

Trends in the Effects of Dental and Oral Diseases on Under-Five- Year-Old Children's Nutritional Status

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Abstract

Energy protein malnutrition in under-five-year-old-children is responsible for 54% of 10.8 million deaths per year which ranks second as the major cause of deaths among children under five years old in developing countries. Several studies report that under fives with dental and oral diseases have undernutrition status and even poor nutritional status.

Cohort prospective study was carried out to 3-5 year-old-children in Ambulu, Jember. The simple random sampling was performed involving 102 children that were divided into 2 groups (non caries and caries group). The variables were dental and oral diseases and children's nutritional status. Data were analyzed using Structural Equation Modeling.

Dental and oral diseases affect children's nutritional status ($p=0,000$). The magnitude of the effects of dental and oral diseases on children's nutritional status was 0,499 at the 1st month, 0,644 at the 2nd month, 0,760 at the 3rd month and 0,813 at the 4th month. Trend of dental and oral diseases with impact on under five-year-old children's nutritional status was continuously increasing until 4th month. Direct effects and indirect effects of dental and oral diseases affect children's nutritional status.

Dental and oral diseases affect under five-year-old children's nutritional status with increasingly stronger influences in trend.

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Introduction

Protein energy malnutrition in children under five is responsible for 54% of the 10.8 million deaths per year which ranks second as the major causes of deaths among children under five years old in developing countries. Protein energy malnutrition in children under five years old disrupts the linear growth, nutrient absorption and increased metabolic requirements, secondary immune deficiencies, susceptibility to infection, transmitted diseases and even deaths.¹ The result of Basic Medical Research 2010 shows that the prevalence of emaciated children (wasting) did not undergo any significant decrease. It just slightly revised down from 13,6% in 2007 to 13,3% in 2010. East Java is the third province with highest prevalence of

malnutrition children in Indonesia with four hundred and thirty four thousand children affected. This number is concentrated in the horseshoe areas such as Probolinggo, Jember, and Lumajang. Decreasing the number of malnourished children under five years old to 12,6% is a target of Millenium Development Goals (MDGs) in 2015. To achieve this goal, earnest efforts and nutritional status improvement strategies for under five are needed.^{2,3}

In the other hand, most of under fives who suffer from dental and oral diseases have undernutrition status and even poor nutritional status. This phenomenon is supported by several existed researches. A cohort prospective study on five-year-old children in America states that children with tooth decay underwent slightly smaller weight gain and height increase from the previous year compared to those without tooth decay.⁴ Children under five years old with caries who need treatments have lower mean weights than those without treatment need.⁵ Severe dental caries affects nutrition. The relationship between dental caries and growth is established

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as once it occurs, the pain afflicted from dental caries restricts food intake.⁶⁻⁸

Poor oral health in children associated with underweight and growth failure. Children with severely dental caries have significantly lower body weights than caries free children. Severe dental caries can cause dental pain that can negatively affect children's abilities to eat and sleep. Eating disruption may affects the quality and quantity of nutritious food consumed.⁹⁻¹³

Structural Equation Modeling (SEM) is a statistical tool that is capable of analyzing latent variables, indicator variables, and measurement errors simultaneously, it is according to this study, where the variable nutritional status consists of three variable indicators such as W/A, W/H and MUAC/A. This study aims to analyze trends in the effects of dental and oral diseases on under five-year-old children's nutritional status with SEM.

Materials and methods

This study was prospective cohort study which was conducted in four months from March until June 2014. The research population involves the total number of 461 children whose age ranging from 3-5 years old in Ambulu Public Health Center's working area, Jember district. Screening was performed using inclusion and exclusion criteria and 309 children were obtained. Inclusion criteria comprise parents of the children who approved the informed consent forms, well-nourished children, caries free children, caries children without chewing and sleeping interferences, and children with no systemic diseases and infection records. Systemic diseases including cancer, AIDS, bronchitis, type 1 diabetes mellitus, and heart failure in children result in malnutrition.¹⁴⁻¹⁶ Infection diseases including diarrhea, respiratory infection, tuberculosis and worms are certain diseases affecting children nutritional status.¹⁷⁻²⁰ Exclusion criteria are children with physical disabilities like cerebral palsy, down syndrome which impair food intake mechanism.²¹⁻²³ Samples were divided into 2 groups, the first group is non caries and the second group is caries which has not impacted yet (on chewing and sleeping disorders). The samples were taken using simple random sampling consisting of 42 persons in each group.^{24,25}

Dental caries examinations were conducted by applying PUFA index (pulpitis, ulcerative, fistula, abscess) using certain instruments (mouth mirror, sonde, pinset, mask, gloves, cotton pellet, and cotton roll). Nutritional status measurements were performed using W/A index with scales by CAMRY brand (until 50 gram level of precision) and battery 3A used by alkaline. Data were analyzed using Descriptive Analysis and continued by Structural Equation Modeling (SEM).

The trial was approved, managed and monitored by the Research and Ethics Committee in Faculty of Public Health, Airlangga University number 171-KEPK 2014.

Results

SEM is used to analyze the trend in the effects of dental and oral diseases on children's nutritional status. Prior to the SEM analysis, assumption test is conducted to ensure that the established structural model can be used. This assumption consists of normality, multivariate outlier and fit model. Normality test can be seen in the Table 1.

Data	c.r. multivariate	Requirement	Keterangan
1 st month	1,673	Within range -2,58 until +2,58	Normal
2 nd month	2,362		Normal
3 rd month	1,681		Normal
4 th month	1,599		Normal

Table 1. Multivariate normality test result.

Normality test results show that multivariate in all data are within range from -2,59 until +2,58 indicating that multivariate data are in the normal distribution. The other assumption is multivariate outlier, which can be seen in the Table 2.

Data	Biggest Mahalanobis d-squared	Requirement	Keterangan
1 st month	16,839	Under 18,47	No outlier
2 nd month	16,990		No outlier
3 rd month	14,573		No outlier
4 th month	16,766		No outlier

Table 2. Multivariate outlier test result.

Outlier test results show that all observations have *mahalanobis d-squared* smaller than 18,47. Thus, all data observation from the first month until fourth month are none of outliers indication and all are appropriated to be used in the subsequent analysis. The other important test is model conformance test (GFI) which can be seen in the Table 3.

	1 st month	2 nd month	3 rd month	4 th month
GFI	0,939	0,970	0,976	0,984
value				

Table 3. The measurement result of goodness of fit indices value generated by base model resulted in the following GFI value.

GFI provides explanations similar to the coefficient of regression analysis indicating the percentage of data diversity explained by the model. GFI critical value required is more than 0,90. All model base measurement on all months resulted in GFI value more than 0,90, thus model conformance test has provided appropriated index according to the suggestion.

From the assumption result above, SEM analysis in the form of inter variable testing can be conducted subsequently. The effects of dental and oral diseases on children's nutritional status from the first month until fourth month can be seen in the Table 4.

Causality relationship	P-Value< 0.001			
	1 st month	2 nd month	3 rd month	4 th month
Dental and oral diseases → children's nutritional status	0,000	0,000	0,000	0,000

Table 4. Dental and oral disease effects on under-five-nutritional-status from first month until fourth month.

Table 4 shows that dental and oral diseases had impacts on children's nutritional status from the first month until fourth month ($p=0,000$). The magnitude of the effects of dental and oral diseases on monthly under five nutritional status can be seen in table 5.

Table 5 identifies that the magnitude of dental and oral disease effects to under five-year-old children's nutritional status was 0,499 at the 1st month, 0,644 at the 2nd month, 0,760 at the 3rd month and 0,813 at the 4th month. The

magnitude of dental and oral diseases with impact on children's nutritional status is classified into the strong category with negatively inverse correlation meaning that the higher level of dental and oral diseases, the poorer the children's nutritional status. Trend in the effects of dental and oral diseases on children's nutritional status continuously grew stronger until 4th month.

Causality relationship	Coefficient in influence			
	1 st month	2 nd month	3 rd month	4 th month
Dental and oral diseases → children's nutritional status	-0,499	-0,664	-0,760	-0,813

Table 5. The magnitude of the effects of dental and oral diseases on under-five-nutritional-status from 1st month until 4th month.

Discussion

Dental and oral diseases, mainly caries, evidently affect children's nutritional status. Some studies report a relationship between caries and poor growth. Research by Narang et al, 2012 on the nutritional status and caries experience of children aged 12 to 15 years in Lucknow, revealed that the average dental caries was higher in children with malnutrition. Defects in tooth structure can occur during tooth formation (enamel hypoplasia). Various local and systemic factors have been identified as risk factors for hypoplasia, of which malnutrition is one of the systemic factors.²⁶ Two theories may explain this relationship. The first theory is that the direct impact of extensive untreated caries and associated pain and inflammation on the child's ability to eat may result in undernutrition and growth impairment. The second theory includes the indirect effects of untreated caries and different body responses to chronic dental infection. Three mechanisms are suggested. The first concerns immune responses. Infected dental pulp may affect immunity and erythropoiesis, which may result in anemia and influence bone remodeling, sleep patterns, and food intake. This mechanism is supported by results of a randomized controlled trial showing that treatment of severe caries in children aged 6 to 7 years significantly improved their appetite. The second mechanism is related to endocrine responses. The interruption of slow wave sleep

due to pain and infection may lead to impairment of growth hormone secretion. The third mechanism is linked to metabolic responses. Infections and related inflammation might result in micronutrient undernutrition through increasing energy expenditure and metabolic demands and impaired nutrient absorption.²⁷

Dental caries causes chewing disturbances, continuous waking during the night because of oral pain, stress, and inhibition of growth hormone (GH) as the results of increased glucocorticoid secretion. The extension of caries determines changes in diet as children tend to eat liquid or semi liquid food and reduce caloric intake. The reduction in GH serum levels accounts for inhibitory effects in growth.²⁸⁻³³

The effects of dental and oral diseases on children's nutritional status grew stronger as the time went by. It was proven by the magnitude of those two variables which increased from 0.499 at the 1st month to 0.813 at the 4th month. Dental caries will develop as a result of poor oral hygiene. Untreated enamel caries in children under five years old which is left untreated would extend to dentine and subsequently infect pulp tissue. Trend in dental caries has a tendency to become severe involving a lot of teeth.²⁷

Oral cavity is the main contributor which affects decreased appetite and malnutrition.³⁴ Dental caries that left untreated can develop into more severe. Dental caries is initially without symptoms, the pain has not emerged yet as the damage has not reached dental pulp yet, and inflammation process continues to develop until the pain arises once the infection is on dental pulp.³⁵

Children with severe caries (caries which already infected the pulp) experience growth restrictions, mainly in the body height and weight. Dental caries causes reduced food intake because of pain and discomfort, high sucrose diet threatening other nutrient absorption.^{5,31,36} As the time goes on, oral and dental diseases will become more severe when they are left untreated and that condition will lead to poorer nutritional status of children.

The study has some limitations. First, not all children can be followed until the last month of the research since some are drop out because they are uncooperative during the examination and changing school. Total of drop out children was 18. Twelve came from the group with caries hasn't impacted yet and six children from non

caries group. Fortunately, the number of samples in this study still met the minimum sample size (42 children for each group). Second, the duration of the research which lasted during four months can't fully analyze the growth patterns of children aged 3-5 years and it's also not being able to fully explain the relation between non caries and caries group. Detailed data can be achieved by conducting longer observation, but putting dental care off over 4 months is considered unethical for allowing children with dental caries.

Conclusions

Dental and oral diseases affect under five-year-old children's nutritional status with increasingly stronger influences in trend.

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Declaration of Interest

The authors report no conflict of interest.

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