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THE MOST CRINGE – WORTHY FACT ABOUT DOUBLE BURDEN OF MALNUTRITION; SOCIAL DETERMINANTS

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ABSTRACT

We investigate the social determinants moreover because of the geographical variations of under- and over-nutrition in Indonesia using the biggest public health study ever conducted within the country, the National Basic Health Research 2007 (N¼ 645,032). Multilevel multinomial logistic regression and quintile regression models are fitted to estimate the association between nutritional status and several socio-economic indicators at both the individual and district levels. We find that: (1) education and income reduce the chances of being underweight by 10–30% but at the identical time increase those of overweight by 10–40%; (2) independent from the compositional effect of poverty, income inequality is detrimental to population health: a 0.1 increase within the Gini coefficient is related to an 8–12% increase within the odds of a personality's being both under- and overweight; and (3) the consequences that these determinants have upon nutritional status aren't necessarily homogeneous along the continuum of body mass index. Equally important, our analysis reveals that there's substantial spatial clustering of areas with an elevated risk of under-or over-nutrition across the 17,000-island archipelago. The income inequality accompanying Indonesia's economic process may aggravate the twin burden of under and over nutrition.

KEYWORDS: nutritional status, socio-economic indicators, archipelago, substantial spatial clustering.

INTRODUCTION

The simultaneous presence of under- and over-nutrition within populations of developing countries undergoing rapid economic transition has been widely documented (Gillespie & Haddad, 2003; Jehn & Brewis, 2009). The changes in dietary intake patterns and leisure-time activities related to industrialization and urbanization are known to own contributed to an increased prevalence of obesity in numerous countries (Popkin, 1998, 1999); at the identical time, the matter of under-nutrition remains undefeated. This dual burden, which can also exist within one household (Doak, Adair, Bentley, Monteiro, & Popkin, 2005; Lee, Houser, Must, de Fulladolsa, & Bermudez, 2012), is dear for the health in addition because of the economy of a nation. Under-nutrition impairs cognition (Sandjaja et al., 2013) and physical development (Mani, 2012), reduces economic productivity (Victora et al., 2008), raises morbidity, and even induces an intergenerational cycle of malnutrition

(Barker, 1997); on the opposite extreme of the nutritional spectrum, over-nutrition is thought to extend the danger of non-communicable diseases, inflate health care costs (Cawley & Meyerhoefer, 2012; Withrow & Alter, 2011), and reduce the general quality of life. The body of nutritional epidemiology and development economics research suggests that over and above the biological aspects old and sex, socio-economic status, together with several environmental factors like an urban environment, area-level economic development, and income inequality, seems to consistently determine the social distribution of malnutrition (Doak et al., 2005; Ha et al., 2011; Lee et al., 2012; Rahmanian et al., 2014; Roemling & Qaim, 2013; Shafique et al., 2007; Sub- Romanian, Kawachi, & Smith, 2007; Vaezghasemi et al., 2014). Notwithstanding the increasing number of studies during this stream of research, the literature, however, doesn't yet include sufficient evidence from Indonesia, which is that the most populous developing country after China and India. Exploiting the actual fact that an oversized, nationally representative sample has recently become available, this paper aims to analyze the social determinants similarly because the geographical variations of under- and over-nutrition among adults aged 15 years and older living in 440 districts in Indonesia. Specifically, we have an interest in understanding.

(1) the pattern of association between an individual's socio-economic position and his or her nutritional status;
(2) The influeance of contextual factors at the district level on one's probability of being under or overweight;
(3) The geographical distribution of the danger of malnutrition within the archipelago after accounting for the results of observable socio-demographic determinants.

2. METHODS DATA

The Ministry of Health of the Republic of Indonesia, Riskesdas is that the largest public health research initiative ever administrated within the country. The repeated cross-sectional study includes 987,205 individuals from 258,366 households residing all told 440 districts and is thus representative of the Indonesian population (Kemenkes, 2008). Consent was obtained before the interview and participants' confidentiality was strictly protected.

Table 1
Exploratory factor analysis of district deprivation index.

Proportion of village without	Factor loading	Summary statistics	
Communication facilities	0.86	Explained variance	88%
Electricity	0.81	Cronbach's α	0.82
Street lighting	0.76	Eigenvalue	3.58
Healthcare facilities	0.75	KMO	0.80
TV signal coverage	0.73	*N*	454
Education facilities	0.65		
Entertainment facilities	0.30		

The proportion of shared variance yet as other statistics obtained during the derivation of the index are shown in Table 1. it's noteworthy, at now, that the inclusion of measures of area-level economic development and facility deprivation alongside the income inequality variable allows researchers to separate the contextual effect of INCOME INEQUALITY In the statistical models described next, we also control for survey respondent people (15–24, 25–34, 35–44, 45–54, 55–64, or 65 þ), sex (dummy variable for female survey respondents), marital status (married, never married, divorced or widowed), self-report physical activity (indicator variable for those reporting inadequate physical activity in keeping with the standards set by Kemenkes (2008), urban/rural residential setting (dummy variable for urban residency), and several other household members. Con- continuous covariates are either centred to their respective grand means (log per capita household expenditure, Gini index) or to a representative value (household size of three, deprivation index equals 0) so the intercept will be meaningfully interpreted. The poorest quintile and interesting inadequate physical activity.

MODELLING TECHNIQUES

To predict the nutritional status of individual I residing in district j with three possible nominal outcomes s ¼, we

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specify the subsequent generalized linear mixed model with logit link-function (Goldstein, 2011; Rabe-Hesketh & Skrondal, 2012): log Pr yij ¼ s =Pr yij ¼ normal ¼ Xβðsþ þuðsÞ; s ¼ underweight; overweight: In this specification, X is that the matrix of explanatory variables at both individual and district levels that also includes a continuing term and cross-level interaction terms. The unknown parameter vector β(s) captures the common effect of every explanatory variable on the probability of an adult being underweight or overweight relative to having a standard BMI.

To facilitate interpretation, β(s) is reported as a relative risk (odds) ratio. The uðjsÞ is that the contrast- and district-specific random effect that's assumed to be uncorrelated with X and is generally distributed with zero mean and variance to be estimated from the information. A parameter capturing the correlation (ρ) between random effects uðsÞ and uðsþ 1Þ is additionally obtainable from the model and is especially useful for measuring the strength moreover as the direction within which the risks of under- and over-nutrition covary within one district. Such an interpretation has been utilized in some earlier studies in India (Subramanian & Smith, 2006; Subramanian et al., 2007); after all, Corsi et al. (2011) have recently needed wider use of this parameter to gain a proper way of assessing the existence of the double burden of malnutrition within a given geographic area.

it's important to notice, however, that this model maintains the belief of the independence of irrelevant alternatives (IIA), meaning that 'adding or deleting alternatives doesn't affect the percentages among the remaining alternatives' (Long & Freese, 2006: 243). this could not be a very major problem for this study because the outcomes can plausibly be assumed to be distinct from each other (McFadden, 1973).

Table 2
Sample description and bivariate analysis (N 14 645 032).

Variable	Descriptive statistic	Unadjusted odds ratio	
		Underweight	Overweight
Nutritional status:			
Body mass index	22.05 7 3.81		
Normal	67.7%		
Underweight	14.4%		
Overweight	17.9%		
Age group:			
Age 15–24	22.9%	1.00	1.00
Age 25–34	22.7%	0.407 0.01	2.727 0.04
Age 35–44	21.3%	0.337 0.01	4.267 0.07
Age 45–54	16.0%	0.457 0.01	4.397 0.09
Age 55–64	9.1%	0.807 0.02	3.447 0.08
Age 65 þ	8.0%	1.557 0.03	2.217 0.06
Sex:			
Male	48.8%	1.00	1.00
Female	51.2%	1.157 0.01	1.897 0.03
Marital status:			
Married	68.3%	1.00	1.00
Never married	23.4%	2.077 0.03	0.297 0.01
Divorced	1.8%	1.517 0.04	0.847 0.02
Widowed	6.5%	2.637 0.04	0.917 0.02
Education:			
Primary school or less	53.3%	1.00	1.00
Middle school	20.3%	0.927 0.01	0.927 0.01
High school	21.1%	0.687 0.01	1.227 0.02
College	5.3%	0.507 0.01	1.787 0.05
Employment status:			
In employment or schooling	88.9%	1.00	1.00
Unemployed	11.1%	2.077 0.03	0.657 0.01
Physical activity:			
Adequate physical activity	70.1%	1.00	1.00
Less physical activity	29.9%	1.477 0.02	1.187 0.02
Residential setting:			
Rural	62.6%	1.00	1.00
Urban	37.4%	0.957 0.02	1.787 0.04
Household size and income:			
Household size	4.597 1.90	1.007 0.00*	0.977 0.00
Log(PCE)	12.507 0.51	0.747 0.01	1.817 0.03
District characteristics:			
Median PCE (million Rupiah)	0.277 0.08	0.827 0.06	11.457 2.01
Deprivation (standardized)	−0.037 1.03	0.917 0.02	0.817 0.03
Inequality	0.257 0.04	1.027 0.03*	1.337 0.05

DESCRIPTIVE AND BIVARIATE ANALYSIS,

Albeit with some positive more than kurtosis. The estimated national prevalence of underweight is 14.4% while that of overweight is 17.9%; despite our additional data cleaning procedure (Section 2.1), these figures remain very near the official tabulation released by the Ministry of Health (14.8% and 19.1%, respectively; Kemenkes, 2008).

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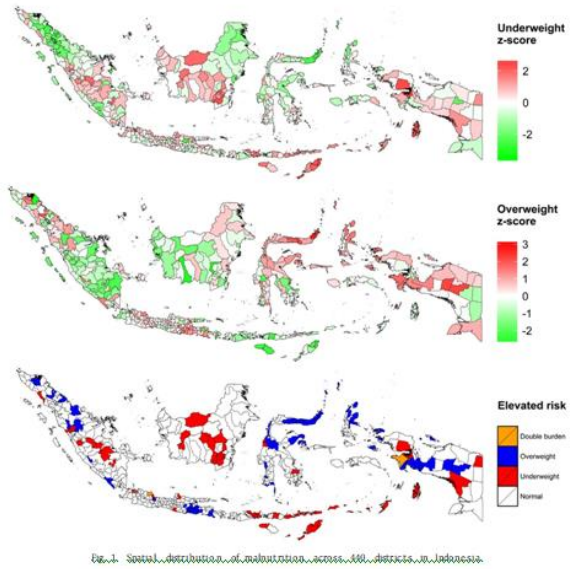

In the sample, sex is distributed equay; and therefore the majority of survey respondents (92%) are of working age (15–64 years old). About two-thirds of them are married; half haven't completed the nine-year compulsory education, and most (70%) report adequate physical activity. Two-thirds of adults participating within the study sleep in a rural area; the typical number of household members across residential settings is 4.6 persons per household, and also the per centum is at about 11%. Income inequality ranges from 0.13 (most egalitarian) to 0.40 (least egalitarian) with the mean adequate 0.25. The bivariate association is presented within the last two columns of Table 2. As may be expected from a dataset that has large statistical power, nearly all parameters are precisely estimated. the percentages of being both under and overweight generally increase with being older (notably at age 65 and older), female, having inadequate physical activity, and living in a very less egalitarian neighborhood. Larger household size is negatively related to over-nutrition, but there's no statistically discernible effect on under-nutrition. in keeping with the pattern observed across the globe, urban environments in Indonesia also seem to be obesogenic. Multilevel multinomial logistic multivariate analysis Having identified potential risk factors for under- and over-weight through an easy bivariate procedure that doesn't take confounding into consideration, we now fit a series of multilevel multinomial logistic regression models to estimate the independent effect of every predictor on nutritional status. The analysis is conducted during a stepwise manner: first, we fit an age–sex-adjusted model (Null Model) before introducing the complete set of explanatory variables within the second model (Full Model 1); we further characterize the connection between individual income facility deprivation and urban/rural residential location.

In essence, this tells us that the effect of income is more pronounced among women than men which adults of both sexes are equally deprived once they board less egalitarian environments. During this section, we relax this assumption by allowing each predictor to own a bearing on both the situation and also the scale of conditional BMI distribution. The results of fitting a quantile regression model with the total Model 1 specification is presented in Fig. 2. within the figure, the X-axis represents the conditional quantile of BMI, while the Y-axis indicates the estimated regression coefficient; a bold black line shows the independent effect of every explanatory variable on the respective conditional quantile with its associated 95% point-wise confidence interval shown in grey shade; the three solid black circles represent the conditionally underweight (the 0.1th quantile), The goal of this modeling exercise is to find out for whom the effect of every covariate is especially relevant. A flat line means the effect is equal for all individuals, no matter their nutritional status.

A U-shaped line suggests that the effect is different between individuals with BMIs within the normal range and people at both extremes of the nutritional spectrum. Finally, any line crossing the zero Y-axis shows that there's divergence within the direction (a positive-to-negative reversal, or vice versa) of a control. As shown in Fig. 2, being married, having a high education level, being employed, and having one additional household member are related to a relentless positive increase of BMI. In contrast, the results of income, age, and concrete environment on BMI are monotonically positive with magnitudes that become increasingly stronger together

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moves from the underweight to the overweight sub-population. An exception, though, is that the oldest age bracket (65 years old and older). Among the underweight, later life is related to a lower BMI, while among the overweight, it's related to a better BMI; this is often, however, of little consequence for normal individuals.

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Ultimately, to establish whether these relationships are robust across dis-aggregations by sex and urban/rural location, we perform stratified analyses. Table 4 shows that these findings are indeed consistent. Having investigated the determinants of nutritional status, we now try and understand the geographical distribution of the danger of malnutrition within the Indonesian archipelago using extracting the standardized random effects for every contrast (Ackerson et al., 2008) within the best fitting model Quantile multivariate analysis.

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DISCUSSION AND CONCLUSION

Analyzing a nationally representative dataset, this paper investigates the social determinants additionally because of the geographical variations of the double burden of malnutrition in 440 districts in Indonesia. the most objectives of this research are to review (1) how individuals' socio-economic positions relate to nutritional status, (2) how contextual factors at the district level influance individuals' nutritional status, and (3) how the risks of under- and over-nutrition are distributed around the Indonesian archipelago after adjusting for the consequences of observable socio-demographic determinants. We found that, in 2007, the prevalence of under- and over-weight was 14.4% and 17.9%, respectively. These figures indicate that one in three Indonesian adults faces a possible nutritional problem which the double burden of malnutrition is shared roughly equally by both under- and over-nutrition problems. We found that education, employment, and income protect Indone- scans from under-nutrition but that they also increase the probability of being overweight. this means that under-nutrition in Indonesia remains a disease of the poor while over-nutrition is one in all the affluent, a finding per the overall trend observed in other low and lower-middle-income countries but not among upper-middle and high-income countries (Jolliffe, 2011; Popkin, 2001; Subramanian, Perkins, & Khan, 2009).

We found little evidence to suggest that the double burden of malnutrition exists within the identical districts in Indonesia. Areas with a high risk of under-nutrition tend to be those with a coffee risk of over-nutrition; after all, only Indramayu district in West Java and Fak-Fak district in West Papua are identified as double burden districts. To some extent, this is often perhaps a

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relief from the purpose of view of policy-makers, for whom the burden of under- and over-nutrition coexisting within the identical districts may need presented a somewhat difficult situation Roemling & Qaim, 2013; Vaezghasemi et al., 2014). While finding little evidence for the presence of double burden districts, we've identified the existence of 'doubly vulnerable' population sub-groups. Our analysis shows that the elderly, women, individuals engaging in insufficient physical activity, and individuals living in highly unequal districts are at risk of both under- and over-nutrition problems. We suspect that, for the elderly, this is often because of the changes in metabolic function and lifestyle further because the psychological challenges related to aging (Hickson, 2006). in some parts of the developing world, the tendency to obesity is further shaped by the best body image maintained by society (fatness as an emblem of maternity, nurturance, and affluence). On the opposite hand, researchers also document that ladies in some poor societies are often subjected to gender discrimination in intra-household food allocation, suggest in their study of Indian society that income inequality may be a marker of both resource maldistribution and inefficient public policy. Unequal areas are likely the places where the privileged over- consume while the underprivileged face food insecurity. Equally likely is that thanks to the low social cohesion further as other negative externalities related to highly skewed income distribution, the public policy during a less egalitarian society is vulnerable to manipulation by vested interests, leading to the poor provision of the amenities that are vital for combating malnutrition. limitations of this study must now be acknowledged. The cross-sectional data that we've don't permit us to include the temporal dimension into our analysis. As a consequence, this study only provides a snapshot capturing the determinants and geographical variations of the double burden of malnutrition in Indonesia within the year 2007. it's known that the burden of obesity gradually shifts to the poor as a nation progresses economically (Brown & Konner, 1987; Popkin, 1998). Whether such a shift has begun to occur in Indonesia is indeed a motivating subject to review, but ending the relevant research obviously necessitates the provision of newer data. Another limitation is that the statistical models fitted during this study failed to explicitly account for spatial-contextual autocorrelation which can, to some extent, affect the precision also because of the smoothness of the estimated risks. The importance of undertaking such an attempt can't be underestimated, but it clearly deserves its own avenue within the vast literature of spatial epidemiology.

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