

Temporal trends in age at menarche among Sri Lankan girls: A review of published evidence (1950–2009)

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Abstract

Mean age at menarche (MAM) is a sensitive biological indicator of childhood nutrition and broader socio-economic conditions of a population, and its decline over time is well documented in developed countries. Several studies have been conducted in Sri Lanka since 1950 to estimate the MAM in different regions, ethnic groups and socio-economic strata, but the published evidence has not previously been collated. PubMed, Google Scholar, ResearchGate and the Sri Lanka Journals Online platform were searched and primary Sri Lankan publications reporting MAM were retrieved for the period 1950 to 2009; no further primary Sri Lankan study reporting MAM after 2009 was identified. The review is therefore limited to publications from 1950 to 2009. Wilson and Sutherland (1950) reported MAM of 12.84 ± 0.07 years for Colombo urban girls and 14.39 ± 0.16 years for rural Ceylon. Studies between 1957 and 1976 reported MAM values between 12.9 and 14.7 years, the higher values being observed among disadvantaged tea estate populations of Nuwara Eliya. From 1984 onwards, probit-based estimates from Colombo declined progressively to 13.06 ± 0.18 years (Jayasekara and Goonewardene, 1987), 11.78 years in high socio-economic-status private schools in 1988 (Godawatta and Wikramanayake), 11.48 years in Ragama in 2008 (Abey Suriya et al.) and 11.20 years in Colombo and Kalutara in 2009 (Wickramasinghe et al.). Overall, MAM in Sri Lanka has fallen by approximately 1.5 to 2.0 years over six decades, paralleling secular declines reported from India, China, the United States and the United Kingdom. A nationally representative contemporary study using standardised methodology is overdue and is essential to inform adolescent reproductive health policy in Sri Lanka.

Keywords: mean age at menarche, secular trend, Sri Lanka, pubertal development, adolescent reproductive health

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Introduction

Menarche is the first menstrual bleed and represents the maturation of the hypothalamic–pituitary–ovarian axis along with the onset of reproductive capability in a woman. Beyond its clinical importance, mean age at menarche (MAM) is widely accepted as a sensitive indicator of childhood nutrition, infectious morbidity, body composition, psychosocial stress and broader socio-economic conditions of a population¹. MAM has also been correlated with later life risks of breast cancer, cardiovascular disease, type 2 diabetes and reproductive tract malignancies².

A secular decline in MAM has been documented in developed countries during the nineteenth and twentieth centuries, of the order of two to three months per decade, and is largely attributed to improvements in nutrition and child health³. Whether a similar trend has occurred in South Asian populations is less well established. Sri Lanka, with universal access to free health care and education, near complete eradication of malaria, sustained reductions in infant mortality and rising household incomes despite a relatively low per capita gross domestic product, is an instructive setting in which to study the secular trend in MAM.

Several studies have been conducted in Sri Lanka since 1950 to estimate the MAM in different regions, ethnic groups and socio-economic strata^{4–17}. The methods used have varied and the findings have not previously been collated in a single review for the obstetric and gynaecological community. This review summarises the published Sri Lankan data on MAM from 1950 to 2009, presents the temporal trend, and compares it with regional and global data.

Methods

PubMed, Google Scholar, ResearchGate and the Sri Lanka Journals Online (SLJOL) platform were searched for primary publications reporting MAM in girls or women resident in Ceylon or Sri Lanka. Search terms used were combinations of “Sri Lanka”, “Ceylon”, “menarche”, “puberty”, “adolescent” and “secular trend”. The search retrieved published data on MAM only for the period 1950 to 2009; no primary Sri Lankan study reporting MAM after 2009 was identified. The review is therefore limited to publications from 1950 to 2009. Studies not retrievable through indexed databases were obtained from university medical libraries and from institutional and professional-college archives in Sri Lanka.

For each included study, the following data were extracted: (i) year of data collection (where reported, otherwise, inferred from the publication date); (ii) sampling frame, ethnicity and socio-economic context; (iii) sample size; (iv) method of estimation; and (v) the reported mean or median MAM with its dispersion. Where a publication reported multiple sub-group estimates, all were captured. A narrative review approach was adopted, appropriate for a heterogeneous body of historical literature. Estimates obtained by probit analysis of status-quo data were used to construct the trend chart as they are less susceptible to recall bias compared to retrospective recall of MAM.

Results

Fourteen primary Sri Lankan publications reporting MAM between 1950 and 2009 were identified and are summarised in Table 1. The temporal trend is displayed in Figure 1, distinguishing studies that used probit / status-quo methodology, retrospective recall and longitudinal observation. The Sri Lankan trend in comparison with published data from neighbouring South Asian and selected non-Asian countries is shown in Figure 2.

Three observations emerge from the assembled data. Firstly, the earliest probit-based estimate from Colombo urban girls (12.84 ± 0.07 years) was already strikingly low for a 1950 South Asian population, and was 1.5 years lower than the corresponding value from rural Ceylon (14.39 ± 0.16 years)⁴. This urban–rural gap is the largest reported anywhere in the Sri Lankan literature and is likely to reflect a sample selection artefact – the Colombo sample was “racially mixed” and included Burghers of Dutch descent and middle class Tamils, whereas the rural cohort was a homogeneous low socio-economic Sinhalese sample^{8,11}.

Secondly, MAM estimates between 1957 and 1976 clustered between 12.9 and 14.7 years, the lowest values consistently observed among girls of higher socio-economic background in Colombo and the highest among Tamil children of the tea estates in Nuwara Eliya. The probit MAM of 14.7 years reported by Balasuriya and Fernando from Nuwara Eliya Tamils is one of the highest contemporaneous values reported anywhere in the world^{7–9,11}. These data emphasised the role of nutrition and socio-economic conditioning rather than ethnicity

Table 1. Sri Lankan studies on age at menarche, 1950–2009

Year of data	First author (publication year)	Setting / sample	n	Method	Reported MAM (years)
1950	Wilson & Sutherland (1950) ⁴	Colombo urban schools (mixed ethnicity)	844	Status-quo / probit	12.84 ± 0.07
1950	Wilson & Sutherland (1950) ⁴	Rural Ceylon (Sinhalese)	296	Status-quo / probit	14.39 ± 0.16
1952	Wilson & Sutherland (1953) ⁵	Same data, international comparison	1,140	Status-quo / probit	12.84 / 14.39
c. 1957	Arumugam & Jayewardene (1957)* ⁶	Colombo schoolgirls (routine medical inspection)	690	Recall	12.89 (Sinhalese 13.20; Tamil 13.03; Burgher 12.72; Muslim 12.61)
c. 1960	Chinnathamby (1962) ⁷	Antenatal / family planning clinics, Colombo and Jaffna (mixed)	5,223	Recall	13.39 ± 1.20
c. 1960	Chinnathamby (1962) ⁷	High income private schoolgirls, Colombo	1,000	Recall	12.40 ± 1.20
1968	David & Jayewardene (1974) ⁸	Thirteen schools in Colombo district	661	Status-quo / probit	13.72 ± 0.12 (cohort 14.20)
1976	Balasuriya & Fernando (1983) ⁹	Kandy, Nuwara Eliya and Jaffna schoolgirls	3,960	Recall + probit	Recall (overall by ethnicity): Sinhalese 13.5, Tamil 13.5. Probit (by district and ethnicity): Kandy Sinhalese 13.8, Kandy Tamil 13.9, Nuwara Eliya Sinhalese 14.2, Nuwara Eliya Tamil 14.7, Jaffna Tamil 14.0
1982–83	Rajapakse & Kodagoda (1984) ¹⁰	Longitudinal cohort, Colombo (predominantly Sinhalese)	406	Longitudinal	13.70 ± 1.30

(Continued)

Year of data	First author (publication year)	Setting / sample	n	Method	Reported MAM (years)
1981	Prakash & Pathmanathan (1984) ¹¹	Five Tamil schools in Jaffna town	333	Status-quo / probit	13.78 ± 0.07 (SD 1.01)
1984	Jayasekara & Goonewardene (1987) ¹²	Four Colombo schools (Sinhalese)	3,967	Status-quo / probit	13.06 ± 0.18
c. 1987	Godawatta & Wikramanayake (1988) ¹³	High fee private schools, Colombo (SBC + HFC)	1,834	Status-quo / probit	11.80 (Sinhalese 11.78; Tamil 11.89)
c. 1987	Godawatta & Wikramanayake (1988) ¹³	Hindu Ladies’ College, Colombo (state school)	177	Status-quo / probit	12.40 ± 0.14
c. 1987	Godawatta & Wikramanayake (1988) ¹³	Two state schools in Kadawata (Gampaha)	278	Status-quo / probit	13.01 ± 0.16
1988	Fernando & Balasuriya (1990) ¹⁴	Schoolgirls from 17 of 24 districts (goitre survey)	13,565	Recall	13.65 ± 1.42 (range 13.16–14.36 by district)
1989	Balasuriya (1990) ¹⁵	Hindagala field practice area, Kandy district (rural)	303	Recall	13.83 (1.71)
c. 2006	Abey Suriya, Salgado & Wickramasinghe (2008) ¹⁶	Four schools in Ragama MOH area	662	Status-quo / probit + recall	11.48 (probit); 12.53 (recall)
c. 2007	Wickramasinghe et al. (2009) ¹⁷	Sinhalese schoolgirls, Colombo and Kalutara districts	1,850	Status-quo / probit	11.20 ± 0.06

MAM = mean age at menarche; c = circa. Where the original publication used the term “mean” or “median” it is reproduced here. Year of data collection is the year of fieldwork where stated; otherwise it is approximated from contextual information in the publication. *Original 1957 publication was not directly consulted; the values shown are as reported by David and Jayewardene, 1974 (reference 8).

per se. Differences in MAM between Sinhalese, Tamil, Moor and Burgher girls within similar income strata were small and rarely statistically significant^{6,9,12}.

Thirdly, from the mid-1980s onwards, probit-based MAM estimates fell consistently. Jayasekara and Goonewardene’s 1984 Colombo Sinhalese sample (13.06 ± 0.18 years) was approximately two-thirds of a year earlier than David and Jayewardene’s

1968 Colombo estimate of 13.72 ± 0.12 years^{8,12}. Godawatta and Wikramanayake (1988) reported a remarkably low mean of 11.78–11.89 years in two high fee Colombo private schools, the lowest reported anywhere for South Asia at that time¹³. The two most recent studies, conducted in Ragama (2008) and the western coastal districts (2009), gave probit medians of 11.48 and 11.20 years respectively – values that would have been unthinkable in Sri Lanka half a century earlier^{16,17}.

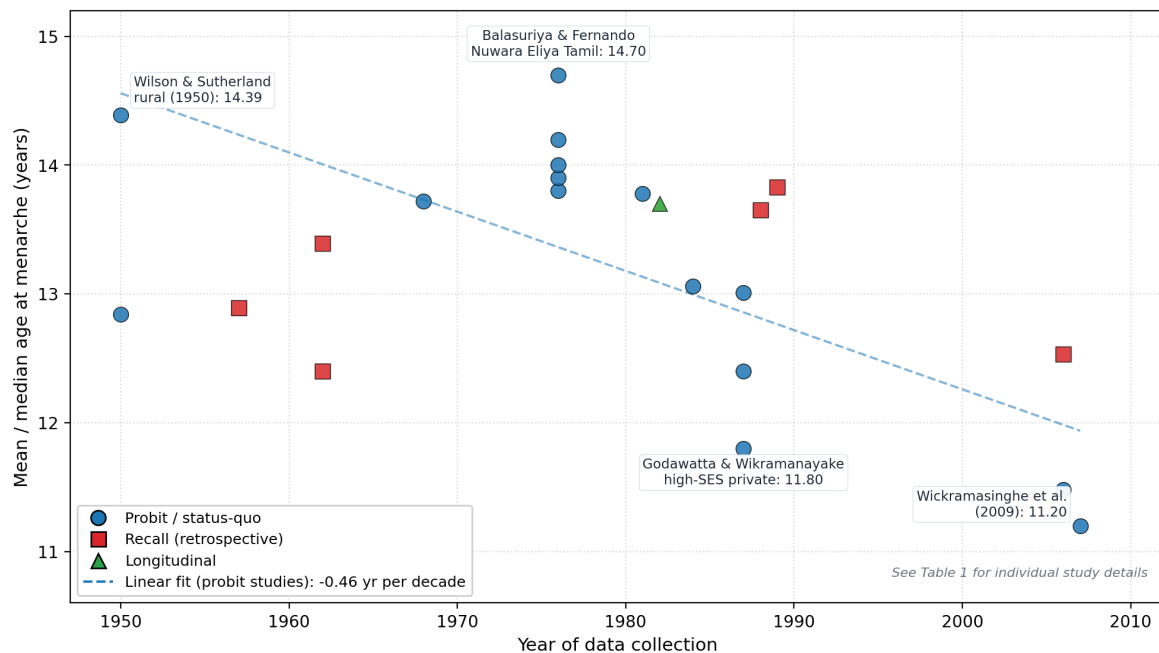


Figure 1. Temporal trend in age at menarche among Sri Lankan girls, 1950–2009.

Each marker represents a published Sri Lankan MAM estimate plotted against the year of data collection. Markers are colour- and shape-coded by method of estimation. The dashed line is the linear fit for probit-based estimates only; its slope corresponds to a decline of approximately 0.46 years (about five and a half months) per decade. Four narrative-critical extremes are labelled inline: the earliest rural estimate (Wilson and Sutherland, 1950), the highest estimate (Balasuriya and Fernando, Nuwara Eliya Tamil, 1976), the first markedly low probit estimate (Godawatta and Wikramanayake, high socio-economic-status private schools, 1987) and the most recent and lowest estimate (Wickramasinghe et al., 2009). Individual study details for every data point are listed in Table 1.

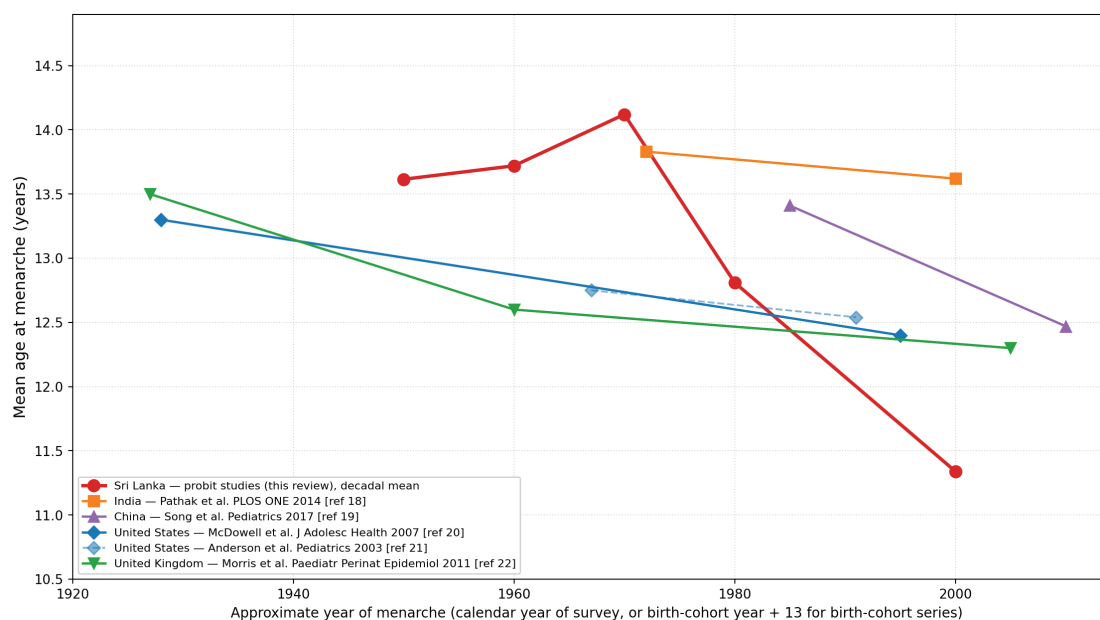


Figure 2. Sri Lankan trend in age at menarche compared with regional and global data.

Decadal means of probit-based Sri Lankan MAM estimates plotted alongside published values from named national-scale studies in India (Pathak et al.¹⁸), China (Song et al.¹⁹), the United States (McDowell et al.²⁰; Anderson et al.²¹) and the United Kingdom (Morris et al.²²). For studies that report MAM by birth cohort, the calendar year on the x-axis is the cohort midpoint + 13 years (an approximation of the year of menarche); for those that report by calendar year of survey (including the Sri Lankan series), the x-axis is the year of fieldwork. Sri Lankan values now lie close to – and at the most recent estimates beneath – contemporary South Asian and Western reference values.

Taken together, probit-based studies suggest an overall fall of approximately 1.5 to 2.0 years in MAM in Sri Lanka over six decades, equivalent to a decline of two-and-a-half to four months per decade overall and considerably faster in the most recent two decades. Recall-based studies are broadly consistent in direction but show a smaller decline, reflecting the well-recognised upward bias of retrospective recall in older populations^{8,9}.

Discussion

The published Sri Lankan literature shows that MAM has declined substantially since the middle of the twentieth century. The decline is most marked among urban and economically advantaged girls and parallels rapidly improving childhood conditions in the country: malaria was eradicated in the late 1960s, infant mortality fell from over 80 per 1,000 live births in 1950 to below 12 by the early 2000s, stunting in pre-school children was more than halved, and per capita energy intake rose substantially^{1,3,14}.

The Sri Lankan trend is in keeping with secular declines reported from other rapidly transitioning populations. Pathak et al. reported a decline in MAM among Indian women from 13.83 years in the 1955–64 birth cohort to 13.62 years in the 1985–89 cohort, equivalent to approximately one month per decade in nationally representative Indian Human Development Survey data¹⁸. Song et al. reported a fall in MAM in China from 13.41 years in 1985 to 12.47 years in 2010 (approximately 4.5 months per decade) in serial nationally representative surveys of schoolgirls aged 9–18 years¹⁹. NHANES and NHES based analyses in the United States reported a decline of MAM from approximately 12.75 years in 1963–70 to 12.54 years in 1988–94²¹ and to 12.4 years among women born in 1980–84²⁰. In the United Kingdom, the Breakthrough Generations Study traced a fall in MAM from 13.5 years in women born 1908–19 to 12.3 years in those born 1990–93²². A worldwide meta-analysis of breast bud (Tanner stage 2) attainment estimated a global decline of approximately three months per decade since 1977²³.

Several caveats need to be considered in interpreting these findings. Firstly, methodological heterogeneity remains the principal threat to direct comparison. Probit analysis of status-quo data gives systematically lower – and probably more accurate – estimates than retrospective recall, and recall estimates are themselves sensitive to the age range of the sample

and to the prevailing memory window^{8,16}. Secondly, none of the post-1990 Sri Lankan studies has been nationally representative; the published cluster of low MAM estimates from Ragama, Colombo and Kalutara may exaggerate the national trend if tea estate, dry zone and northern populations have not advanced at the same pace. Thirdly, secondary sexual development other than menarche has been little studied in Sri Lanka. The two most recent reports documented mean ages of breast bud appearance and adrenarche at 9 and 10 years respectively in coastal Western Province girls^{16,17}. If these findings are broadly representative, the implications for adolescent gynaecological consultation, school health services, mental health support and sex education are considerable.

Importantly, no further primary Sri Lankan estimate of MAM has been published since the report of Wickramasinghe et al. in 2009¹⁷. This fifteen year evidence gap is noteworthy in a country that has otherwise maintained a vigorous adolescent health research output, and it limits any inference about the most recent trajectory of MAM. Secular decline in MAM has continued through the 2010s in comparable populations internationally; whether Sri Lanka has followed the same trajectory or has plateaued in line with the slowing of decline reported from some high income settings cannot be determined from currently published data.

From a public health perspective, the trend has practical consequences. Earlier menarche lengthens the reproductive life span and is associated with a small but consistent increase in lifetime risk of breast cancer, type 2 diabetes and adverse cardio-metabolic outcomes^{1,2}. At a population level, a falling MAM should prompt a review of menstrual hygiene provision in primary schools, the age at which sex and relationships education is introduced and the legal age structure governing protection of adolescent girls. From a clinical gynaecological perspective, the assumption that a normal Sri Lankan girl menstruates first between her thirteenth and fourteenth birthdays – an assumption embedded in older textbooks of regional gynaecology – is no longer warranted. A contemporary normal range of approximately 10 to 15 years should be expected, with first menarche before 10 years and after 16 years warranting investigation.

The strengths of this review are its long historical reach (six decades of consecutive data) and the

inclusion of every primary Sri Lankan study that could be identified, irrespective of publication venue. The principal limitations follow from the narrative design: a formal systematic search of indexed databases with predefined inclusion and exclusion criteria was not undertaken, estimates were not pooled statistically, and study quality was not assessed using a standardised instrument. A planned next step is a formal systematic review and meta-regression incorporating unpublished data from the school health programme and the more recent Demographic and Health Survey datasets, and – most urgently – a fresh primary survey to fill the post-2009 evidence gap.

Conclusion

Over six decades of published Sri Lankan literature, the mean age at menarche has fallen by approximately 1.5 to 2.0 years, the pace of decline being accelerated since the 1980s. The most recent estimates are approaching – and in some sub-populations falling below – contemporary Western values. No primary Sri Lankan estimate of MAM has been published since 2009, and the most recent fifteen years of secular change in this important indicator remain unmeasured. A nationally representative, ethnically inclusive study using a standardised status-quo / probit methodology, supplemented by anthropometric and socio-economic data, is an area that needs to be explored and invested in to inform evidence-based adolescent reproductive health policy in Sri Lanka.

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