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Predicting sedentarism and its impact on caloric requirements

Introduction

A recent study conducted by PhD candidate Jacob Michels and Agricultural economist John Beghin delves into the question of whether global estimates of food insecure populations need a reevaluation of their methodology to account for increasing sedentarism. This reevaluation is prompted by the increasing prevalence of sedentary lifestyles worldwide, which calls for a redefinition of caloric thresholds indicating the onset of food insecurity. In this short article, we provide a nontechnical summary of their investigation recently published in Michels and Beghin (2024).

The analysis begins with a conceptual model that accounts for labor allocation in four types of activities related to work and leisure, distinguishing between physically demanding activities (physical work or active leisure) and sedentary human-capital-intensive activities (computer work, playing games online). The model explores the impact of higher relative returns to and productivity improvements in sedentary activities, revealing an increasing trend in sedentarism. This foundational model guides their empirical investigation, aiming to correct physical activity levels (PALs) that underlie food security estimates to account for the increase in sedentary work and leisure worldwide.

The authors assembled a unique dataset encompassing sitting-time from national surveys and covariates for 136 countries from 2002 to 2022. Employing econometric techniques, they estimate how sitting time, serving as a proxy for sedentarism, varies with increasing income, decreasing rurality, increasing education attainment, increasing access to the internet, and decreasing income inequality. The chosen econometric estimations are then formally aggregated into a robust transfer function. This transfer function predicts country-specific (e.g., Pakistan) and year-specific (e.g., 2020) sitting times based on covariate values. Once the new sitting time is predicted, the PAL is adjusted downward to account for increased sedentary time between its original value in 1985 and more recently in 2020. Notably, agencies (e.g., FAO) estimating food insecurity often use a minimum caloric requirement (Minimum Dietary Energy Requirement or MDER), indicating the food insecurity threshold, which has not been adjusted since the mid-1980s. The approach developed by Michels and Beghin allows for measuring the change in PAL between 1985 and 2020 with corrections for increased sedentarism, expressed as a multiple of the basal metabolic rate (BMR) estimated in 1985.

Regression Results

The authors estimate 24 alternative models using robust regression techniques. They select 5 best models based on the goodness of fit (adjusted R squared above 0.7) and consistency of estimated impacts of the covariates with the conceptual model. Table 1 summarizes the preferred five models' results in terms of estimated

direction of the impact of the covariate (positive or negative) and its statistical significance for these 5 best models.

The preferred models exhibit expected signs for the estimated responses, indicating a positive impact of better web access, increasing education, income, and urbanization (the opposite of rurality) on sitting time. Additionally, a wider income distribution is associated with reduced average sitting time. All preferred models include a series of fixed effects (years, data sources, and a few others), which capture omitted variables and biases associated with particular data sources or years.

Predicting Sitting Time

Table 2 presents aggregated regression coefficients in slope and elasticity forms for the five preferred models. They are essentially averaged after some transformations for comparability. These coefficients of the two transfer functions are instrumental in constructing predictions of sitting time for any chosen nation. Michels and Beghin illustrate the transfer functions with some examples. They proceed to predict the change in sitting time from 1985 to 2020 for four countries: Democratic Republic of the Congo (DRC), Ethiopia, Italy, and Pakistan. Table 3 illustrates the estimated PAL inflation for a female in the 30-60 age group with a weight of 55kg and a male in the 18-30 age group with a weight of 65 kg. The table displays the MDER inflation as a percentage change, applicable to all gender and age groups. These changes are then applied to derive calorie reductions, leading to the "corrected" MDER accounting for more sedentary time during the day.

Table 3 shows that PAL inflation is approximately 41 calories per day for the female MDER case and 53 calories per day for the male MDER example, averaging over the four countries. The estimated PAL inflation for these four countries is 2.12%. These seemingly small changes have significant implications, translating to millions fewer people being deemed food insecure in assessments such as those conducted by the USDA or FAO. For instance, in the case of Pakistan, a modest PAL correction of 1.278% implies a notable 6% decrease in the Prevalence of Undernourishment (PoU), representing the share of the population facing food insecurity as predicted by USDA or FAO global food security models.

The contribution of this investigation lies in quantifying the global change in PAL and reductions in MDERs resulting from increased sedentarism. The approach and estimates developed in this analysis are not only applicable but also scalable to a broad range of countries. This makes it feasible to enhance food insecurity estimates, such as FAO's PoU, by estimating country-specific MDERs and their changes over time. Lower MDERs will lead to more accurate PoU estimates, correcting the systematic positive bias implied in the current MDERs and associated food insecurity estimates. An ongoing project is currently undertaking such assessment.

Reference

Michels, Jacob, and John Beghin. "Accounting for the evolution of sedentarism on minimum dietary energy requirements." *Global Food Security* 40 (2024): 100740. https://www.sciencedirect.com/science/article/pii/S2211912424000026

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Table 1. Significance results of five preferred regressions

Variable	Count of Models Variable Appears in	Negative Not Significant	Negative Significant	Positive Significant	Positive Not Significant
Proportion of population on Web	2	0	0	0	2
Proportion on Web Squared	3	0	0	3	0
Rural Population Percentage	5	0	5	0	0
Theil index if income inequality	5	4	0	0	1
Upper Secondary Completion Rate	5	0	0	5	0
GDP Per Capita	5	0	0	2	3

Source: Michels and Beghin (2024)

Table 2. Aggregated estimates in slope and elasticity forms (five best models)

Variable	**Average Value Slope Form**	**Average Value Elasticity Form**
Proportion of population on Web	0.00155257	0.01598409
Rural Population Percentage	-0.01534265	-0.13869909
Theil index if income inequality	-0.45133782	-0.02161740
Upper Secondary Completion Rate	0.99188630	0.14512952
GDP Per Capita	0.00001197	0.05295006
Proportion on Web Squared	0.00014684	0.10269896

Source: Michels and Beghin (2024)

Table 3. 1985-2020 MDER correction with PAL adjustment

	DRC	**Ethiopia**	**Italy**	**Pakistan**
PAL inflation in %	1.681%	1.844%	3.657%	1.278%
Female age 30-60 55kg				
Original 1985 MDER (Kcal/day)	2003.441	2003.441	2003.441	2003.441
PAL inflation (Kcal/day)	33.12	36.274	70.689	25.287
Male age 18-30 65 kg				
Original 1985 MDER (Kcal/day)	2589.902	2589.902	2589.902	2589.902
PAL inflation (Kcal/day)	42.815	46.892	91.381	32.689

Source: Michels and Beghin (2024)

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