporting of age at menarche in middle age. The 95% limits of agreement were -2.19 to 2.15 years, indicating that 95% of women reported an age at menarche in middle age which differed by no more than 2.2 years in either direction from that recorded in adolescence. Pearson’s correlation coefficient (r) was 0.59 between the age at menarche reported in adolescence and that reported in middle age. In analyses including all 1050 women with ages at menarche at or above 14 years grouped together, 527 (50.2%) women had recalled the same age at menarche in completed years at age 48 years as had been recorded during the interview at age 14–15 years; $\kappa = 0.35$ ($p < 0.001$), which indicates fair agreement between the two measures.¹⁵ Pearson’s correlation coefficient was 0.66.

When age at menarche was grouped into three categories (≤ 11 , 12–13, ≥ 14 years), 685 (65.2%) women were assigned to the same category by both measures (table 2); $\kappa = 0.43$ ($p < 0.001$), which indicates moderate agreement.¹⁵

We found no association between childhood social class and agreement between the two categorical measures of age at menarche (table 3). In unadjusted analyses, there was greater agreement among the more educated women and women in the most advantaged social classes ($p = 0.03$ in both cases) compared with less educated women and women in the least advantaged social classes. The effect of adult

Table 2 Cross-tabulation of categories of age at menarche derived from ages of menarche ascertained during adolescence and in middle age in the Medical Research Council National Survey of Health and Development cohort (n = 1050)

Age at menarche (years), recorded at age 48 years	Age at menarche (years), recorded at age 14–15 years			Total
	≤ 11	12–13	≥ 14	
≤ 11	122 (71.3)*	144 (22.0)	2 (0.9)	268
12–13	45 (26.3)	386 (58.8)*	44 (19.7)	475
≥ 14	4 (2.3)	126 (19.2)	177 (79.4)*	307
Total	171 (100)	656 (100)	223 (100)	1050

*The two measures are in agreement. Values are n (%).

social class was attenuated after adjustment for education and childhood social class, whereas the effect of education remained on the borderline of conventional significance after mutual adjustment. The results given in table 3 include only those women with complete data on all three social and educational measures (n = 999); however, we found no difference in the findings from unadjusted analyses including the total available sample (results not shown).

We found no association between the psychological symptom score and agreement between the two categorical measures of age at menarche (results not shown), but found greater agreement among the women who had experienced a stillbirth or miscarriage than among those who had not (table 4). However, a similar association was not seen by hysterectomy and oophorectomy status. Adjusting for education did not change these findings.

The 1050 women included in the analyses were significantly more likely to have a higher adult social class and more formal educational qualifications than the 1497 women who were not included owing to death, refusal to participate, being abroad or lost to follow-up, or failing to answer both relevant questions (p = 0.001 and p < 0.001, respectively).

DISCUSSION

The results of this comparison suggest that there is at best only a moderate agreement between the two measures of age at menarche, one collected in adolescence and the other in middle age. When all the available data were included

(n = 1050) and age at menarche of ≥ 14 years was necessarily grouped, which we would expect to overestimate the true level of validity, the level of agreement (κ = 0.35) and the correlation (r = 0.66) between the two measures were only moderate. Our results therefore suggest that age at menarche self-reported in middle age is not very accurate. However, categorising age at menarche into three groups (early, normal and late) improved agreement (κ = 0.43). Agreement between the two measures of age at menarche was influenced by educational level and having experienced a stillbirth or miscarriage. Women who had a stillbirth or miscarriage might have had more reason to acquire accurate information as part of providing or understanding their gynaecological history.

Several studies have examined the validity of age at menarche reported retrospectively.^{8–11 16–19} The five studies with a length of recall similar to that considered in this study,^{8–11 16} all of which are American, have comparable results. In one study, age at menarche was accurately recalled by 59% of women (n = 160).¹⁰ In the other four studies, comparisons of recalled measures with prospective measures of age at menarche produced correlation coefficients of 0.60 (n = 143),¹⁵ 0.67 (n = 50),¹¹ 0.75 (n = 43)⁸ and 0.79 (n = 368).⁹ Differences in results between the studies could be attributable to several factors, including differences in the characteristics of the study populations, variation in the length of recall, differences in the method by which women were asked to recall age at menarche (ie, face-to-face

Table 3 Tests of the association between agreement and socioeconomic and education characteristics (n = 999)

Characteristic	Agreement between the two measures*		Unadjusted OR for agreement (95% CI), n = 999	p Value†	Adjusted OR for agreement‡ (95% CI), n = 999	p Value‡
	Yes, n = 657	No, n = 342				
Father's social class§						
I or II	167 (65.0)	90 (35.0)	1.00	0.89	1.00	0.28
III ^{NM} or III ^M	328 (65.6)	172 (34.4)	1.03 (0.75 to 1.41)		1.20 (0.86 to 1.68)	
IV or V	162 (66.9)	80 (33.1)	1.09 (0.75 to 1.58)		1.39 (0.92 to 2.08)	
Own social class in adulthood						
I or II	255 (70.1)	109 (30)	1.00	0.03	1.00	0.15
III ^{NM} or III ^M	292 (65.2)	156 (34.8)	0.80 (0.59 to 1.08)		0.83 (0.60 to 1.17)	
IV or V	110 (58.8)	77 (41.2)	0.61 (0.42 to 0.88)		0.66 (0.44 to 1.01)	
Highest educational attainment						
Degree or higher	42 (77.8)	12 (22.2)	1.00	0.03	1.00	0.06
Advanced secondary	161 (66.3)	82 (33.7)	0.56 (0.28 to 1.12)		0.56 (0.28 to 1.13)	
Ordinary secondary	191 (70.2)	81 (29.8)	0.67 (0.34 to 1.35)		0.71 (0.34 to 1.47)	
Below secondary	54 (57.5)	40 (42.6)	0.39 (0.18 to 0.83)		0.40 (0.18 to 0.91)	
None	209 (62.2)	127 (37.8)	0.47 (0.24 to 0.93)		0.50 (0.24 to 1.05)	

Agreement is when a woman is placed in the same age at menarche category (early, normal or late) by both measures.

*Values are n (%).

†p Value from likelihood ratio test.

‡Adjusted for the two other variables shown.

§According to the Registrar General's classification: III^{NM}, category III non-manual; III^M, category III manual.

Table 4 Tests of the association between agreement and gynaecological events (n = 1050)

Gynaecological event	Agreement between the two measures*		Unadjusted OR for agreement (95% CI)	p Value†
	Yes (n = 685)	No (n = 365)		
Ever had surgery to remove uterus or ovaries				
No	529 (66.5)	266 (33.5)	1.00	0.18
Yes (age <48 years)	106 (63.5)	61 (36.5)	0.89 (0.62 to 1.26)	
Yes (age ≥48 years)	50 (56.8)	38 (43.2)	0.65 (0.42 to 1.03)	
Ever had a stillbirth or miscarriage				
No	476 (63.4)	275 (36.6)	1.00	0.01
Yes	165 (72.4)	63 (27.6)	1.51 (1.09 to 2.10)	
Data missing	44 (62.0)	27 (38.0)	-	

Agreement is when a woman is placed in the same age at menarche category (early, normal or late) by both measures.

*Values are n (%).

†p Value from likelihood ratio test.

interview, postal questionnaire, supervised self-completed questionnaire) and whether the women were asked to recall their age at menarche in years or in years and months.

This study has several limitations as follows:

1. Age at menarche of 14–15 years reported during the medical interview was still subject to recall error because it was not collected at the time of the event.
2. A group of women had not reached menarche by the time of that interview.
3. The question on age at menarche posed in middle age asked women to report their age at menarche in years and hence we could not assess the validity of recall of a more precise timing of menarche (ie, by month and year).
4. Only 1050 women of the original female cohort were included in analyses. This sample was more educated and from a higher social class than those with missing data (n = 1497). The level of agreement in the general population may therefore be lower than our results suggest, given the need to group women with later ages of menarche together, and because of the association between educational level and accuracy of recall coupled with the over-representation of educated women in our responding sample of women in mid-life.
5. Although there was no evidence overall of systematic under-reporting or over-reporting of age at menarche in middle age, it appears from table 1 and basic analyses (results not shown) that women who in adolescence were recorded as having an age at menarche of 9 years are less likely to report an age at menarche in middle age that was in agreement than women who experienced a later age at menarche.
6. Women with an age at menarche of 9 or 10 years recorded in adolescence seem more likely to have over-reported age at menarche in middle age than other women. However, our study has insufficient power, because of the small number of women in this study with an age at menarche

What is already known

- Existing studies suggest that age at menarche recalled in adulthood is valid. However, these studies have several limitations, have not fully assessed the level of agreement and have not considered factors that may predict the accuracy of recall.

of 9 or 10 years, to test whether there are significant differences in levels of either over-reporting or under-reporting in middle age by age at menarche.

This study has three important strengths as follows.

1. We evaluated the validity of age at menarche recalled retrospectively using limits of agreement and κ as well as Pearson's correlation coefficient. Most other studies^{8 11 16} focus on only correlation coefficients, which are tests of association rather than of agreement.^{13 14}
2. We investigated factors that might influence the accuracy of recall of age at menarche, which no previous study has done.
3. Our results are likely to be more generalisable than those from other studies because of the larger sample size and the representativeness of the population from which the study sample is drawn.²⁰

The level of validity shown in this study throws some doubt on whether it is justifiable to use age at menarche in years self-reported in middle age in research or in a clinical setting to determine a woman's risk profile from which to estimate her risk of associated diseases. We suggest that categorising data will improve validity, although this may still be subject to bias by educational status and having had a stillbirth or miscarriage. When designing questionnaires that ask participants to recall the timing of events, researchers and clinicians should consider using methods (eg, comparison with peers) that may elicit more accurate responses than are gained by asking one simple question about timing.

We had expected that age at menarche, an event usually of some importance for women, would be accurately remembered. As it is not, our findings have wider implications for the validity of other measures in earlier life recalled retrospectively many years later.

What this paper adds

- Age at menarche recalled in middle age is only moderately valid and should be used with caution.
- Validity is improved by categorising age at menarche, but the measure is still subject to biases, as the accuracy of recall is influenced independently by educational attainment and experience of stillbirth and miscarriage.

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