European Journal of Clinical Nutrition (2004) 58, 660–666
 0954-3007/04 $25.00
www.nature.com/ejcn

ORIGINAL COMMUNICATION

Changes in the nutritional status of Bolivian women 1994–1998: demographic and social predictors

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Introduction: Bolivia, as one of the poorest Latin American countries, has dealt with the problems of undernutrition for the last 50 y. Little importance has been given to the increase in overweight and obesity among the population, despite the scientific evidence linking overweight and obesity with mortality and morbidity.
Objective: To describe the social and demographic determinants of the nutritional status among women in Bolivia between 1989 and 1998 to gain a better understanding of the nutrition transition phenomena and to identify urgent research needs.
Methodology: Secondary analysis of the raw data of the Bolivian National Demographic and Health Surveys of 1994 and 1998. Changes in the prevalence of underweight, obesity and overweight are described by sociodemographic characteristics of Bolivian women. Social and demographic determinants of nutritional status have been fitted into a logistic model.
Results: The prevalence of overweight (defined as $25 \leq \text{BMI} < 30\,\text{kg/m}^2$) among women of reproductive age (20–44 y) increased by 9 percentage points between 1994 and 1998 ($P<0.001$), while the prevalence of normal BMI decreased by 10 percentage points ($P<0.001$). The decrease in the prevalence of underweight (defined as BMI $<18.5\,\text{kg/m}^2$) from 2.4% in 1994 to less than 1% in 1998 was statistically significant ($P<0.001$). Obesity (defined as BMI $\geq 30\,\text{kg/m}^2$) was positively associated with geographical region ($P=0.001$), educational level ($P<0.001$), age ($P=0.003$) and total number of children ($P=0.001$) and negatively associated to rural locality ($P=0.001$) and native languages ($P<0.001$). Overweight was inversely associated with rural locality ($P=0.013$) and with Quechua language ($P=0.04$), while the total number of children ($P<0.001$) and year of survey ($P<0.001$) were positively associated. Underweight decreased dramatically ($P<0.001$), being positively associated with the region of residence ($P=0.04$) and inversely associated with the total number of children ($P=0.006$).
Conclusion: The present study suggests that the population of Bolivia is in a transitional stage, with overweight becoming as much of a problem as undernutrition.
European Journal of Clinical Nutrition (2004) **58,** 660–666. doi:10.1038/sj.ejcn.1601862

Keywords: Bolivia; nutritional transition; nutritional status; overweight; women; DHS

Introduction

Nutritional transition has been defined as the adoption of Western diets by developing societies, to the detriment of traditional foods. This shift in diet patterns, in addition to a change in physical activity, increased use of alcohol and tobacco and increased stress is also related to rapid increases in the prevalence of overweight, obesity and hence to other chronic and degenerative diseases (Popkin, 2001; Kim *et al*, 2001).

In Latin America, dietary patterns and lifestyles are changing dramatically, leading to a rapid increase in the prevalence of obesity (Filozof *et al*, 2001); after which, chronic nontransmissible diseases are becoming an important public health burden (Peña and Bacallao, 2001; Thompson and Wolf, 2001), while undernutrition is still affecting large sectors of the population (Martorell *et al*, 1998).

Bolivia is one of the poorest countries of Latin America, with more than half of the total population living under the national poverty line. Many studies have been carried out to date on nutritional, demographic and health issues, providing nutritional data, but focusing mainly on child undernutrition and overnutrition (de Onis *et al*, 2000; de Onis &

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Received 13 March 2003; revised 9 July 2003; accepted 31 July 2003

Blossner, 2000). These data also provide information on overweight and obesity among women; however, the changes in prevalence have not been reported (Martorell *et al*, 1998), nor the associated socioeconomic and ecological factors. Since the association between overweight-obesity and several diseases such as noninsulin-dependent diabetes mellitus (Barcelo *et al*, 2001), cardiovascular disease (Freedman *et al*, 1999, 2001; Gunnell *et al*, 1998), hypertension, gall bladder disease and specific types of cancer (Rauscher *et al*, 2000; Murphy *et al*, 2000) has been well established during the last decade (Solomon & Manson, 1997; Monteiro *et al*, 2001), this study focuses on predictors of overweight and obesity among Bolivian women. The present findings may be applied to target future interventions and research.

Methodology

Two data sets from the Demographic and Health Surveys (DHS) collected in Bolivia between 1994 and 1998 were used with the authorisation of Macro International, Coordinator of the DHS Program. The data collection for the DHS was carried out by the Bolivian National Institute of Statistics and the main results have been published elsewhere (Instituto Nacional de Estadística, 1994, 1998).

Briefly, both surveys were performed on representative stratified samples of the Bolivian population, based on the sampling frame of the National Population Census of 1992. The tools for these surveys included (i) a 'household questionnaire' including social and demographic characteristics, income activity, educational level, household equipment and access to public services (water, electricity) and (ii) an 'individual women questionnaire', focusing on reproductive history, contraceptive methods, current pregnancy, breastfeeding practices, anaemia (only 1998), marital status and anthropometric measures for all children and for women if they had delivered a baby in the previous 3–5 y. The individual questionnaire was applied to a total of 9114 women in 1994 and 11 187 women in 1998. A data set was created including all two sets of data to perform the analysis.

As anthropometric data for women were only recorded in the DHS if women had had a pregnancy in the previous 3–5 y, women were excluded when weight or height values were missing or if either of them were out of range; to overcome possible confounding, women pregnant at the time of the interview were not considered for the present study. Women who had had children in the previous year (40% of both samples) were included in the analysis, as a preliminary univariate assessment of the data showed that the effect of having had a child in the last year was not associated with nutritional status as expressed in terms of body mass index (BMI) ($P>0.07$). Since this value is marginally significant, further univariate logistic models were fitted with overweight and obesity as dependent variables and 'pregnancy/births in the last year' as the independent variable. The obtained *P*-values were, respectively, 0.379 and 0.89 for the overall effect of the variable. None of the categories was statistically significant, hence supporting the decision to exclude the independent variable from the analysis.

Although information is available for subjects between 15 and 49 y old, it was decided to eliminate the category between 15 and 19 y because a cutoff point for BMI-for-age in adolescents is still under debate (Cole *et al*, 2000; Lopez *et al*, 2001; Ogden *et al*, 2002; Wang and Wang, 2002). Owing to the few number of women in the 45–49 y age group, this group was merged with the 40–44 y category in order to create the 40–49 y age group. Therefore, a total number of 4527 women, 1949 in 1994 and 2578 in 1998, were retained for analysis. The data were weighted to produce country representative estimates using the weighting factors provided by the data set. The weighting factors were calculated to restore the actual participation of each Bolivian Region (each composed by three departments) as explained elsewhere (Instituto Nacional de Estadística, 1994, 1998).

The χ^2 test was applied to identify the statistical significance of the observed anthropometric differences between the 1994 and 1998 survey data (Carlin & Doyle, 2001). Trend analysis was not possible with only two points in time (Firebaugh, 1997). Logistic regression (Bender & Grouven, 1996; Preisser & Koch, 1997) was applied to determine the predictors of overweight, obesity and undernutrition in Bolivian women. Each of them was included in the model as a dichotomous dependent variable. Educational level (Liberatos *et al*, 1988; Muller, 2002) and literacy were included in the model as they show the final result of the development process (Fernandez *et al*, 2002), locality (urban or rural) and region (high plateau, valleys, low land), which were considered as ecological conditions. Income data were available for less than 50% of the sample, so it could not be included in the model, and therefore 'access to electricity' was used as a marker of wealth in the model, as other variables like 'equipment' (radio, TV, telephone), 'currently breastfeeding' or 'roof material' either did not show statistical significance or decreased the Goodness-of-Fit-test. However, 'access to electricity' was highly correlated with 'locality' ($P<0.001$) and eliminated from the final set of variables. Another factor included in the model was the 'total number of children ever had'. All independent variables were introduced as categorical, with the exception of 'age' and 'number of children ever born', which are continuous. To determine which variable was to be retained in the final model, a backward conditional procedure was used. The removal of variables was at $\alpha>0.05$ for the Wald test. The Hosmer and Lemeshow Goodness-of-Fit test (Lemeshow & Hosmer, 1982) was used to assess whether the model's estimates fit the data at an acceptable level (Bender & Grouven, 1996).

Data management and data analysis were performed using SPSS software (version 11) and EPI-INFO (version 6.04). A *P*-value <0.05 was considered significant.

Results

Table 1 shows the distribution of the studied population. The distribution of women according to the Bolivian region, type of locality and educational achievement were similar in both the surveys.

Table 2 shows the differences in nutritional status of Bolivian women between 1994 and 1998 using BMI as an indicator. In 1998, 10% ($P<0.001$) less women could be considered as having a normal BMI in all age categories. There was a 9% increase in overweight in Bolivian women aged 20–49 y between 1994 and 1998 ($P<0.001$). Overall, undernutrition decreased by 1.5% ($P<0.001$). The overall increase in the prevalence of obesity of 1.4% was not statistically significant at 95% CI ($P=0.089$).

In order to identify the sociodemographic predictors of nutritional status, different regression models were applied. Table 3 shows the odds ratio of obesity, overweight and underweight in Bolivian women by demographic and social characteristics after adjustment for the effects of the other variables. The Hosmer and Lemeshow Goodness-of-Fit-tests provided *P*-values higher than 0.05, implying that the models' estimates fit the data at an acceptable level.

These findings suggest that overweight is a period effect, even after adjusting for other factors like educational level, age, total number of children, region and locality. Bolivian women were 1.6 times more likely to be overweight in 1998 than in 1994 ($P<0.001$), which is a parallel observation to the shift in prevalence. Speaking Spanish and Aymara at

Table 1 Distribution of Bolivian women in each survey according to sociodemographic characteristics

Characteristic	*1994 survey* N*(percent)*	*1998 survey* N*(percent)*
By geographical region		
High plateau	888 (45)	1105 (43)
Low lands	478 (25)	706 (27)
Valley	583 (30)	767 (30)
By place of residence		
Urban	1060 (54)	1542 (60)
Rural	889 (46)	1036 (40)
By educational attainment		
No education	285 (15)	284 (11)
Primary	904 (46)	1160 (45)
Secondary	644 (33)	850 (33)
Higher	116 (6)	284 (11)
By age group (y)		
20–24	500 (26)	696 (27)
25–29	549 (29)	722 (28)
30–34	414 (22)	541 (21)
35–39	312 (16)	413 (16)
40–49	174 (7)	206 (8)
By language spoken at home		
Spanish	1257 (65)	1925 (75)
Aymara	211 (11)	188 (7)
Quechua	439 (22)	429 (16)
Others (foreign and Guarani)	42 (2)	36 (2)
Total number of women	*1949*	*2578*

Table 2 Differences in nutritional status[a] of Bolivian women between 1994 and 1998 according to BMI

	Prevalence of undernutrition in percentage (±CI)			*Prevalence of normal BMI in percentage (±CI)*			*Prevalence of overweight in percentage (±CI)*			*Prevalence of obesity in percentage (±CI)*		
	Survey 1994	*Survey 1998*	P-*value*	*Survey 1994*	*Survey 1998*	P-*value*	*Survey 1994*	*Survey 1998*	P-*value*	*Survey 1994*	*Survey 1998*	P-*value*
Age groups (y)												
20–24	3.2 (±1.5)	0.9 (±0.7)	0.003*	71.5 (±4.0)	62.4 (±3.6)	0.001*	19.2 (±3.5)	29.3 (±3.4)	<0.001*	6.0 (±2.1)	7.4 (±2.0)	0.35
25–29	2.6 (±1.3)	1.3 (±0.8)	0.094	62.8 (±4.0)	56.9 (±3.7)	0.035*	26.3 (±3.7)	34.0 (±3.5)	0.003*	8.4 (±2.3)	7.8 (±2.0)	0.70
30–34	1.2 (±1.1)	0.9 (±0.8)	0.940	62.7 (±4.7)	51.5 (±4.3)	0.001*	26.4 (±4.3)	35.2 (±4.1)	0.004*	9.7 (±2.9)	12.3 (±2.8)	0.20
35–39	1.0 (±1.1)	0.0	0.158	54.6 (±5.5)	47.7 (±4.8)	0.064	32.9 (±5.2)	40.0 (±4.7)	0.051	11.5 (±3.5)	12.3 (±3.2)	0.73
40–49	1.7 (±1.9)	0.0	0.145	58.0 (±7.3)	43.6 (±6.3)	0.004*	31.0 (±6.9)	43.6 (±6.3)	0.009*	9.2 (±4.3)	12.9 (±4.2)	0.25
Region												
High plateau	1.9 (±0.9)	0.9 (±0.6)	0.052	67.7 (±3.1)	55.8 (±2.9)	<0.001*	23.2 (±2.8)	36.7 (±2.8)	<0.001*	7.2 (±1.7)	6.6 (±1.5)	0.59
Low lands	4.0 (±1.7)	0.6 (±0.6)	<0.001*	55.3 (±4.5)	48.9 (±3.7)	0.029*	28.0 (±4.0)	36.3 (±3.5)	0.001*	12.7 (±3.0)	14.3 (±2.6)	0.44
Valleys	0.9 (±0.7)	0.8 (±0.6)	0.878	63.1 (±3.9)	57.8 (±3.5)	0.102	28.7 (±3.7)	30.9 (±3.3)	0.373	7.4 (±2.2)	10.4 (±2.2)	0.05
Level of education												
No educat.	1.7 (±1.6)	0.0	0.081	70.1 (±5.3)	58.7 (±6.0)	0.009*	26.0 (±5.1)	37.0 (±5.6)	0.006*	2.1 (±1.6)	4.3 (±2.4)	0.264
Primary	1.7 (±0.8)	0.5 (±0.4)	0.009*	61.3 (±3.2)	52.3 (±2.9)	<0.001*	26.7 (±2.9)	36.6 (±2.8)	<0.001*	10.3 (±2.0)	10.6 (±1.8)	0.981
Secondary	3.4 (±1.4)	0.9 (±0.6)	<0.001*	61.5 (±3.8)	53.6 (±3.3)	0.002*	25.0 (±3.3)	34.5 (±3.2)	<0.001*	10.1 (±2.3)	11.0 (±2.1)	0.571
Higher	0.9 (±1.7)	2.6 (±1.9)	0.498	69.3 (±8.5)	62.5 (±5.8)	0.276	25.4 (±8.0)	26.5 (±5.2)	0.882	4.4 (±3.8)	8.5 (±3.2)	0.231

[a]Undernutrition defined as BMI $<18.5\,kg/m^2$; normal BMI as: $18.5\,kg/m^2 \leq BMI \leq 25\,kg/m^2$; overweight as: $25\,kg/m^2 < BMI < 30\,kg/m^2$; obesity as BMI $\geq 30\,kg/m^2$.
*Indicates statistical significance of the χ^2 test of two proportions at the 0.05 level.

Table 3 Odds ratio of obesity, overweight and underweight in Bolivian women by demographic and social characteristics after adjustment for the effects of other variables

	Obesity[a]		*Overweight*[b]		*Underweight*[c]	
	OR (95.0% CI)	P-*value*	*OR (95.0% CI)*	P-*value*	*OR (95.0% CI)*	P-*value*
Geographical region		0.001		NS		0.042
High plateau (reference)	1				1	
Low lands	1.60 (1.23–2.06)	<0.001			1.57 (0.90–2.74)	0.11
Valleys	1.47 (1.12–1.92)	0.005			0.65 (0.33–1.30)	0.22
Locality						
Urban (reference)	1		1			
Rural	0.44 (0.33–0.58)	<0.001	0.81 (0.69–0.95)	0.01		NS
Educational level		<0.001		NS		NS
No education (reference)	1					
Primary	3.38 (2.03–5.66)	<0.001				
Secondary	2.98 (1.71–5.18)	<0.001				
Higher education	1.79 (0.92–3.49)	0.09				
Age (y)[d]	1.03 (1.01–1.06)	0.003	1.01 (0.99–1.03)	0.08		NS
Total number of children[e]	1.08 (1.02–1.14)	0.001	1.08 (1.04–1.12)	<0.001	0.83 (0.74–0.94)	0.004
Language spoken at home		<0.001				NS
Spanish (reference)	1		1			
Aymara	0.43 (0.23–0.81)	0.009	1.20 (0.92–1.50)	0.02		
Quechua	0.66 (0.44–0.98)	0.04	0.81 (0.70–0.99)	0.04		
Other (Guarani, foreign)	2.4 (1.27–4.50)	0.007	0.80 (0.47–1.36)	0.42		
Year of survey						
Survey 1994 (reference)			1		1	
Survey 1998		NS	1.54 (1.35–1.76)	<0.001	0.35 (0.20–0.60)	<0.001

[a]The Hosmer and Lemeshow Goodness-of-Fit-test—obesity: P=0.772 implying that the model fits the data at an acceptable level.
[b]The Hosmer and Lemeshow Goodness-of-Fit-test—overweight: P=0.412 implying that the model fits the data at an acceptable level.
[c]The Hosmer and Lemeshow Goodness-of-Fit-test—underweight: P=0.177 implying that the model fits the data at an acceptable level.
[d]Increment for age: 1 y.
[e]Increment for total number of children: one child.
NS: not significant.

home are positively associated with overweight in Bolivian women ($P<0.001$), while speaking Quechua at home decreases the odds of being overweight by 19%. Each child born to a woman adds her a 1.08 likelihood of becoming overweight ($P<0.001$).

Underweight was inversely associated with the year of survey ($P<0.001$) and the number of children ($P=0.007$). In 1998, women were 65% less likely to be considered as undernourished than in 1994. This suggests a dramatic improvement in nutritional status. The protective role of the number of children corresponds with the previous statement for overweight. Each child lowers the odds of being underweight by 17%.

The positive associated predictors of obesity were age ($P=0.004$), total number of children ($P=0.003$), educational level ($P<0.001$) and locality ($P<0.001$), while the inversely associated predictor was language ($P<0.001$). The year of survey, however, did not reach statistical significance and therefore was not included in the model.

Individual models for each year were also fitted. However, because the Hosmer and Lemeshow Goodness-of-Fit test gave $P<0.05$ values, the estimates did not fit the data at an acceptable level (95% CI), impeding further comparisons within each year.

Discussion

Among others (Ruel & Menon, 2002), the main advantage of using the DHS/NIS data for the present study is that they are representative of the country, which is supported by the homogeneous distribution of subjects by region, locality and educational level. In this case, as the samples are representative for Bolivia and all households have been weighted for extrapolation to the whole population, cohort effects on the observed results are therefore assumed to be negligiable (Firebaugh, 1997). Although having had a child in the previous year could be a confounding factor in BMI, separate analyses including only those women who had not had a child in the previous year showed similar figures of prevalence (data not shown). Univariate analysis of other variables such as equipement (radio, TV and telephone), access to electricity and breastfeeding status showed that they are not statistically significant ($P>0.05$) and also decreased the values of the Hosmer and Lemeshow Goodness-of-Fit test; therefore they have been excluded from the final model. Locality and access to electricity were highly correlated ($P<0.001$), which may be explained by the fact that in Bolivia electricity is mainly available only in urban areas, despite the efforts to improve access to electricity by the local authorities.

Two points in time do not allow the estimation of trends and analysis of time effect, cohort effects or ageing effects (Firebaugh, 1997). However, two points in time have been previously used (Wang *et al*, 2002) to compare prevalences and provide sufficient information for public health policy purposes. The period effect observed for both overweight and underweight, suggests first, a shift from a normal BMI towards overweight among women in all age groups in a very short period of 4 y and second, an improvement in the nutritional status of Bolivian women in reproductive age translated into almost no prevalence of undernutrition (defined as BMI $<18.5\,kg/m^2$).

Although some studies have mentioned Bolivian data among many other countries (Martorell *et al*, 1998, 2000), some unique characteristics have been set aside. Bolivia, being the poorest country in the region, has nevertheless maintained a policy of economic stability and growth in the last decade. Despite the overall and sustained economic growth, the data presented in this paper suggest that Bolivia is undergoing the early stages of a nutritional transition, where the prevalence of overweight is increasing, while underweight is almost disappearing among women of reproductive age.

This study found that education achievement is negatively associated with overweight and obesity as previously reported for obesity in Brazil (Monteiro *et al*, 2001). Highly educated women are 1.5 times less likely to be obese than those with only primary or secondary education. As the observed difference in the prevalence of obesity in Bolivian women is not statistically significant, the variable for period, year of survey, was removed from the model ($P>0.05$). This also suggests that determinants remained the same between 1994 and 1998. Hence, the observed sociodemographic predictors of obesity may help to target preventive interventions. In Bolivia, around 70% of the population is Spanish-speaking. The results suggest that the native Bolivian population, mainly composed of those speaking the Aymara and Quechua languages, are at lower risk ($P<0.05$) of obesity than the majority of the white and mixed population who are speaking Spanish at home. However, during the last survey, 10% more people reported to speak Spanish at home when compared to the previous one, while 3% less people reported speaking Aymara and 6% less reported speaking Quechua at home.

The level of urbanisation has been reported to be one of the main predictors of nutritional transition (Popkin, 2001). In agreement with previous studies in developing countries (Monteiro *et al*, 1995; Popkin, 2001), the present results suggest that Bolivian women living in urban areas are 1.2 times more likely to be overweight than those in rural areas ($P=0.016$), and even 2.3 times more likely to be obese. This may be associated with different eating patterns between rural and urban populations and lower physical activity due to urbanisation.

Nutritional transition has been defined as the adoption of Western diets by developing societies to the detriment of traditional foods, leading to increased prevalence of overweight (BMI $>25\,kg/m^2$) (Popkin, 2001). This shift in the prevalence of overweight in Bolivia suggests that obesity and other chronic and degenerative diseases (Martorell *et al*, 1998; Bianchini *et al*, 2002) may become a burden for public health budgets in the near future (Thompson & Wolf, 2001). Obesity impairs quality of life (Kolotkin *et al*, 2001) and has been identified as a strong predictor of mortality from all causes combined (Solomon & Manson, 1997), among which are cardiovascular (Murray & Lopez, 1997) disease and some cancers (Bianchini *et al*, 2002).

This paper describes a significant shift in the prevalence of overweight among women, but not a statistically significant increase in the prevalence of obesity. This probably reflects the fact that the nutritional transition in Bolivia may be in an incipient state; however, our findings, added to previous ones (Martorell *et al*, 1998; de Onis & Blossner, 2000) on the prevalence of obesity in children, suggest that it is still possible to prevent negative outcomes. Otherwise, if one considers that the wealthy neighbouring country Chile showed a 5% increase in the prevalence of overweight among children in a period of 14 years, while the prevalence of obesity increased by 10% in the same period (Kain *et al*, 2002), it is possible to infer that eventually all the problems linked to the epidemiological transition may touch bigger proportions of the Bolivian population.

Living in the Bolivian low lands increases the likelihood of overweight and obesity among women. The explanatory reasons may be first that the low land region is the more wealthy region of the country. This region has experienced a dramatic improvement in the living conditions of the population in the last 25 y, with a consequent change in physical activity, and represents a more advanced stage of nutritional transition. A second reason may be the different eating patterns between regions and a shift towards the so-called Western diet. On the one hand, the traditional food in the low lands of Bolivia, although rich in fruits, starchy roots like cassava and vegetables, is also very rich in added lipids, as many of the traditional dishes are fried; however, it is less monotonous than that in the highlands and valleys. On the other hand, fast development brought new eating patterns, mainly fast food and sugary beverages, which have become a daily part of the diet.

A small-scale study carried out among first year students at the public university of La Paz (Guzmán *et al*, 1996) found that the nutritional status of male students was poorer than the female students. A better nutritional status of women has been observed in both developed and developing countries (Anjos, 1992; Monteiro *et al*, 1995; Martorell *et al*, 1998); therefore, research is urgently needed to depict the prevalence of undernutrition, overweight and obesity in particular including Bolivian school age children and adolescents (Must, 1996; Moor & Davies, 2001), as well as to describe the underlying causes. Lifestyles like physical activity or eating patterns consolidate early in life and may predict health outcomes in adulthood (Dietz, 1998; Wright

et al, 2001; Gillis *et al*, 2002). Research is also needed in males and the elderly, groups that are normally not included in health surveys and for whom the risk of chronic nontransmissible diseases would be of greater concern.

The present findings are the first to describe changes in overweight among Bolivian women. This study suggests that Bolivia is undergoing an incipient stage of nutritional transition, and that the implementation of health campaigns may be pertinent in order to prevent future undesirable health outcomes.

Acknowledgements

This study is part of a research project partially funded by *Nutrition Tiers Monde*, a Belgian nonprofit organisation. We thank Mrs Christa Dreezen for the statistical advice, and Mr and Mrs David and An Bolton-Eeraerts for correcting the language.

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