



TIMING OF MENARCHE IN RELATION TO PHYSICAL GROWTH PATTERNS AMONG GIRLS IN SUMBAWA ISLAND

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**ANIMAL BIOSCIENCES
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Bogor, August 2026

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SUMMARY

NINDA LUQYA NAKADIRA. Timing of Menarche in Relation to Physical Growth Patterns among Girls in Sumbawa Island. Supervised by KANTHI ARUM WIDAYATI and ENENG NUNUZ ROHMATULLAYALY.

Menarche is a key marker of girls sexual maturity and is closely linked to physical growth during puberty, which is influenced by genetic, environmental, and biocultural factors. Although studies on menarche and growth have been conducted in several Indonesian populations, information on the timing of menarche and physical growth is limited for girls in Sumbawa Island, which has ecological and social characteristics that differ from those of the larger islands in Indonesia. Therefore, this study aimed to characterize the timing of menarche in relation to physical growth patterns and to determine the influence of sociodemographic factors on physical growth among girls in Sumbawa Island. A cross-sectional study was conducted among 374 girls aged 6–20 years from Sumbawa Island, Indonesia. Menarche status was assessed using the status quo method, and median age at menarche was estimated using a generalized linear model (GLM) with a probit link. Age-specific growth curves for height, weight, body mass index (BMI), and percentage body fat (PBF) were constructed using the generalized additive model for location, scale, and shape (GAMLSS). The relationship between household income and physical growth indicators was evaluated using a GLM after adjusting for chronological age.

The estimated median age at menarche was 12.2 years. Peak height velocity occurred at 9.5 years of age, approximately 2.7 years before menarche, whereas peak weight velocity occurred at 11.2 years of age, approximately one year before menarche. Meanwhile, peak BMI velocity and peak body fat percentage (PBF) velocity occurred near the age of menarche, with both peaking at 12.5 years of age, approximately 0.3 years after menarche. At menarche, girls had reached a median height of 143.05 cm (92.9% of adult height), weight of 33.78 kg (69.7% of adult weight), BMI of 16.5 kg/m² (82.5% of adult BMI), and PBF of 21.32% (82.4% of adult PBF). Household income was positively associated with BMI but not significantly associated with height, weight, or PBF. These findings suggest that most linear growth occurs before menarche, while increases in body mass and adiposity continue after the onset of reproductive maturation. The observed relationship between menarche timing and physical growth patterns is consistent with the developmental framework of life history theory. The relatively early menarche observed in this population may be interpreted within the context of Sumbawa Island's semi-urban characteristics, whereas variation in physical growth patterns may be associated with environmental conditions and sociodemographic factors.

Keywords: Life History, Menarche, Physical growth, Sociodemographic factors, Sumbawa Island

RINGKASAN

NINDA LUQYA NAKADIRA. Waktu terjadinya menarke dalam kaitannya dengan pola pertumbuhan fisik pada anak perempuan di Pulau Sumbawa. Dibimbing oleh KANTHI ARUM WIDAYATI dan ENENG NUNUZ ROHMATULLAYALY.

Menarke merupakan salah satu penanda penting kematangan seksual pada perempuan dan berkaitan erat dengan pertumbuhan fisik selama masa pubertas, yang dipengaruhi oleh faktor genetik, lingkungan, dan biokultural. Meskipun penelitian mengenai menarke dan pertumbuhan telah dilakukan pada beberapa populasi di Indonesia, informasi mengenai waktu terjadinya menarke dan pola pertumbuhan fisik pada perempuan di Pulau Sumbawa masih terbatas, padahal wilayah ini memiliki karakteristik ekologis dan sosial yang berbeda dari pulau-pulau besar lainnya di Indonesia. Oleh karena itu, penelitian ini bertujuan untuk mengkarakterisasi waktu terjadinya menarke dalam kaitannya dengan pola pertumbuhan fisik serta menentukan pengaruh faktor sosiodemografi terhadap pertumbuhan fisik pada perempuan di Pulau Sumbawa. Penelitian dengan desain potong lintang dilakukan pada 374 perempuan berusia 6–20 tahun di Pulau Sumbawa, Indonesia. Status menarke ditentukan menggunakan metode status quo, sedangkan median usia menarke diestimasi menggunakan generalized linear model (GLM) dengan tautan probit. Kurva pertumbuhan berdasarkan usia untuk tinggi badan, berat badan, indeks massa tubuh (IMT), dan persentase lemak tubuh (PBF) dibentuk menggunakan generalized additive model for location, scale, and shape (GAMLSS). Hubungan antara pendapatan rumah tangga dan indikator pertumbuhan fisik dievaluasi menggunakan GLM dengan penyesuaian terhadap usia kronologis.

Estimasi median usia menarke adalah 12,2 tahun. Kecepatan pertumbuhan tinggi badan maksimum (peak height velocity/PHV) terjadi pada usia 9,5 tahun, sekitar 2,7 tahun sebelum menarke, sedangkan kecepatan pertumbuhan berat badan maksimum (peak weight velocity/PWV) terjadi pada usia 11,2 tahun, sekitar satu tahun sebelum menarke. Sementara itu, kecepatan pertumbuhan IMT dan persentase lemak tubuh (PBF) maksimum terjadi mendekati usia menarke, yaitu pada usia 12,5 tahun atau sekitar 0,3 tahun setelah menarke. Pada saat menarke, perempuan mencapai median tinggi badan 143,05 cm (92,9% dari tinggi badan dewasa), berat badan 33,78 kg (69,7% dari berat badan dewasa), IMT 16,5 kg/m² (82,5% dari IMT dewasa), dan PBF 21,32% (82,4% dari PBF dewasa). Pendapatan rumah tangga berhubungan positif dengan IMT, tetapi tidak berhubungan secara signifikan dengan tinggi badan, berat badan, maupun PBF. Temuan ini menunjukkan bahwa sebagian besar pertumbuhan linear berlangsung sebelum menarke, sedangkan peningkatan massa tubuh dan adipositas berlanjut setelah dimulainya kematangan reproduktif. Hubungan yang diamati antara waktu terjadinya menarke dan pola pertumbuhan fisik sejalan dengan kerangka

perkembangan dalam teori life history. Usia menarke yang relatif dini pada populasi ini dapat dipahami dalam konteks karakteristik Pulau Sumbawa yang bersifat semi-perkotaan, sedangkan variasi pola pertumbuhan fisik dapat berkaitan dengan kondisi lingkungan dan faktor sosiodemografi.

Kata kunci: *Life History*, Menarke, Pertumbuhan fisik, Faktor sosiodemografi, Pulau Sumbawa

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TIMING OF MENARCHE IN RELATION TO PHYSICAL GROWTH PATTERNS AMONG GIRLS IN SUMBAWA ISLAND

NINDA LUQYA NAKADIRA

Thesis
Submitted in partial fulfillment of the requirements for a
Master's Degree
in
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**ANIMAL BIOSCIENCES
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TABLE OF CONTENTS

TABLE OF CONTENTS	x
LIST OF TABLES	xi
LIST OF FIGURES	xi
I INTRODUCTION	1
1.1 Bacround	1
1.2 Problem Steatment	2
1.3 Aims of The Study	2
1.4 Benefits of the Study	3
1.5 Research Framework	3
II LITERATURE REVIEW	5
2.1 Puberty	5
2.2 Menarche	5
2.3 Physical Growth	6
2.4 Factors Influencing Menarche and Physical Growth	6
2.5 Research Related to the Timing of Menarche and Physical Growth	7
2.6 Life History	8
2.7 Sumbawa Island	9
III METHODS	10
3.1 Time and Location of the Study	10
3.2 Ethics	10
3.3 Respondents	10
3.4 Data Collection	10
3.5 Statistical analysis	11
IV RESULTS AND DISCUSSION	13
4.1 Results	13
4.2 Discussion	19
V CONCLUSION AND SUGGESTION	22
5.1 Conclusion	22
5.2 Suggestion	22
REFERENCES	24
APPENDIX	28
CURRICULUM VITAE	33

LIST OF TABLES

1. Sociodemographics characteristics of the respondents	13
2. Association of sociodemographic factors with body height using a generalized linear model (GLM)	17
3. Association of sociodemographic factors with body weight using a generalized linear model (GLM)	17
4. Association of sociodemographic factors with body mass index (BMI) using a generalized linear model (GLM)	18
5. Association of sociodemographic factors with percentage body fat (PBF) using a generalized linear model (GLM)	18

LIST OF FIGURES

1. Research framework of the study	4
2. Average age curves for menarche in the Sumbawa Island population	14
3. Association between menarche and body height among girls in Sumbawa Island population	15
4. Association between menarche and body weight among girls in Sumbawa Island population	15
5. Association between menarche and body mass index (BMI) among girls in Sumbawa Island population	16
6. Association between menarche and percentage body fat (PBF) among girls in Sumbawa Island population	16