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# THE CORRELATION BETWEEN FOOD INSECURITY LEVEL AND STUNTING IN INDONESIA

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## *ABSTRACT*

*Indonesia is among the five countries with the highest burden of stunting. Food insecurity reflecting the availability of food in the household is one of the indirect causes of undernutrition. This study examines the relationship between food insecurity and stunting in Indonesia. We used data from the 2021 Indonesian Nutrition Status Survey (SSGI) with a sample size of 82,777 under-five children selected using multistage random sampling. The relationship between food insecurity and stunting was calculated using cox regression to obtain crude and adjusted prevalence ratios (PR) considering strata and weights. Children from households with moderate food insecurity had a (PR unadj) 1.24 (1,18 – 1,31) times higher risk of stunting, and the risk rose in households with severe food insecurity (PR unadj) 1.39 (1,27 – 1,53). Subgroup analysis based on regional categories showed that the association between food insecurity and stunting was only significant in rural areas. Children in rural regions who experienced moderate food insecurity had a 1.09 (95% CI 1.02-1.16) times greater risk of stunting and an increased risk of 1.15 times (95% CI 1.03 – 1.28) in households with severe food insecurity. Interventions are needed to prevent stunting by improving household food security, particularly in rural areas. Further research is needed with better study designs to prove a causal relationship between food insecurity and stunting.*

***Keywords****: food insecurity, stunting, children under five years*

## ABSTRAK

Prevalensi stunting di Indonesia masih cukup tinggi bahkan masuk dalam lima besar kasus stunting di dunia. Kerawanan pangan menjadi cerminan dari ketersediaan pangan dalam rumah tangga merupakan salah satu penyebab tidak langsung dari permasalahan gizi. Tujuan dari studi ini untuk melihat hubungan tingkat kerawanan pangan dengan kejadian stunting di Indonesia. Studi ini menggunakan data Survei Status Gizi Indonesia (SSGI) tahun 2021 dengan besar sampel 82.777 responden yang dipilih dengan cara *multistage random samping.* Hubungan antara kerawanan pangan dengan stunting dihitung menggunakan rasio prevalens baik *crude* maupun *adjusted* dengan menggunakan *cox regression* dengan tingkat kepercayaan 95% dan menggunakan *complex sample* untuk mempertimbangkan strata dan bobot. Hasil studi menunjukkan balita dari keluarga rawan pangan sedang memiliki risiko (PR unadj) 1,24 (1,18 – 1,31)kali lebih tinggi untuk mengalami stunting dan meningkat risikonya pada keluarga rawan pangan berat (PR unadj) 1,39 (1,27 – 1,53). Namun, jika kita lakukan analisis subgroup berdasarkan kategori wilayah ternyata hubungan kerawanan pangan terhadap stunting hanya terlihat signifikan di wilayah perdesaan. Di wilayah perdesaan, balita dari keluarga rawan pangan sedang memiliki risiko (PR adj)1,09 (95% CI 1,022 – 1,160) kali lebih tinggi untuk mengalami stunting dan meningkat risikonya 1,15 kali (95% CI 1,035 – 1,277) pada keluarga rawan pangan berat. Dapat disimpukan bahwa kerawanan pangan berhubungan dengan stunting terutama pada wilayah perdesaan. Dibutuhkan penelitian lebih lanjut dengan desain studi yang lebih baik untuk membuktikan hubungan kausal antara kerawanan pangan dengan stunting.

**Kata kunci** : kerawanan pangan, stunting, balita, status gizi

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## Introduction

Stunting still becomes a health problem in the world, and it is one of the most significant obstacles to human development, affecting around 162 million children globally.[1] Global Health Observatory data showed that around 150 million children under five were stunted, or around 21.9%. In line with the global public health priority agenda, it is hoped that the prevalence of stunting will decrease in 2030 to 17.5%.[2] The problem of stunting is experienced by most poor children and developing countries like Indonesia.[3] The prevalence of stunting in Indonesia is still quite high, even in the top five cases of stunting in the world. Indonesia's position is only better than India, China, Nigeria, and Pakistan.[4] The stunting rate in Indonesia continues to decline from 37.8% in 2013 to 31% in 2018, and the latest data for 2021 shows the stunting rate has fallen to 24.4%.[5,6] Even though in Indonesia there has been a decrease in the prevalence of stunting by 13.4% from 2013 to 2021, stunting is still one of the focuses of the problem because this figure is still below the WHO stunting case standard of 20 percent[7] and Indonesia is targeting to reduce the stunting rate to 14% by 2024.[8]

Stunting during childhood can result in negative health effects throughout life, including high morbidity and mortality, such as life-threatening complications during childbirth, increased infant mortality, decreased cognitive performance and development, increased risk of infection, poor psychomotor development, a decline in school performance, poor intellectual intelligence (IQ), the emergence of chronic diseases, decreased productive capacity as adults, and can affect the loss of economic growth and social development of the country.[9] The magnitude of the impact of stunting is one of the reasons why stunting must be addressed immediately both in Indonesia and at the global level.

Several factors cause children to become malnourished, including stunting, inappropriate feeding practices and behavior, and inadequate intake of micronutrients.[10] Other influential factor in developing countries includes low maternal education [11], household structure [12], household economic shocks, inadequate ANC, low birth weight, short birth spacing, living in rural areas, and poor access to health services. Some of these factors are the root cause of poverty. Malnutrition is the result of various factors, most of which are caused by unfavorable socio-economic conditions, such as difficulty obtaining food, food insecurity, high unemployment, which determines unstable income for the breadwinner of the family, limited access to education and health services, or diseases that caused by unsanitary conditions.[13] At the household level, food insecurity is associated with low socioeconomic status, inadequate food intake, and poor nutritional status. Low household socioeconomic status has characteristics such as low monthly income, low per capita

income, low education level, large household size, unemployment among adults, single female head of household, and contracted residence status.[14,15 ,16]

Data from Central Statistics Agency *(BPS)* showed that the prevalence of people with moderate or severe food insecurity based on the experience of food insecurity scale (FIES) continues to decline from 5.42% in 2019 to 4.79% in 2021.[17] At the household level, food insecurity is closely related to low socioeconomic status, inadequate food intake, poverty, and nutritional status.[14] The results of a study in Surabaya show that in children aged 2-5 years, food insecurity is closely related to the risk of stunting at mild, moderate, and severe levels. Children from families with mild food insecurity are at risk of 1,687, moderate 1,562, and severe 2,005 times to experience stunting.[18] According to Tiwari et al., 2014, family food insecurity was strongly associated with stunting at both the light and severe food insecurity levels in children aged 0 to 59 months and 0 to 23 months. This showed that household food insecurity was significantly related to stunting in preschool children.[19]

Studies on the relationship between food insecurity and stunting still show inconsistent results, although most show a positive relationship. Studies in Indonesia are utilizing large survey data where national representation on this matter has not been carried out much, so this study is important to do. This study aims to determine the relationship between the level of food insecurity and stunting in children aged 0-59 months, representing results at the national level.

## Methods

This research analyzed the secondary data from the 2021 Indonesian Nutrition Status Survey (*SSGI*). The *SSGI* of 2021 collected information on nutritional status and other indicators of children's health. The sampling method was carried out by multistage random sampling. *SSGI* 2021 was carried out in two stages; the first was to estimate the provincial level, and the second was to estimate the district level. This research only used the first stage of *SSGI* 2021, where the questionnaire included complete information. The first phase of the *SSGI* 2021 sample consisted of 95,911 children aged 0-59 months in 9,500 census blocks covering 34 provinces. The sample in this study were toddlers aged 0-59 months. The inclusion criteria in the study were toddlers aged 0-59 months with complete data, while the exclusion criteria were toddlers with physical disabilities. All samples that met the exclusion and inclusion criteria in the dataset were taken as the sample, and the total was 82,777 respondents.

The dependent variable in this study was stunting, where a child was said to be stunted if his height was below -2 SD from the WHO standard. The calculation of the z-score was carried out by using the WHO anthro application. The main independent variable in this study was food insecurity. Food insecurity was defined as the limited or uncertain availability of sufficiently nutritious and safe food or the limited or uncertain ability to obtain acceptable food in a socially

acceptable manner.[20] Measuring food insecurity used the FIES instrument developed by the World Food and Agriculture Organization (FAO) through the Voice of Hunger Project and has been used by BPS in the National Socioeconomic Survey (Susenas) to measure the level of food insecurity in Indonesia since 2017, and this scale had been validated.[21] The Food Insecurity Experience Scale (FIES) measured the percentage of individuals in the national population who have experienced or experienced moderate or severe food insecurity at least once in the last 12 months. The FIES instrument consisted of 8 questions which were arranged sequentially and described the increasing level of food insecurity based on the experiences of the respondents, which included: 1) worries that they will not have enough food to eat due to lack of money or other resources, 2) have never been able to eat healthy food and nutritious food due to lack of money or other resources, 3) has eaten very little food due to lack of money or other resources, 4) has skipped one meal on a particular day due to lack of money or other resources, 5) has eaten less than it should due to lack of money or other resources, 6) have run out of food due to lack of money or other resources, 7) have been hungry but have not eaten due to lack of money or other resources, and 8) have not eaten all day due to lack of money or other resources.

Respondents will answer "yes" (code 1) or "no" (code 0) to 8 questions. Then the total score was made, ranging from 0 to 8. The level of food insecurity was divided into 3 categories, namely 1) not experiencing food insecurity if it has a score of 1-3, 2) moderate food insecurity if it has a total score of 4-6, and 3) severe food insecurity (severe) if it has a total score of 7-8. This was based on the assumption that the FIES question sequence was designed to capture increasing levels of food insecurity where questions 1-3 lead to mild food insecurity (mild), questions 4-6 lead to moderate food insecurity, and questions 7-8 lead to in severe food insecurity.[22] The relationship between the independent and dependent variables would be controlled with covariate variables, including the area of residence, mother's education, father's education, mother's employment status, family planning participation, number of household members, wealth quintile, low birth weight, and history of infectious diseases/morbidity.

The analysis was carried out in stages starting from univariate, bivariate, and multivariate. Univariate analysis was conducted to determine the characteristics of each variable. Bivariate and multivariate analyzes were performed using the Cox Regression test with a 95% confidence level to obtain the Prevalence Ratio (PR) value, both crude and adjusted with the covariate variables. Data analysis was carried out using a complex sample, considering strata, sample units, and weights because this data is survey data, and sampling was not random. This research has received ethical approval from the Health Research and Development Agency, Ministry of Health, with number LB.02.01/2/KE.677/2021.

## Results

The total sample in this study was 82,777 respondents from 34 provinces in Indonesia, and this data could represent the national level. Table 1 showed the characteristics of the respondents where more than half of the respondents lived in urban areas (57.7%), most of the mothers and fathers had secondary education, those who had graduated from junior high or high school (61.2% and 60.9%), as many as 67 .7% of mothers did not work, most did not use family planning (86.3%), more than half of the respondents came from families with <5 household members, when it was viewed from the wealth quintile, they were spread evenly from quintile 1 to 5. The main focus of the independent variable in this study was food insecurity, where 84.8% came from families with food insecure status, 11.9% came from families with moderate food insecurity status, and 3.3% came from families with severe food insecurity status. If it was seen from the characteristics of the toddlers, most of them were born not LBW (84.8%), and there was no history of infectious diseases (87.4%).

Factors related to stunting from the bivariate results were food insecurity, area of residence, mother's education, father's education, mother's employment status, family planning participation status, number of household members, ownership index quintile, low birth weight status, and history of infectious diseases. Parity and received antenatal care (Table 1). Toddlers from moderately food-insecure families had a 1.24 times higher risk of experiencing stunting, and an increased risk in severely food-insecure families (PR unadj 1.39), toddlers living in rural areas were 1.26 times more at risk of experiencing stunting than those in urban areas, the lower level of education of mothers and fathers the higher the risk of having children with stunting, children with mothers who did not work have a 1.15 times higher risk compared to working mothers, children of mothers who have never used family planning have a risk of 0.80 times more children from families with ≥5 household members have a 1.05 times higher risk of stunting, the lower the wealth/poor quintile have a higher risk of stunting, children born with LBW have a 1.861 times higher risk experience stunting and children who had a history of infectious diseases have a 1.2 times higher risk of experiencing stunting. However, these results have not been controlled for by other variables, so a multivariate analysis was necessary.

**Table 1. The Characteristics of Respondents and Bivariate Analysis of Factors Associated with Stunting**

| Variable | Stunting n (%) | Normal n (%) | Total N (%) | *Simple cox regression* PR unadj (96% CI) | p-value |
|---|---|---|---|---|---|
| **Food Insecurity** | | | | | |
| Mild | 16.022 (22,8%) | 54.199 (77,2%) | 70.222 (84,8%) | *reference* | |
| Moderate | 2.788 (28,4%) | 7.043 (71,6%) | 9.831 (11,9%) | 1,24 (1,18 – 1,31) | <0,001 |
| Severe | 864 (31,7%) | 1.860 (68,3%) | 2724 (3,3% | 1,39 (1,27 – 1,53) | <0,001 |
| **Residential area** | | | | | |
| Urban | 10.247 (21,4%) | 37.540 (78,6%) | 47.787 (57,7%) | *reference* | |
| Rural | 9.427 (26,9%) | 25.563 (73,1%) | 34.990 (42,3%) | 1,26 (1,20 – 1,31) | <0,001 |
| **Mother's Education** | | | | | |
| High | 1.558 (14,7%) | 9.052 (85,3%) | 10.610 (12,8%) | *reference* | |
| Low | 6.506 (30,2%) | 15.036 (69,8%) | 21.542 (26,0%) | 2,06 (1,91 – 2,22) | <0,001 |
| Moderate | 11.609 (22,9%) | 39.016 (77,1%) | 50.625 (61,2%) | 1,56 (1,45- 1,68) | <0,001 |
| **Father's Education** | | | | | |
| High | 1.271 (15,1%) | 7.135 (84,9%) | 8.406 (10,1%) | *reference* | |
| Low | 7.130 (29,7%) | 16.861 (70,3%) | 23.991 (29,0%) | 1,97 (1,82 – 2,13) | <0,001 |
| Moderate | 11.273 (22,4%) | 39.106 (77,6%) | 50.380 (60,9%) | 1,480 (1,82 – 2,13) | <0,001 |
| **Mother's employment status** | | | | | |
| Working | 5.745 (21,5%) | 20.964 (78,5%) | 26.709 (32,3%) | *reference* | |
| Not working | 13.929 (24,8%) | 42.139 (75,2%) | 56.068 (67,7%) | 1,15 (1,11 – 1,21) | <0,001 |
| ***KB* membership status** | | | | | |
| Using *KB* | 17.466 (24,5%) | 53.968 (75,5%) | 71.434 (86,3%) | *reference* | |
| Not using *KB* | 2.208 (19,5%) | 9.135 (80,5%) | 11.343 (13,7%) | 0,80 (0,75 – 0,85) | <0,001 |
| **Total number of family** | | | | | |
| < 5 people | 10.093 (23,3%) | 33.468 (76,8%) | 43.561 (52,6%) | *reference* | |
| >= 5 people | 9.581 (24,4%) | 29.635 (75,6%) | 39.216 (47,4%) | 1,05 (1,01 – 1,10) | <0,10 |
| **Ownership index quintile** | | | | | |
| Quintile 5 | 2.266 (14,4%) | 13.516 (85,6%) | 15.782 (19,1%) | *reference* | |
| Quintile 1 | 4.882 (33,7%) | 9.611 (66,3%) | 14.493 (17,5%) | 2,35 (2,20 – 2,51) | <0,001 |
| Quintile 2 | 5.028 (26,7%) | 13.796 (73,3%) | 18.824 (22,7%) | 1,860 (1,74 – 1,99) | <0,001 |
| Quintile 3 | 4.056 (24,0%) | 12.872 (76,0%) | 16.928 (20,4%) | 1,669 (1,56 – 1,79) | <0,001 |
| Quintile 4 | 3.442 (20,5%) | 13.308 (79,5%) | 16.750 (20,2%) | 1,431 (1,33 – 1,54) | <0,001 |
| **Low Birth Weight (LBW)** | | | | | |
| Not LBW | 17.415 (22,5%) | 59.970 (77,5%) | 77.385 (93,5%) | *reference* | |
| LBW | 2.259 (41,9%) | 3.133 (58,1%) | 5.392 (6,5%) | 1,861 (1,76 – 1,967) | <0,001 |
| **History of infectious disease** | | | | | |
| Not having | 16.763 (23,2%) | 55.567 (76,8%) | 72.330 (87,4%) | *reference* | |
| Having | 2.911 (27,9%) | 7.536 (72,1%) | 10.447 (12,6%) | 1,20 (1,14 – 1,27) | <0,001 |
| **Total** | 19.674 (23,8%) | 63.103 (76,2%) | 82.777 (100%) | | |

The results of the multivariate analysis (Table 2) showed that if subgroups were carried out based on the area of residence, in rural areas, children from families with moderate food insecurity were at risk of 1.09 (95% CI 1.022 – 1.160) times higher for stunting, and the risk increases by 1.15 (95% CI 1.035 - 1.277) times in families with severe food insecurity (Adj PR 0.136; 95% CI: 0.09-0.20) after controlling for variables of mother's education, number of household members, ownership index quintile, low birth weight and history of infection. However, the results were different in urban areas, food insecurity status was not statistically related to the risk of stunting.

**Table 2. Multivariate Analysis of the Relationship between Food Insecurity and Stunting by Region Category**

| Variable | Rural | | Urban | |
|---|---|---|---|---|
| | PR adj (95% CI) | p-value | PR adj (95% CI) | p-value |
| **Food Insecurity** | | | | |
| Mild food insecurity (ref) | *reference* | | *reference* | |
| Moderate food insecurity | 1,09 (1,02 – 1,16) | 0,008 | 0,99 (0,91-1,07) | 0,763 |
| Severe food insecurity | 1,15 (1,04 – 1,28) | 0,009 | 1,04 (0,90-1,20) | 0,594 |
| **Mother's Education** | | | | |
| High | *reference* | | *reference* | |
| Low | 1,34 (1,22 – 1,47) | <0,001 | 1,43 (1,26-163) | <0,001 |
| Moderate | 1,22 (1,12- 1,34) | <0,001 | 1,20 (1,08-1,34) | <0,001 |
| **Mother's employment status** | | | | |
| Working | - | | *reference* | |
| Not working | - | | 1,09 (1,01-1,16) | 0,018 |
| ***KB* membership status** | | | | |
| Using *KB* | - | | 0,89 (0,81-0,97) | 0,009 |
| Not using *KB* | - | | *reference* | |
| **Total number of family** | | | | |
| < 5 people | *reference* | | *reference* | |
| >= 5 people | 1,05 (1,00 – 1,09) | 0,046 | 1,08 (1,01-1,15) | 0,017 |
| **Ownership index quintile** | | | | |
| Quintile 5 (ref) | *reference* | | *reference* | |
| Quintile 1 | 1,62 (1,46 – 1,80) | <0,001 | 2,02 (1,80-2,28) | <0,001 |
| Quintile 2 | 1,35 (1,23 – 1,49) | <0,001 | 1,68 (1,51-1,87) | <0,001 |
| Quintile 3 | 1,31 (1,87 – 1,46) | <0,001 | 1,50 (1,35-166) | <0,001 |
| Quintile 4 | 1,19 (1,07 – 1,32) | <0,001 | 1,33 (1,21-1,47) | <0,001 |
| **Low Birth Weight** | | | | |
| Not Low Birth Weight | *reference* | | *reference* | |
| Low Birth Weight | 1,78 (1,69 – 1,90) | <0,001 | 1,78 (1,64-1,94) | <0,001 |
| **History of infectious disease** | | | | |
| Not having | *reference* | | *reference* | |
| Having | 1,15 (1,07 – 1,22) | <0,001 | 1,09 (1,00-1,20) | 0,047 |

## Discussion

The prevalence of households experiencing food insecurity from this study was 11.9% with a moderate level of food insecurity and 3.3% of households with a severe level of food insecurity. This figure is higher than the results of the 2017 Susenas where 8.5% of households experienced food insecurity, and 1.12% of households experienced severe food insecurity.[23] The prevalence of food-insecure households in Indonesia was still relatively low when compared to world data, where

it was predicted that around 29.5% of the world's population was experiencing moderate or severe food insecurity.[24] Nonetheless, this almost double difference was a crucial figure and requires more serious attention because of the high rates of food insecurity in households with children under five that need to be addressed, especially in households with infants aged <2 years who were still in the golden age.

The prevalence of stunting in this study is 23.8% (Table 1), where the results were slightly different by 0.6% from the SSGI 2021 results, which may be due to this study only using SSGI data for phase 1 only.[6] The Ministry of Health was guided by WHO provisions; if the prevalence of stunting was more than 20 percent, then it can be considered a chronic public health problem. This meant that nationally the problem of stunting in Indonesia was classified as chronic.[25] The results of the study showed that toddlers from moderate food insecure families had a 1.24 times higher risk of experiencing stunting, and the risk increased in severely food insecure families (PR unadj 1.39). These results were in line with previous research in the urban area of Surabaya, Indonesia, that food insecurity was positively related not only to stunting but also to obesity/overweight in mothers.[18]. The results of a study in Malaysia showed that children from food insecure households were 2.15 times more likely to experience underweight and 3 times more likely to experience stunting. 15 Food insecure households were vulnerable to having malnourished children due to the inability to meet quality and varied food, which was proven to contribute significantly to malnutrition, especially micronutrient deficiencies.[26] Research in Nepal[27], and Iran [28] also reported similar results to this study. Food insecurity related to delays in the introduction of complementary foods, a tendency to consume more foods high in starch but low in protein; consuming less nutritious foods such as vitamin A, iron, and zinc; lower intake of animal protein, higher intake of snack foods, and a lower intake of fruits and vegetables.[29,30]

If we did a subgroup analysis based on the rural and urban areas, it would turn out that the relationship between food insecurity and stunting was only significant in rural areas. This result is in line with previous studies in Indonesia, which estimated the prevalence of stunting in villages to be 55% higher compared to 34.9% in cities with an AOR of 1.55.[31], and also the results of a study in Nepal [19]. One possible cause was poverty, where based on BPS data for 2021, the percentage of poor people in rural areas was higher (12.53%) than in urban areas (7.6%).[32] This was also the case in Malaysia, where malnourished children were more common in rural areas with a high poverty index.[14] Analysis of IDHS data in Nepal from 2011-2017 shows that families with the lowest wealth quintile had a greater risk of being stunted.[33] In poor families, low income and limited resources lead to an inability to buy food, and then it became the main cause of food insecurity and family nutrition.[34] Another study by Mkhawani et al. suggested that a higher prevalence of stunting in rural areas compared to urban areas is associated with greater sensitivity to changes in food prices. Families in rural areas were more sensitive to rising food prices because they allocated two-

fifths of their budget for basic needs. Along with rising food prices, the purchasing power of families in rural areas has decreased, making it increasingly difficult to meet their essential nutritional needs.[35] Another factor that also influences nutritional status is the low level of education, [36] where the percentage of people with low education in Indonesia was more in rural areas than urban areas.

In addition, adequate access to health services was important for rural and urban communities because health services were one of the factors associated with stunting.[37] But unfortunately, in Indonesia, there was a gap in access to health services between rural and urban areas. People living in urban areas had access to better health services and were supported by other related infrastructure, such as roads which reduced travel time to health care facilities, while access to health services in rural areas was limited. As many as 6.3% of sub-districts in Indonesia did not have access to Puskesmas, and as many as 4.2% of Puskesmas in rural areas did not have doctors on duty at health facilities and also infrastructure facilities which were more limited in rural areas.[38]

The advantages of this study were using a relatively large sample that came from a large sample calculation with a high-power test, the sample was selected by multistage random sampling, and the results could be generalized to the national level. This study also used food insecurity instruments which were validated and have been used by *BPS* in the National Socioeconomic Survey (*Susenas*) to measure the level of food insecurity since 2017, and interviews were conducted by trained interviewers so as to reduce the bias. However, this study also had several limitations. Where the design used was cross-sectional, so it could not draw causal conclusions between food insecurity and stunting, so further research was needed with a better study design.

## Conclusion

The results of the bivariate analysis showed that food insecurity was related to stunting in children under five, and the risk was increasing in households with a severe level of food insecurity. However, the results of the multivariate analysis showed that the relationship between food insecurity and stunting only looked significantly different in rural areas. Therefore, efforts to tackle stunting needed to be focused on households with food insecurity, especially in rural areas. Further research was needed with better study designs, such as cohort studies, to support and prove a causal relationship between food insecurity and stunting.

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