

# Psychosocial Stress, Cortisol and Growth Hormone Levels among Stunting Adolescent of Minangkabau Ethnicity in West Sumatera Province, Indonesia: A School-Based Study

\*Masrul<sup>1</sup>, Nur Indrawati Lipoeto<sup>1</sup>, Amel Yanis<sup>2</sup>, Idral Purnakarya<sup>3</sup>, Ikhwan Resmala Sudji<sup>4</sup>, Ricvan Dana Nindrea<sup>5</sup>

<sup>1</sup>Department of Nutrition, Faculty of Medicine, Universitas Andalas, Padang City Indonesia.

<sup>2</sup>Department of Psychiatry, Faculty of Medicine, Universitas Andalas, Padang City Indonesia.

<sup>3</sup>Department of Nutrition, Faculty of Public Health, Universitas Andalas, Padang City, Indonesia.

<sup>4</sup>Biomedical Laboratory, Faculty of Medicine, Universitas Andalas, Padang City Indonesia.

<sup>5</sup>Department of Public Health and Community Medicine, Faculty of Medicine, Universitas Andalas, Padang City Indonesia.

**Corresponding Author:** Masrul

Department of Nutrition, Faculty of Medicine, Universitas Andalas, Padang City, Indonesia.

**E-mail:** [masrulmuchtart@med.unand.ac.id](mailto:masrulmuchtart@med.unand.ac.id)

## ABSTRACT

This study was performed to determine psychosocial stress, cortisol, and growth hormone levels among stunting adolescents of Minangkabau ethnicity in West Sumatera Province, Indonesia based on a school study. This study was a case-control study design. This research was conducted at several senior high schools in Padang City, which is the sub-urban area of Padang city. The study sample was stunting adolescents aged 16-18 years Minangkabau ethnicity Padang City. Cases and control groups matched age and sex. The study sample consists of 42 cases group and 42 control group. Sampling technique with proportional random sampling. Data collection for the first time started with screening to determine cases in selected senior high school. Degrees of stress assessment were obtained using interviews. The diet was obtained by a semi-quantitative food frequency questionnaire (SQ-FFQ). Anthropometry by measured height used microtoise. Growth hormone and cortisol hormone measurement used the ELISA technique. Data analysis used the chi-square test and Mann-Whitney test. P-value < 0.05 was considered as a statistically significant association. Finally, data were collected and analyzed by *GraphPad Prism 7.00* program. There was no significant association of psychosocial stress with stunting adolescents of Minangkabau ethnicity. Psychosocial stress indicator happened among stunting adolescent was emotional, data showed more than half respondents between cases and control groups occurred. The median of cortisol and growth hormone levels in stunting adolescents 12.74 µg/dl and 0.52 ng/ml higher than the control group were 10.26 µg/dl and 0.26 ng/ml. But there was no significant difference in cortisol and hGH levels among stunting adolescents of Minangkabau ethnicity. Our study confirmed psychosocial stress indicator that happened among stunting adolescents was emotional. Cortisol and growth hormone levels were found higher in stunting adolescents.

**Keywords:** Physicosocial Stress; Cortisol; Growth Hormone; Stunting

## Correspondence:

Masrul

Department of Nutrition, Faculty of Medicine, Universitas Andalas, Padang City, Indonesia.

**E-mail:** [masrulmuchtart@med.unand.ac.id](mailto:masrulmuchtart@med.unand.ac.id)

## INTRODUCTION

Stunting is still the main problem in the development of Indonesian children. Data known stunting is still high and highest in Southeast Asia at 30,8%. West Sumatera is one of the province in Indonesia, that had stunting were 32%. This data showed stunting prevalence above national prevalence [1]. Stunting is a problem in the health sector because it has an impact on the education, health, social, economic community, and lifestyle of the nation. Stunting can cause mortality and morbidity. Physical work disorders, mental functions, and intellectuals were stunting impact [2].

Adolescents are the risk groups of stunting because at this age adolescents are in pursuit of Growth Spurt II [3]. Special attention is very important given because they are the most age group and the next generation. Data showed an increase in the prevalence of stunting in adolescents from 31.2% to 31.4% with an increase in severe stunting from 7.2% to 7.5% [1].

The World Health Organization (WHO) suggests that stunting is influenced by biological determinants. Two factors influence growth, namely internal factors, and external factors. Internal factors include genetic, obstetric, and sex while external factors are environment,

diet, physical activity, smoking habits, and disease. Stunting is not only caused by one factor but is caused by many factors, which are related to each other [4].

One genetic factor that is closely related to stunting is the human growth hormone (hGH). This hormone is responsible for the growth process in the body. This gene abnormality will cause growth hormone deficiency which will affect the inhibition of height growth, low growth speed, late puberty, increased amount of fat around the waist, delayed development of teeth, and decreased Intelligence Questions (IQ) levels.

This growth hormone level is very strong with the cortisol hormone. Increased levels of the cortisol hormone will suppress the expression of this gene, so it will also inhibit growth. The hormone cortisol is a hormone released from the adrenal gland when the body experiences stress. This hormone is a catabolic hormone because it can cause changes in the body's metabolic processes. High levels of cortisol in the blood as an effect of excessive and long-term stress will reduce plasma growth hormone levels [5].

The development of the era resulted in excessive psychosocial burden and poor management of stress due to improper parenting often triggered stress conditions in

this age group. These are factors that are thought to be factors associated with the incidence of stunting in adolescents [6]. This study aims to determine psychosocial stress, cortisol, and growth hormone levels among adolescents of Minangkabau ethnicity. The results of this study will provide information about the stress level of adolescents in Padang and whether this stress is one of the causes of stunting in Padang adolescents. This information will be the basis for developing a more specific program in the identification and treatment of adolescents stunting in Padang so that they can return to normal and healthy adolescents.

**MATERIALS AND METHODS**

*Study design and research sample*

This study was a case-control study design. This research was conducted at several senior high schools in Padang City, which is the sub-urban area of Padang city West Sumatera, Indonesia. The study sample was stunting adolescents aged 16-18 years Minangkabau ethnicity Padang City. Cases and control groups matched age and sex. The study sample consists of 42 cases group and 42 control group. Sampling technique with proportional random sampling. Inclusion criteria is a Z-score of -2 standard deviation. Exclusion criteria: (a) not presented in the data collection process, (b) have a chronic disease, (c) physical disability, (e) not taking a similar multivitamin-mineral supplement

*Operational definitions*

The variables of this study consisted of three independent variables, (a) psychosocial stress, b) cortisol, c) growth

hormone levels, and a dependent variable, i.e. stunting adolescent of Minangkabau ethnicity.

*Data collection technique*

In this study, informed consent was prepared to protect respondents and researchers when carrying out research. This study was approved by the Ethics Commission of the Faculty of Medicine, Universitas Andalas. Data collection for the first time started with screening to determine cases in selected senior high school. Degrees of stress assessment were obtained using interviews. The diet was obtained by a semi-quantitative food frequency questionnaire (SQ-FFQ). Anthropometry by measured height used microtoise. hGH and cortisol hormone measurement used the ELISA technique.

*Data analysis*

Data analysis was conducted to get frequency and percentage for characteristic respondents psychosocial stress and stunting adolescents. Central tendency (mean, standard deviation, and median) for cortisol and growth hormone levels. The bivariate analysis used the chi-square test and Mann-Whitney test. P-value < 0.05 was considered as a statistically significant association. Finally, data were collected and analyzed by *GraphPad Prism 7.00* program.

**RESULTS**

Out of 84 subjects, more than half of the respondents in cases and control groups were female and had high mother's educational level. More than half of respondents in the case group had low father's educational level but in the control group only less than half respondents. Characteristics of respondents (Table 1).

**Table 1:** Characteristics of respondents

Variables	Cases (n=42) (f/%)	Control (n=42) (f/%)	p-value
Sex			0.247
Male	11 (26.2)	17 (40.5)	
Female	31 (73.8)	25 (59.5)	
Mother's educational level			0.479
Low	15 (35.7)	11 (26.2)	
High	27 (64.3)	31 (73.8)	
Father's educational level			0.028*
Low	21 (58.3)	13 (31.0)	
High	15 (41.7)	29 (69.0)	

\* significant, p<0.05

Table 1 known there was no significant association between sex and mother's educational level with stunting adolescents of Minangkabau ethnicity (p>0.05). Father's educational level was associated with stunting

adolescents of Minangkabau ethnicity, West Sumatera Province Indonesia (p<0.05).

Association of psychosocial stress with stunting adolescents of Minangkabau ethnicity West Sumatera Province Indonesia (Table 2).

**Table 2:** Association of psychosocial stress with stunting adolescent of Minangkabau ethnicity West Sumatera Province Indonesia

Psychosocial Stress	Cases (n=42) f/%	Control (n=42) f/%	p-value
Low level	28 (66.7)	31 (73.8)	0.536
Moderate level	11 (26.2)	10 (23.8)	
High level	3 (7.1)	1 (2.4)	

\* significant, p<0.05

Table 2 known more than half of respondents between cases (66.7%) and control (73.8%) groups had low-level psychosocial stress. There was no significant association of psychosocial stress with stunting adolescents of

Minangkabau ethnicity (p>0.05). Association of psychosocial stress indicators with stunting adolescents of Minangkabau ethnicity West Sumatera Province Indonesia (Table 3).

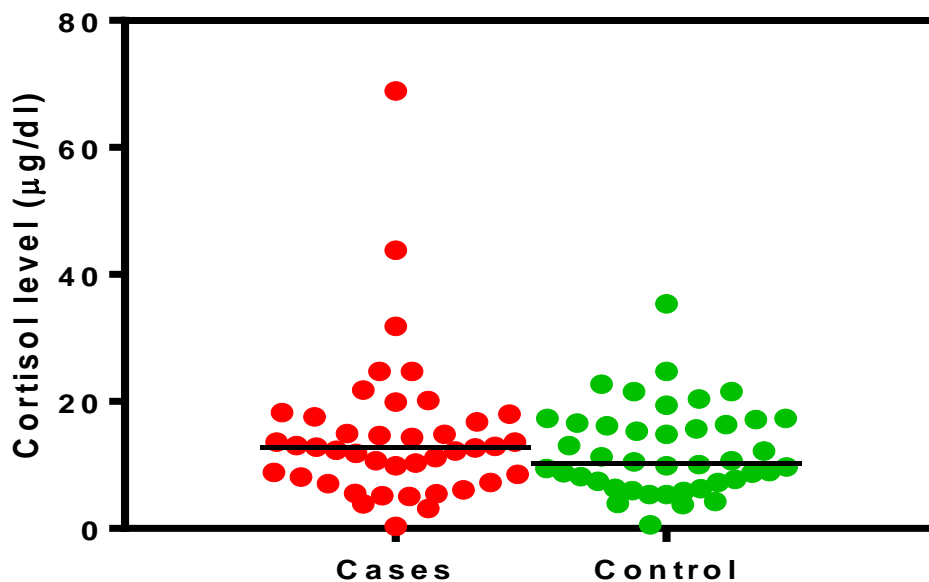
**Table 3:** Association of psychosocial stress indicators with stunting adolescent of Minangkabau ethnicity West Sumatera Province Indonesia

Psychosocial Stress Indicators	Cases (n=42) f/%	Control (n=42) f/%	p-value
Emotional			0.880
Abnormal	26 (61.9)	28 (66.7)	
borderline	4 (9.5)	4 (9.5)	
Normal	12 (28.6)	10 (23.8)	
Conduct problem			0.870
Abnormal	2 (4.8)	3 (7.1)	
Borderline	7 (16.7)	6 (14.3)	
Normal	33 (78.6)	33 (78.6)	
Hyperactivity			0.540
Abnormal	15 (35.7)	15 (35.7)	
Borderline	9 (21.4)	13 (31.0)	
Normal	18 (42.9)	14 (33.3)	
Peer relationship problems			0.291
Abnormal	12 (28.6)	8 (19.0)	
Borderline	22 (52.4)	29 (69.1)	
Normal	8 (19.0)	5 (11.9)	
Prosocial behavior			0.608
Borderline	3 (7.1)	1 (2.4)	
Normal	39 (92.9)	41 (97.6)	

\* significant, p<0.05

Table 3 known psychosocial stress indicators happened among stunting adolescent was emotional, data showed more than half respondents between cases and control groups occurred. There was no significant association of emotional, conduct problem, hyperactivity, peer

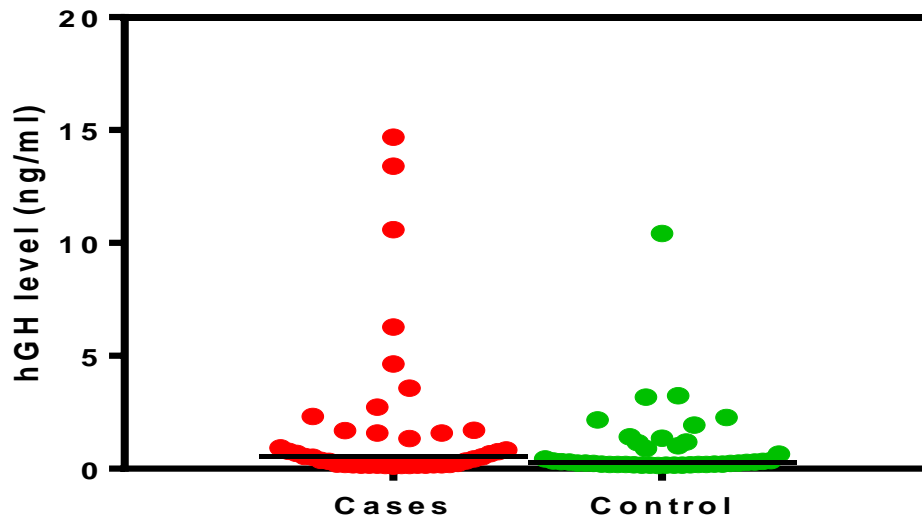
relationship problems, and prosocial behavior with stunting adolescents of Minangkabau ethnicity (p>0.05). Mean difference of cortisol levels among stunting adolescents of Minangkabau Ethnicity West Sumatera Province Indonesia (Figure 1).



**Figure 1:** Mean difference of cortisol levels among stunting adolescent of Minangkabau Ethnicity West Sumatera Province Indonesia

Figure 1 known median of cortisol level in stunting adolescent 12.74 µg/dl higher than control group were 10.26 µg/dl. But there was no significant difference in cortisol levels among stunting adolescents of

Minangkabau ethnicity (p>0.05). Mean difference of hGH levels among stunting adolescents of Minangkabau ethnicity West Sumatera Province Indonesia (Figure 2).



**Figure 2:** Mean difference of hGH levels among stunting adolescent of Minangkabau ethnicity West Sumatera Province Indonesia

Figure 2 known median of hGH level in stunting adolescent 0.52 ng/ml higher than control group were 0.26 ng/ml. But there was no significant difference in hGH levels among stunting adolescents of Minangkabau ethnicity West Sumatera Province Indonesia ( $p > 0.05$ ).

#### DISCUSSION

There was no significant association of psychosocial stress with stunting adolescents of Minangkabau ethnicity West Sumatera Province Indonesia. Psychosocial stress indicator happened among stunting adolescent was emotional, data showed more than half respondents between cases and control groups occurred. In a previous study known from the measurement of psychosocial stress's score, there were 61.2% in a non-stress condition, while the other was on stress at a different level. The statistical test showed that there was no relationship between psychosocial stress and nutritional status [7]. This study supported the result of the study researcher found. But another study showed there was a correlation between psychosocial stress with nutritional status [8], [9]. Growth retardation is associated with alterations in stress-sensitive systems. Besides, the stunted children were less happy, more inhibited, and more frustrated during the psychological tests than non stunted children [10].

There were no significant associations between psychosocial stress and the incidence of stunting in this study due to internal and external factors of the study. Explanation of research time is illustrated by the short time of observation and the limited number of respondents. Ideally, the research to look at stress factors is carried out in a long time, namely by the cohort method, because the cohort method is the best method of knowing the incidence and exposure to the effects of study. Based on the working mechanism of stress, the cohort method is more appropriate, considering that not all individuals exposed to stressors will experience stress and the stunting impact could be known clearly.

The median of cortisol and hGH in stunting adolescents 12.74  $\mu\text{g}/\text{dl}$  and 0.52 ng/ml higher than the control group

were 10.26  $\mu\text{g}/\text{dl}$  and 0.26 ng/ml. But there was no significant difference in cortisol and hGH levels among stunting adolescents of Minangkabau ethnicity. The genetic factor of stunting is derived, one of which is the hGH gene. This gene is responsible for the synthesis of growth hormones in the body. hGH gene is a gene that is associated with the incidence of stunting. Mutations in this gene will cause gene expression to decrease, that's GH production will decrease. Most GH type 1 gene mutations will cause a deficiency of the GH type II hormone, where mutations occur in the intron section 3. Mutations cause a slowdown in growth and cause stunting. The results of the studies that researcher found a median of cortisol and hGH in stunting higher than the control group but statistically not any significant [11], [12].

These findings suggest that the physiologic differences in psychosocial stress that we report here were linked directly to growth retardation [13], [14]. The changes to the stress systems may be associated with concurrent stunting, but because stunting usually occurs in the first 5 years of life, it is likely that the insult probably occurred in early childhood and persisted [15]. Thus, children with increased cortisol and hGH secretion may be at higher risk of growth failure. Future work should address the issue of pre and postnatal growth retardation, thus allowing better differentiation and thereby disentanglement of the specific consequences of stunting during various phases of life. We cannot found strong claims about the cortisol and hGH mechanisms for stunting adolescents at work here, and further work is necessary to understand the complexities of these mechanisms.

#### CONCLUSION

This study confirmed psychosocial stress indicator happened among stunting adolescent was emotional. Cortisol and hGH levels were found higher in stunting adolescents.

#### ACKNOWLEDGMENTS

The authors would like to thank Riyani Betri Novialita, B.Sc for translating and all participants in this research.

#### SOURCE OF FUNDING

This study was a part of implementation in grant accelerated research to professor project supported by Universitas Andalas, Padang, Indonesia.

#### CONFLICT OF INTEREST

The authors declared no potential conflicts of interest.

#### REFERENCES

1. Ministry of Health Republic of Indonesia. Basic Health Research. Ministry of Health Republic of Indonesia. Jakarta. 2013.
2. Zottarelli LK, Sunil TS, Rajaram S. Influence of parental and socioeconomic factors on stunting in children under 5 years in Egypt. *East Mediterr Health J.* 2007;13(6): 1330-42.
3. Reinecke M, Björnsson BT, Dickhoff WW, McCormick SD, Navarro I, Power DM, Gutiérrez J. Growth hormone and insulin-like growth factors in fish: where we are and where to go. *Gen Comp Endocrinol.* 2005;142(1-2):20-4.
4. Subramanian SV, Mejia-Guevara I, Krishna A. Rethinking policy perspectives on childhood stunting: time to formulate a structural and multifactorial strategy. *Matern Child Nutr.* 2016;12:219-36.
5. Säwendahl L. The effect of acute and chronic stress on growth. *Sci Signal.* 2012. 5(247): pt9.
6. Aly GS, Shaalan AH, Mattar MK, Ahmed HH, Zaki ME, Abdallah HR. Oxidative stress status in nutritionally stunted children. *Egyptian Pediatric Association Gazette.* 2014; 62(1): 28-33.
7. Mutiara TL, Wirasto RT, Huriyati E. Status stress psikososial dan hubungannya dengan status gizi siswa SMP Stella Duce 1 Yogyakarta. *Jurnal Gizi Klinik Indonesia.* 2010; 6(3): 138-44.
8. Goodman, Elizabeth, Robert C, Whitaker A. Prospective study of the role of depression in the development and persistence of adolescents obesity. *Pediatr.* 2002; 110(3): 497-504.
9. O'Connor DB, O'Connor RC. Perceived changes in food intake in response to stress: the role of conscientiousness. *Cell Biochem Funct.* 2004; 20(5): 279.
10. Yada T, Muto K, Azuma T, Hyodo S, Schreck CB. Cortisol stimulates growth hormone gene expression in rainbow trout leucocytes in vitro. *Gen Comp Endocrinol.* 2005;142(1-2):248-55.
11. Fernald LC, Grantham-McGregor SM. Growth retardation is associated with changes in the stress response system and behavior in school-aged jamaican children. *J Nutr.* 2002;132(12):3674-9.
12. Mullis PE, Akinci A, Kanaka C, Eblé A, Brook CG. Prevalence of human growth hormone-1 gene deletions among patients with isolated growth hormone deficiency from different populations. *Pediatr Res.* 1992;31(5):532-4.
13. Nindrea RD, Sari NP, Harahap WA, Haryono SJ, Kusnanto H, Dwiprahasto I, Lazuardi L, Aryandono T. Survey data of COVID-19 awareness, knowledge, preparedness and related behaviors among breast cancer patients in Indonesia. *Data Brief.* 2020;32:106145.
14. Lipoeto NI, Masrul, Nindrea RD. Nutritional contributors to maternal anemia in Indonesia: Chronic energy deficiency and micronutrients. *Asia Pac J Clin Nutr.* 2020;29(Suppl 1):S9-S17.
15. Masrul M, Usman E, Yanis A, Nindrea RD. Scoring System in Prediction of Stunting Risk Among Children in West Sumatera Province, Indonesia. *Sys Rev Pharm.* 2020; 11(9): 636-641.