

# Navigating the Nutrition Transition: What Is It? How Can Whole Grains Play a Helpful Role?

NOEL T. MUELLER<sup>1</sup>

## ABSTRACT SUMMARY

In this abstract I briefly describe the nutrition transition, how it is taking hold in low- and middle-income countries (LMICs) worldwide, and potential public health interventions emphasizing whole grain foods with a perspective on primordial prevention of noncommunicable chronic diseases (NCDs).

## What Is the Nutrition Transition?

Fueled by urbanization and a global economy, the nutritional landscape in many LMICs has changed more rapidly over the last several decades than at any other time in history (10). In LMICs across diverse regions of the world, Western dietary patterns rich in processed meat, refined carbohydrates, and sugar-sweetened beverages are supplanting traditional diets. In addition to these unfavorable shifts in diet, individuals are decreasing their energy expenditure (9,10).

Concurrent with the nutrition transition, the burden of disease in LMICs has shifted from that of pestilence and famine to one of obesity and NCDs alongside nutrient deficiencies (i.e., epidemiologic transition) (8,14). In conjunction with these nutritional and epidemiological shifts, fertility and mortality rates continue to decline as countries become more industrialized (i.e., demographic transition) (8). And as a result, more deaths worldwide are now attributed to overweight and obesity than to underweight (14). Moreover, in LMICs the burden of diet and physical activity risks now equal that of HIV/AIDS and tuberculosis combined (14). In light of these changes, there is a clear need for a paradigm shift in LMIC public health nutrition efforts.

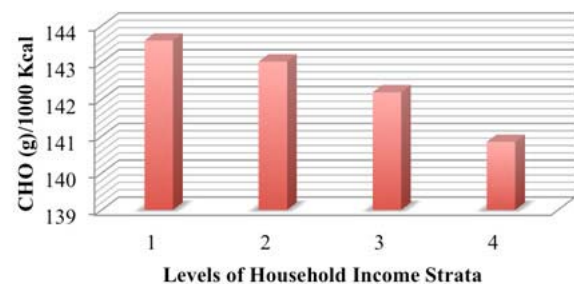
## Whole Grain Intake in LMICs

In comparison to studies on sugar-sweetened beverages, dietary fat, protein, and sodium (all of which contribute to the nutrition transition), systematic research on trends in intake of whole grains in LMICs is sparse. Case studies suggest that intake of coarse grains such as sorghum and millet have declined significantly over the last several decades across Asia, Africa,

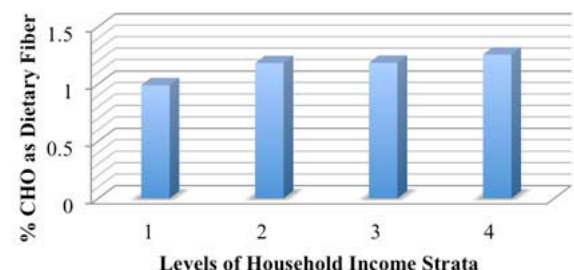
and Latin America, and overall consumption of whole grains remains far below what is recommended (10). By contrast, refined grains such as white bread, rice, and biscuits are becoming increasingly popular staple foods in many of these regions, and are disproportionately consumed by the poor. In Colombia, for example, carbohydrate intake is higher in low income families in children, while whole grain consumption in these children is lower (Figure 1 and Figure 2 present original data from Colombian children in the SIMBA study [7]).

## Evidence for Whole Grains and NCDs

Unlike refined grains, whole grain foods contain ample fibers, resistant starches, vitamins, minerals, phytoestrogens, and antioxidants that may protect against NCDs (11). The epidemiologic evidence for the association between whole grain intake and NCDs is largely consistent, with most studies sug-



**Fig. 1.** Mean carbohydrate (g) per 1000 Kcal in 1025 Colombian children aged 6–10 yrs by household income.



**Fig. 2.** Percent carbohydrate as dietary fiber in 1025 Colombian children aged 6–10 yrs by household income.

<sup>1</sup> Department of Epidemiology, Columbia University, New York, New York 10032, U.S.A. E-mail: [nm2768@columbia.edu](mailto:nm2768@columbia.edu).

gesting diets rich in whole grains are inversely associated with risk of type 2 diabetes (2), cardiovascular diseases (5), and cancer (1,3). In contrast, data from randomized controlled trials are less harmonious and larger high quality trials are warranted (16).

### Whole Grains in Primordial Prevention

While the epidemic of (cardiovascular) risk factors has pervaded the consumer societies, it still has not reached the majority of the developing world. Real grassroot prevention should start by preserving entire risk factor epidemics. Here lies the possibility of averting one of tomorrow's world health problems. For expressing this important concept, I wish to propose the term of proto-prophylaxis or primordial prevention.

—Dr. Toma Strasser, 1978

It has been over three decades since Dr. Strasser's proposal of the term "primordial prevention" and his clairvoyant prediction of the emergence of NCDs in LMICs (12). Fortunately, there may still be a glimmer of hope for preserving risk factor epidemics in these populations. Recent research indicates that policies to promote consumption of whole grains, fruits, vegetables, nuts, and fish and reduce intake of animal fats, and sodium could prevent millions of premature deaths worldwide (6). As children lag behind adults in experiencing the consequences of the nutrition transition, targeting youth for public health nutrition intervention may yield the greatest gains (8).

In addition to population-level policy efforts, educating individuals to replace refined grain staples with whole grain substitutes may be a step in the right direction. A recent study from Sun et al. found that substituting 50 g of white rice with brown rice was associated with a 16% decreased risk of type 2 diabetes, while substitution with other whole grains was associated with a 36% decreased diabetes risk (13). However, in an experimental trial, the substitution of white rice with brown rice over 16 weeks did not have any measureable effect on cardiometabolic disease outcomes in Chinese adults with, or at high risk of, type 2 diabetes (16). Future trials that are larger and longer, and that use alternative whole grain substitutes for refined-grain staples in LMICs are clearly warranted.

### Barriers to Whole Grain Consumption

Notwithstanding the potential health benefits of whole grain foods, levels of whole-grain intake remain low in most parts of the world, including LMICs and their most vulnerable sub-populations. Thus, addressing the barriers to meeting the recommended levels of whole-grain intake in LMICs is an important research priority. A recent study by Zhang *et al.* reported that the main barriers to acceptance of brown rice were the rough texture, unpalatable taste, and higher price. However, after participants tried the brown rice, the majority indicated a willingness to substitute white rice with brown rice (15). Other reasons reported for low whole-grain intake include unfamiliarity with cooking whole grains, limited availability of whole-grain foods, and lack of awareness of the health benefits of whole grains (4).

### Conclusion

Consuming more whole grain foods remains an important part of a healthful dietary pattern, and a way forward in the

prevention of NCDs in regions of the world undergoing the nutrition transition. More observational and experimental research on palatable and affordable whole-grain substitutes for refined-grain staples in LMICs is warranted. Furthermore, considering intake in most countries remains very low, more research on the barriers to increasing whole-grain food consumption, on both the population and individual level, is needed to promote primordial prevention of nutrition related noncommunicable diseases.

### Acknowledgments

I would like to acknowledge Dr. Mark Pereira for stimulating discussions related to this abstract. I would also like to thank the participants in SIMBA (Estudio Longitudinal para la Evaluación de Riesgo Cardiometa**l**ico en Población Joven de Bucaramanga), and Drs. Cristina Villa-Roel, Adriana Buitrago-Lopez, Diana C. Rodríguez, Alvaro E. Duran, Alvaro J. Ruiz, Diana J. Cano, Maria P. Martinez, Paul A. Camacho, Walter Mosquera and Juan G. Ruiz, for their contributions to SIMBA. Finally, I would like to express our gratitude to the clinical and research staff at the Fundación Cardiovascular de Colombia.

SIMBA was supported by the Colombian institute for the development of science and technology (COLCIENCIAS 65660418215). Research reported in this publication was supported by the National Heart, Lung, and Blood Institute of the National Institutes of Health under Award Number T32HL007779. The content is solely the responsibility of the author and does not necessarily represent the official views of the National Institutes of Health.

### References

1. Aune D, Chan DS, Lau R, et al. Dietary fibre, whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies. *BMJ* 2011;343: d6617.
2. de Munter JS, Hu FB, Spiegelman D, Franz M, van Dam RM. Whole grain, bran, and germ intake and risk of type 2 diabetes: a prospective cohort study and systematic review. *PLoS medicine* 2007 Aug;4(8): e261.
3. Jacobs DR, Jr., Marquart L, Slavin J, Kushi LH. Whole-grain intake and cancer: an expanded review and meta-analysis. *Nutrition and cancer* 1998;30(2): 85-96.
4. Kuznesof S, Brownlee IA, Moore C, Richardson DP, Jebb SA, Seal CJ. WHOLEheart study participant acceptance of wholegrain foods. *Appetite* 2012 Aug;59(1): 187-93.
5. Mellen PB, Walsh TF, Herrington DM. Whole grain intake and cardiovascular disease: a meta-analysis. *Nutrition, metabolism, and cardiovascular diseases : NMCD* 2008 May;18(4): 283-90.
6. Mozaffarian D, Capewell S. United Nations' dietary policies to prevent cardiovascular disease. *BMJ* 2011;343: d5747.
7. Mueller NT, Pereira MA, Buitrago-Lopez A et al. Adiposity indices in the prediction of insulin resistance in prepubertal Colombian children. *Public Health Nutrition* 2013 16:248-255.
8. Omran AR. The epidemiologic transition. A theory of the epidemiology of population change. *The Milbank Memorial Fund quarterly* 1971 Oct;49(4): 509-38. Popkin BM. An overview on the nutrition transition and its health implications: the Bellagio meeting. *Public health nutrition* 2002 Feb;5(1A): 93-103.
9. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition reviews* 2012 Jan;70(1): 3-21.
10. Slavin JL, Martini MC, Jacobs DR, Jr., Marquart L. Plausible mechanisms for the protectiveness of whole grains. *The American journal of clinical nutrition* 1999 Sep;70(3 Suppl): 459S-63S.
11. Strasser T. Reflections on cardiovascular diseases. *Interdisciplinary Science Reviews*. 1978;3:225-230
12. Sun Q, Spiegelman D, van Dam RM, et al. White rice, brown rice, and risk of type 2 diabetes in US men and women. *Archives of in-*

*ternal medicine* 2010 Jun 14;170(11): 961-9.

13. World Health Organization. Obesity and Overweight: Factsheet No 311. Updated March 2013.  
<http://www.who.int/mediacentre/factsheets/fs311/en/>
14. Zhang G, Malik VS, Pan A, et al. Substituting brown rice for white rice to lower diabetes risk: a focus-group study in Chinese adults.

*Journal of the American Dietetic Association* 2010 Aug;110(8): 1216-21. Zhang G, Pan A, Zong G, et al. Substituting white rice with brown rice for 16 weeks does not substantially affect metabolic risk factors in middle-aged Chinese men and women with diabetes or a high risk for diabetes. *The Journal of nutrition* 2011 Sep;141(9): 1685-90.