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PAPER

The dual burden household and the nutrition transition paradox

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OBJECTIVE: The purpose of this study is to document the prevalence of households with underweight and overweight persons (henceforth referred to as dual burden households) and their association with income and urban residence. The explorations by urban residence and income will test whether dual burden households differ from '*underweight only*' and '*overweight only*' households, respectively. These comparisons are relevant to differentiating or adapting nutrition-related interventions wherever obesity and undernutrition cluster at the household level.
POPULATION: Data analysis is based on national surveys conducted in Brazil, China, Indonesia, the Kyrgyz Republic, Russia, Vietnam and the United States.
METHODS: All persons were first classified into categories for underweight and overweight, using body mass index (BMI) cutoffs, and then all households were categorized into four types: dual burden, overweight, underweight and normal. Income and urban residence were explored as key risk factors for being a dual burden household, with the effects modeled separately for each country. Multiple logistic regression was used to explore income and urban risk factors, controlling for household size, region of residence and either urban residence or income, as appropriate.
RESULTS: In six of the countries studied, 22–66% of households with an underweight person also had an overweight person. Countries with the highest prevalence of dual burden households were those in the middle range of gross national product (GNP). The dual burden household is easily distinguished from the '*underweight only*' households in Brazil, China, Indonesia, the United States and Vietnam. In these five countries dual burden households were more likely to be urban and more likely to be among the highest income tertile. There were no significant differences between dual burden and '*underweight only*' households in Russia and the Kyrgyz Republic. In contrast, dual burden households were not easily distinguished from the '*overweight only*' households in China, Indonesia, the Kyrgyz Republic, the United States and Vietnam. In Brazil and Russia dual burden households were more likely to be lower income and urban than '*overweight only*' households.
CONCLUSION: The prevalence of dual burden households presents a significant public health concern, particularly for those countries in the middle range of GNP. In some countries (China, Indonesia, the Kyrgyz Republic, the United States and Vietnam), dual burden households share sociodemographic profiles with overweight households, raising concerns for underweight individuals who may inadvertently become the focus of obesity prevention initiatives. For this reason, obesity prevention efforts should focus on messages that are beneficial to the good health of all, such as increasing fruit and vegetable intake, improving overall diet quality and increasing physical activity.
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Introduction

Recent studies show that underweight or stunting can coexist with overweight and obesity. This has been found at the community level in South Africa[1,2] and Brazil.[3] Within households, stunting among children was found to coexist with overweight and obese mothers in several developing countries;[4] households with an overweight person coexisting with an underweight person were found in China, Russia and Brazil.[5] The possibility of undernutrition and overweight coexisting is not usually considered in the design and implementation of nutrition interventions. This study examines this topic using large representative surveys from the seven study countries.

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In previous studies, these households have been called 'under/over',[5] but will be referred to here as 'dual burden households'. A dual burden household is defined as a household in which one person in the household is overweight and another is underweight, reflecting the dual burden of overweight and undernutrition clustering within a single household. The economic conditions of a country are usually related to changes in diet and physical activity patterns that contribute to obesity and chronic disease. Popkin[6,7] has described this pattern as a shift in the stage of the nutrition transition—as a low gross national product (GNP) country experiences economic growth, the population's diet structure shifts, and combined with reduced physical activity, results in greater obesity. Subsequently, GNP per capita reflects the relative nutrition concerns of a country in terms of undernutrition *vs* overweight. Generally, the public health concerns of a country with a relatively low GNP will be focused on underweight and undernutrition.

In low GNP countries, underweight prevalence is relatively high and overweight prevalence is low. Thus, more households contain an underweight person and few include an overweight person. In these countries, we hypothesize the dual burden condition will be more likely to occur among households with the resources required for one person to consume excess energy relative to expenditure. For example, for one person to become overweight, there must be sufficient income to allow that individual to maintain a sedentary lifestyle and/or consume excess energy relative to their need. If so, the dual burden household is less of a concern to programs targeting the prevention of undernutrition, as these are largely focused on low-income rather than high-income households.

Households with an underweight person are likely to be the focus of public health interventions that address the underweight condition. As these interventions are likely to increase food availability to the whole household, there may be an increased risk of overweight and obesity to other individuals in the household. This is particularly true of households with an individual that is already overweight or obese. Thus, for undernutrition interventions, it is important to identify the extent of dual burden as a proportion of underweight. Furthermore, it is important to identify socio-demographic factors, such as income and urban residence, which distinguish the households with an underweight person from households with the dual burden condition.

In contrast, policy makers in countries with a higher GNP are more likely to be concerned with the rising prevalence of obesity and chronic disease. In countries experiencing or concerned about the prevention of obesity, it is important to compare the dual burden household against households with an overweight person. If the intervention focuses on reducing the energy density of the diet, other members of the household may also be affected. This is most important if there is an underweight person in the household. However, it is first necessary to determine whether the dual burden household is an important concern for public health interventions that focus on obesity.

Prior studies have shown the dual burden household to be associated with socio-demographic factors such as income and urban residence[8,9] in countries experiencing rapid changes in diet and physical activity. However, it is not clear whether these differences will be strong when compared to the '*overweight only*' and '*underweight only*' household types in Brazil, China, Indonesia, Kyrgyz Republic, Russia, the United States and Vietnam. It is important to consider whether demographic differences appear and whether there are clear patterns according to GNP. In the low-GNP countries, where undernutrition is a primary health concern, the sociodemographic comparison between the dual burden household and the '*underweight only*' household is most relevant. In the middle- and high-GNP countries, where the prevention of obesity and chronic disease is a primary concern, the focus will be on the comparison between the dual burden and the overweight household.

Methods

The country surveys

This study uses data from surveys conducted in Brazil, China, Indonesia, the Kyrgyz Republic, Russia, Vietnam and the United States. In each country and at the University of North Carolina at Chapel Hill, School of Public Health, human subjects clearance used approved consent procedures. All data are based on large national surveys as described below, with height and weight measured directly for all persons in the household; all exclusions from the logistic analysis were because there was only one person in the household or because the household had more than 10 persons (to be explained later). Household sample sizes for all countries are shown in Table 1.

1. *Brazil:* The national survey from Brazil was based on the 1989 Pesquisa Nacional sobre Saude e Nutricao (PSNS). The survey was conducted by the Instituto Brasileiro de Geografia e Estatistica (IBGE), the federal agency in charge of national statistics. Multistage stratified clustering sampling procedures were employed. The sample included 14431 households; of these, 1404 households were excluded from the logistic analysis.
2. *China*: The national survey from China was based on the 1993 China Health and Nutrition Survey (CHNS).[10] The CHNS is a large national longitudinal survey covering eight provinces. Four provinces were from the eastern region (Guangxi, Jiangsu, Liaoning and Shandong) and four from the center region (Guizhou, Henan, Hubei and Hunan). The provinces were chosen to reflect the variability in geography and economic development of China. The sample included 3440 households; of these, 100 households were excluded.

Table 1 Survey characteristics: household sample, country GNP and survey prevalence of underweight and overweight for children and adults

Survey characteristic	*Vietnam*	*China*	*Kyrgyz Republic*	*Indonesia*	*Russia*	*Brazil*	*United States*
Household sample size	4600	3340	1702	6461	3070	13 027	7694
Median household size[a]	5	4	5	4	3	4	3
Per capita GNP in PPP[b] terms ($)	1180	2070	2450	2600	4270	5420	26 250
Underweight prevalence							
Children (%)	43.7	21.2	15.8	32.2	11.4	12.3	7.5
Adults (%)	34.4	9.7	4.0	19.2	2.6	5.7	2.4
Overweight prevalence							
Children (%)	1.2	9.5	28.2	5.1	13.0	9.4	23.3
Adults (%)	2.0	13.1	34.4	14.6	52.8	31	59.1
Households with an underweight person: the proportion with an overweight person (ie dual burden)							
Dual burden households (%)	5.0	23	63	22	58	44	53
Households with an overweight person: the proportion with an underweight person (ie dual burden)							
Dual burden households (%)	60	24	24	40	9.9	18	7.9

[a]The median household size for all the surveys is four. [b]Purchasing power parity (PPP) used to convert GNP per capita to US dollars across these seven countries.

3. *Indonesia*: The survey from Indonesia was based on the 1993 Indonesia Family Life Survey (IFLS).[11] The 1993 IFLS was the first wave (IFLS 1) of a longitudinal survey conducted in 1993–1994 in 321 communities and 13 provinces by the RAND Corporation in collaboration with Lembaga Demografi, University of Indonesia. The 1993 IFLS is representative of 83% of the population of Indonesia. The survey included information from 7162 households, 701 of which were excluded.
4. *The Kyrgyz Republic*: The survey from the Kyrgyz Republic was based on the 1993 Kyrgyzstan Multipurpose Poverty Survey (KMPS).[12] The survey was nationally representative and was conducted in October and November 1993. The survey was conducted under the direction of researchers from the University of North Carolina at Chapel Hill, Paragon Research International, Inc., and the Institute of Sociology of the Russian Academy of Sciences. The sample included 1937 households, of which 235 were excluded.
5. *Russia*: The survey from Russia was based on round seven of the 1996 Russia Longitudinal Monitoring Survey (RLMS).[13] The sample included 3750 households, of which 680 were excluded.
6. *Viet Nam*: The Viet Nam sample was based on the 1992–1993 Viet Nam Living Standards Survey (VNLSS).[14] The survey was conducted from September 1992 until October 1993 with an original sample of 4800 households covering all areas of Vietnam. Sample selection ensured proportional representation of urban and rural households, with sample selection from all provinces, of which 200 households were excluded. The State Planning Committee (SPC) and the General Statistical Office (GSO) of Viet Nam jointly managed the VNLSS.
7. *The United States*: The survey from the United States was based on the third National Health and Nutrition Examination Survey (NHANES III).[15] NHANES III was conducted from October 1988 through October 1994 in two phases, each of which comprised a national probability sample. Survey design used stratified, multistage, probability analyses. In the final stage of sample selection, persons within the sample of households or group of quarters were included. In 1991, data were available from 14 683 households sampled; of these, 6989 were excluded as single person households (the majority) or as households containing more than 10 persons (less than 1%).

Classifications of overweight and underweight

This analysis focuses on the current status of undernutrition and overweight; hence, we ignored stunting. All individuals in the household were categorized as underweight, overweight, or normal weight. The criteria for defining underweight and overweight for adults is a body mass index (BMI) of <18.5 and $\geq 25\,kg/m^2$, respectively.[8] Despite its potential for misclassifying children, BMI is widely used as an indicator of nutritional status. BMI references have been established and recommended for use in determining overweight children, 2 y old and older.[16] The International Obesity Task Force (IOTF) has published BMI cutoffs for children 6–18 y of age,[17] equivalent to adult values of overweight. Additional, unpublished, cutoffs were developed for children 2–6 y based on nationally representative surveys from Brazil, Britain, Hong Kong, the Netherlands, and the United States and also for underweight. We had access to an unpublished version of the IOTF references (T Cole personal communication, Institute of Child Health, London, UK). The unpublished IOTF cutoffs provide centile equivalents to the adult BMI of 18.5 and $25\,kg/m^2$ for underweight and overweight,

respectively. In order to be consistent, we used the same reference for both underweight and overweight, thus we used BMI as the criteria for both measures.

Exclusions

Pregnant women and children, under the age of 2 y, were excluded from the household definitions. Households with more than 10 persons represent the 98th percentile of household size for all surveys; thus, a household size of 10 or more was used as the basis for exclusion as an extreme value. Single-person households were also excluded.

Classification of the households into four types

In these surveys, a household was defined as persons living together with shared economic and food resources. The classification of households into four types has been described in earlier publications,[8,9] these are: (a) dual burden, (b) underweight, (c) overweight and (d) normal weight. All classes of households may contain any number of normal weight persons. The categorization of the households was based on available data for the individuals within the household. Individuals who were excluded from classification or who had missing data for height, weight or age did not contribute to the classification of the household. Thus, some overweight or underweight individuals who had missing information were excluded. The two comparison household types that are most relevant for prevention programs are:

(1) the underweight household (households with one or more persons who are underweight and no overweight persons); and
(2) the overweight household (households with one or more overweight and no underweight persons).

Independent variables

Per capita household income. Per capita household income was calculated using total household expenditure or income, divided by the total number of persons living in the household. Per capita household income was used to rank households by income tertiles for each country. Total household income was initially measured either as a total household expenditure or total household income variable. The definition of the variable as expenditure or income depended on how the variable was created in the original survey. Where both measures were available, total household expenditures were used because they were a better measure of permanent income and were subject to less systematic measurement error. Purchasing Power Parity (PPP) data from the World Bank were used to create comparable GNP per capita measures across these seven countries.

Urban residence. Urban residence was defined as a dichotomous variable; all households were categorized as either urban or not urban. In countries with multiple categories of types of residence, the variable was defined in order to reflect (as closely as possible) an urban type of lifestyle. Generally speaking, urban was defined as a residence in a metropolitan area and all other households were deemed nonurban.

Control variables

Household size. All logistical models controlled for actual household size in order to account for the greater probability of having both conditions coexisting in a larger household. Household size was entered in the model as a covariate, based on the number of individuals included in the household surveys.

Region. The definition of region was based on known economic and dietary differences for each country, or standard region definitions commonly used. Region was associated with income, urban residence, and also the dual burden household—and thus was considered to be a potential confounder in all seven countries. This was expected to be due to regional differences in behavior patterns, diet and culture that exist within the country.

Urban residence or income. Urban residence was included as a control variable when testing the effects of income. Likewise, income was included as a control variable when testing the effects of urban residence.

Statistical analysis

The data sets were created using SAS statistical software.[18] The risk associations were expected to differ according to the GNP level of the country and to the reference groups. Statistical analysis was performed separately for each country using multinomial logistic regression and STATA statistical software.[19] Multinomial logistic models for each country tested the likelihood of being a dual burden household as a function of urban residence and income—controlling for household size, region of residence within each country, and either urban residence or income, as appropriate. The models first used the underweight household as reference, but were repeated using the overweight household as reference. The effect of urban residence across income tertiles was tested to determine possible interaction between urban residence and income. Owing to the differences in household size across the countries, predicted probabilities of dual burden household were used to compare the likelihood of dual burden households across the seven countries, while controlling for household size. Similar to adjusted prevalence, predicted probabilities were calculated based on an imposed value. In this analysis a household size of four, the median value of household size for the seven surveys, was used.

Results

The prevalence of the dual burden household

Figure 1 shows the prevalence of dual burden households being largest in the Kyrgyz Republic (15. 5%), which is a low- to middle-GNP country based on a GNP comparison of the seven countries. The lowest prevalence of dual burden households occurs at both ends of the per capita GNP comparison—Vietnam (3.7%) and the United States (5.4%), respectively. In Figure 1, the seven countries are ranked in according to their GNP (lowest to highest): Vietnam, China, the Kyrgyz Republic, Indonesia, Russia, Brazil and the United States.

The solid bars show the crude prevalence values, not adjusted for household size. The value to the right (shaded bars) shows the results based on the predicted probabilities transformed into percentages for the purpose of comparison to the crude prevalence. The predicted probabilities, based on a household size of four, indicate the prevalence of dual burden households would be higher in countries such as the United States and Russia, which have a smaller household size but would be lower in countries with a larger household size. Figure 1 shows that, after controlling for household size, the comparison of dual burden household prevalence is that of an inverted U-shaped curve, with the highest prevalences in the middle range of GNP.

The prevalence of underweight and overweight

Table 1 shows the prevalence of underweight and overweight children and adults in each of the seven countries. The highest prevalences for underweight adults and children are in Vietnam and the lowest are in the United States. For overweight prevalences, the results are the opposite, with the lowest prevalences being in Vietnam and the highest in the United States. Table 1 also shows that, within every country, the prevalence of underweight is higher among children than among adults. In contrast, adults have a higher prevalence of overweight compared to children in each of these seven countries.

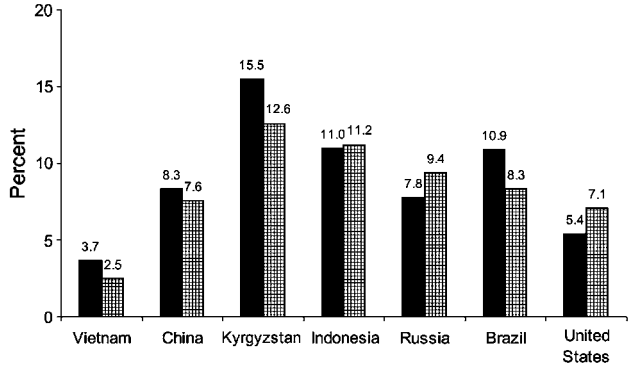

Figure 1 The Prevalence of dual burden households is highest in the middle GNP countries.

Dual burden as a proportion of underweight and overweight household types

Table 1 shows the dual burden household as a proportion of all households with an underweight person. The dual burden household represented 22–63% of underweight households in six of the seven countries, excluding Vietnam. A similar analysis was carried out focusing on households with an overweight person. Table 1 also shows the dual burden household represented 7.9–60% of all households with an overweight individual. The dual burden household represented a relatively high proportion of all households with an overweight person, particularly in countries experiencing the early phases of the nutrition transition (ie where underweight and undernutrition prevalences were relatively high and overweight and obesity prevalences were minimal). In Vietnam, the country at the earliest stages of the nutrition transition, the dual burden households represented only 5% with an underweight individual, but 60% with an overweight individual.

The dual burden household *vs* the underweight household

In general, the dual burden households were associated with high income and urban residence when compared to households with an underweight person.

Income. As shown in Table 2, high-income households were more likely to be classified as dual burden in five of the seven countries, when compared to underweight households. These results were statistically significant. For the Kyrgyz Republic and Russia, there was no significant association, with odds ratios near unity. All models controlled for household size, urban residence and region within each country.

Urban residence. Table 2 also shows that in five of the seven countries, the dual burden household was significantly different according to urban residence, when compared to the underweight household. In the Kyrgyz Republic, urban residence was inversely associated with being a dual burden household; however, in the other countries the association was positive. The results for the United States and Russia were not statistically significant.

The dual burden household *vs* the overweight household

In most surveys there were no significant differences between the dual burden household and the overweight household type.

Household income. When the overweight household was used as the reference, low household income was only associated with being a dual burden household in Brazil and Russia. All models controlled for household size, urban residence and region within each country.

Table 2 Odds ratios associated with the dual burden household: income and urban residence

Characteristic	*Vietnam*	*China*	*Kyrgyz Republic*	*Indonesia*	*Russia*	*Brazil*	*United States*
Dual burden vs underweight household							
High income	3.7 (1.6, 8.6)*	1.8 (1.2, 2.5)**	1.1 (0.65, 1.9)	3.1 (2.5, 4.0)***	1.1 (0.66, 2.0)	2.6 (2.1, 3.2)***	1.6 (1.1, 2.3)*
Urban residence	5.3 (2.8, 10)***	2.0 (1.4,2.6)***	0.6 (0.4, 0.89)**	3.2 (2.7, 3.8)***	0.78 (0.47, 1.3)	1.5 (1.8, 2.1)***	0.92 (0.67, 1.3)
Interaction of income and urban residence: effect of urban residence by income tertile							
Low income	1.5 (0.27, 7.9)	2.7 (1.4, 5.1)*	0.48 (0.21, 1.1)	3.0 (2.1, 4.2)*	0.47 (0.23, 0.98)*	1.8 (1.4, 2.3)*	0.94 (0.58, 1.5)
Middle income	6.3 (1.5, 26.2)*	1.6 (0.94, 2.6)	0.41 (0.20, 0.84)*	2.5 (1.8, 3.4)*	1.1 (0.47, 2.57)	1.8 (1.4, 2.4)*	0.67 (0.4, 1.1)
High income	7.4	2.0	1.32	2.2	1.3	1.8	0.98
Dual burden vs overweight household							
Low income	0.63 (0.19, 2.0)	0.94 (0.65, 1.35)	1.42 (0.97, 2.1)	1.1 (0.83, 1.4)	1.7 (1.1, 2.4)**	1.6 (1.3, 1.9)***	1.1 (0.81, 1.4)
Urban residence	1.3 (0.5, 3.4)	1.1 (0.79, 1.42)	1.0 (0.7, 1.5)	1.1 (0.87, 1.3)	1.9 (1.4, 2.6)*	1.3 (1.1, 1.5)*	1.1 (0.89, 1.4)

*$P<0.05$, **$P<0.01$, ***$P<0.001$.

Urban residence. When compared to the overweight household, the dual burden household was positively and significantly associated with urban residence in Brazil and Russia.

Interaction between urban residence and income

Stratifying by income showed evidence for an interaction between income and urban residence associated with the dual burden household—when the underweight household was used as reference. In Table 2, the odds ratios associated with urban residence are shown stratifying by low-, middle- and high-income. All models controlled for household size and region of residence. The effect of urban residence differed between low-, middle- and high-income households for all countries except Brazil and the United States. In Vietnam, the Kyrgyz Republic and Russia, the urban effect was less within the low-income households—the group most likely to be included in any programs focusing on the prevention of undernutrition. However, the urban effect was strongest among low-income households in China and Indonesia.

Discussion

The dual burden household occurs in all countries, but is a particular concern in countries in the middle ranges of per capita GNP. These countries have the highest prevalence of dual burden households and are also rapidly undergoing the chronic disease phase of the nutrition transition.[6,7] In Vietnam, there is a very low prevalence of dual burden households, reflecting the low prevalence of overweight and obesity in the population as a whole. In the other countries, dual burden households represent more than 20% of all households containing at least one underweight person (Table 1). Generally, the dual burden households are high income, whereas undernutrition interventions target low-income households. However, in the Kyrgyz Republic and Russia, income is not strongly associated with the dual burden condition. Thus, in Russia and the Kyrgyz Republic, undernutrition interventions targeted to low-income households are likely to include dual burden households. Likewise, in China and Indonesia, low-income urban households are approximately three times more likely to be dual burden compared to their nonurban counterparts. Thus, nutrition interventions in urban China and Indonesia must consider the possibility that a low-income urban household includes an overweight or obese individual. Undernutrition prevention programs in these countries must adapt their messages to more specifically target supplementary foods or nutrients to the underweight or undernourished individual. Greater consideration should be given to understanding the underlying behavioral, nutritional and lifestyle factors that contribute to clustering of undernutrition and overweight/obesity in the low income, urban environment.

Given the rising global obesity prevalence,[7,20,21] there is an increasing need to prevent overweight—even in low GNP countries; therefore, the socio-demographic comparisons of the dual burden household *vs* the overweight household are important for all countries. The lack of statistically significant differences illustrates the difficulty in separating the dual burden households from overweight households if interventions are targeted based on income or urban residence. Overweight and obesity prevention programs need to consider the likelihood that their target households may also include underweight individuals. This is particularly important if the intervention encourages changes to the household diet. For example, if the intervention recommends a reduced fat diet, and if this change is made at the household level, the reduced energy density could exacerbate the risks to individuals within the household who are already underweight.

Dual burden and overweight households were only significantly different in two countries: Brazil and Russia. In both cases, dual burden households were more likely to be

low-income and to reside in urban areas. Thus, in Brazil and Russia obesity programs in urban low-income communities should consider the increased likelihood of underweight and undernutrition as a concern for others in the household. Odds ratios for income and urban residence in China, Indonesia and the United States are near unity. Thus, in these countries, the dual burden household is likely to be included in any obesity intervention that is targeted based on income or urban residence.

Identifying the dual burden household is important because it represents a clustering of opposite types of malnutrition among individuals sharing the same household environment. Furthermore, the coexistence of two or more individuals representing opposite sides of the energy balance equation presents a unique difficulty for public health interventions. We must address each problem because of the health risks and societal costs associated with each condition. An intervention that is designed to prevent one problem might exacerbate the other as found in child intervention programs in Chile.[21,22] This is especially true if dual burden households are likely to be included in the target population for underweight or overweight prevention programs.

Although it is beyond the scope of this paper to explore in detail, there has been some some investigation of the demographic composition of the dual burden pairs in each of the seven surveyed countries. In an earlier paper, the age combination of dual burden pairs was explored and four main patterns were found to exist using the China survey.[9] These were: (1) the underweight child 2–9.9 y paired with an overweight young adult 18–39.9 y; (2) the underweight adolescent 10–17.9 y paired with a non-elder adult 18–59.9 y; (3) the underweight young adult 18–39.9 y paired with an overweight child 2–9.9 y and (4) an underweight young adult 18–39.9 y paired with an overweight middle adult 40–59.9 y. Statistical comparisons tested whether these four dual burden types differed in China, but due to limitations of the sample size, the only statistically significant result showed that type 4 was significantly more likely to be from a high-income household than other dual burden pairs. Preliminary analysis of all seven countries surveyed showed a common pattern only after combining pair types 1 and 2 (the underweight child less than 18 y of age together with a non-elder adult). This pair combination represented 31.6% of all dual burden pairs in Vietnam, 36.6% of all pairs in China, and 50% or more of the dual burden pairs in the five remaining countries. Further breakdown of the pair types by gender, as well as age, was not possible due to very small sample sizes.

The extent to which cultural differences, food availability, dieting, and access to health care and/or infectious disease explain the differences in patterns across countries with different levels of economic growth is not yet clear. However, differences in access to health care, average rainfall, annual temperatures and other environmental and social conditions may also contribute to the dual burden phenomenon. Detailed quantitative and qualitative information is needed to better understand the underlying causes of the dual burden condition in a particular household, or the patterns that exist in a particular country. In one household, infectious disease may explain why one person is underweight and another overweight in spite of sufficient food; whereas, a different dual burden household might occur as the result of an eating disorder, such as anorexia nervosa or bulimia. In low-income urban households the coexistence of overweight and obesity may occur simply as the result of rapid changes in the food supply and/or age-specific differences in risks related to obesity *vs* underweight.

As shown in Table 1, the prevalence of overweight and obesity is uniformly higher among the adult population and the prevalence of underweight is higher in children. Although it was not possible to assess the family relationships of the dual burden pairs, the underweight child/overweight adult pair combinations are closely related. The fact that this pair type was the most common subgroup in all countries indicates that the immediate age-specific risks may temporarily over-ride common genetic and environmental factors. For example, individuals in a household may have very different energy density needs related to physiological changes throughout the life cycle. Furthermore, an underweight child may be independently predisposed to becoming overweight or obese later in life. Environmental factors, such as activity patterns and foods available at school and work, could contribute to differences in energy intake and expenditure. Thus, individuals with shared genetic and household environmental risk factors may have sufficiently different lifestyle patterns related to external social, cultural and physiological factors.

Understanding the underlying causes of underweight and overweight in each dual burden household requires detailed information not available from these surveys. Although some national surveys do have individual medical examinations, each survey differs regarding the quality and detail of information collected. Further exploration is needed to understand the specific causes of the dual burden condition and to make appropriate policy recommendations. Regardless of the underlying cause of the dual burden condition, it is appropriate for all physicians and health care professionals to consider the health risks of all persons within a household before making dietary recommendations that involve drastic changes to the household diet. In particular, parents who may be dieting should be made aware of the energy density needs of any young children at home. Energy restriction should be individualized. Lifestyle recommendations for the whole household should focus on increasing physical activity and fruit and vegetable intakes. Increasing fruit and vegetable intakes will also reduce the risks associated with heart disease and diabetes and possibly improve micronutrient intakes for undernourished persons. Likewise, underweight and overweight persons can benefit equally from increased physical activity. Physical activity combined

with adequate energy and protein can help build muscle mass, which can contribute to healthy body composition and reductions in long-term chronic disease risks.

The prevalence of dual burden households in this cross-sectional comparison illustrates that this phenomenon is not a statistical aberration, but rather a pattern of global importance. Furthermore, dual burden households are most prevalent in countries that are experiencing the chronic disease phase of the nutrition transition. Thus, these households are found in countries where there is an increasing focus on the prevention of overweight and obesity. Paradoxically, the presence of an underweight person together with an overweight individual in the same household underscores the continuing importance of undernutrition. In this respect, prevention programs should consider, not only the nutrition concerns of a single individual, but of the whole household. More specifically, nutrition interventions targeting 'at-risk' individuals should be cautioned against making recommendations that would alter household diets and jeopardize vulnerable persons within the same household. Instead, prevention programs should transmit health messages that contribute to the optimal weight and good health of all persons in the household.

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