

## INTERVIEW

# Diet and lifestyle changes: the road to diabetes prevention



**Frank B Hu\***: Frank B Hu, MD, PhD, is Professor of Nutrition and Epidemiology at Harvard School of Public Health (MA, USA) and Professor of Medicine at Harvard Medical School and Channing Division of Network Medicine, Brigham and Women's Hospital. He received his medical training at Tongji Medical University in Wuhan, China and obtained a doctoral degree in Epidemiology at the University of Illinois at Chicago (IL, USA). Dr Hu is Co-director of the Program in Obesity Epidemiology and Prevention at Harvard. He also serves as Director of the Epidemiology and Genetics Core of the NIH-funded Boston Nutrition Obesity Research

Center. His research is mainly focused on the nutritional and genetic epidemiology of obesity and Type 2 diabetes, as well as gene–environment interactions. Dr Hu has published more than 500 original papers and reviews and a textbook on *'Obesity Epidemiology'*. He is the recipient of an American Heart Association National Established Investigator Award and the Kelly West Award for Outstanding Achievement in Epidemiology by the American Diabetes Association in 2010. He currently serves as an Associate Editor for *Diabetes Care* and on the Obesity Guideline Expert Panel at NIH.

**Q** How did you come to be Professor of Nutrition and Epidemiology? Was this always a significant interest for you?

I trained in medicine in China before studying epidemiology in the USA. I became very interested in chronic disease prevention; especially diabetes and cardiovascular disease prevention. After completing the doctoral epidemiology program at the University of Illinois at Chicago (IL, USA), I received a postdoc fellowship in nutritional epidemiology under Dr Walter Willett at Harvard School of Public Health (HSPH; MA, USA) in 1996. At Harvard, I have been fortunate to work on several ongoing, large cohort studies (the Nurses' Health Study and the Health Professionals' Follow-up Study), which are a goldmine for investigating risk factors for Type 2 diabetes and its complications. These cohorts not only provide unparalleled resources for conducting nutritional epidemiologic studies, but also create an intellectually stimulating and

supportive environment for young investigators to develop independent careers. In parallel with the US cohorts, my colleagues and I have also set up prospective cohort studies to examine nutrition transitions and the development of diabetes and other metabolic diseases in China. After finishing my postdoctoral training, I became Assistant Professor in the Department of Nutrition at HSPH in 1999, and was promoted to Associate Professor of Nutrition and Epidemiology at HSPH in 2002. I became a Tenured Professor of Nutrition and Epidemiology at HSPH in 2008 and Professor of Medicine at Harvard Medical School in 2009. Over the years, I have established an independent and productive research program in obesity and diabetes epidemiology at Harvard. Our initial focus on nutritional and lifestyle epidemiology of obesity and diabetes has now expanded to examine potential disease mechanisms through the study of biochemical and



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genetic risk factors for these conditions as well as gene–environment interactions. We have also initiated several nutrition intervention studies to test the effects of dietary interventions for diabetes prevention in developing countries, including China and India.

**Q** What are currently your main areas of research? Can you describe some of the dietary & lifestyle factors you have been researching recently in relation to diabetes risk?

My research is focused on the study of diet, lifestyle, and biochemical and genetic factors involved in the development of obesity and Type 2 diabetes through an interdisciplinary approach. My group has conducted detailed examinations of the relationships between many dietary and lifestyle factors (including sugar-sweetened beverages, coffee, iron, magnesium, red meat, and dietary patterns) and the risk of Type 2 diabetes. These findings have improved our understanding of the role of diet in the development of diabetes, and have contributed to current public health recommendations and policies for the prevention of chronic disease.

We published the first prospective cohort study showing a positive association between regular consumption of sugar-sweetened beverages and the risk of Type 2 diabetes [1]. Our findings have now been replicated in several other studies and confirmed by a recent meta-analysis [2]. We have also carried out extensive research on iron overload, iron intake, and the risk of diabetes. We published a study showing that plasma concentration of ferritin is a strong and independent risk factor of Type 2 diabetes [3]. We have also found that dietary heme iron intake (mostly from red meat) is associated with diabetes risk. In addition, we have found that diet quality, over and above quantity, is a very important contributing factor for obesity and diabetes incidence. In terms of diet quality, we recently published a paper in *New England Journal of Medicine* showing that consuming less liquid sugars and other sweets, as well as fewer starches and refined grains, is beneficial in preventing long-term weight gain in middle-aged and older individuals [4].

In terms of lifestyle factors, we are very interested in physical activity, sedentary lifestyle, such as prolonged TV watching, and sleep patterns and the risk of diabetes. We found that a longer duration of TV watching was a significant risk factor for the development of Type 2 diabetes, independent of physical activity levels. Recently,

we published a paper in *PLoS Medicine* showing that rotating shift work was significantly associated with an increased risk of Type 2 diabetes in female nurses and this relationship was partially mediated through body weight [5].

**Q** What do you aim to achieve through your work? Do you have any specific goals?

Obesity and Type 2 diabetes are among the most important and difficult public health challenges of our time, and an overarching goal of our work is to understand and address these problems. More specifically, our work aims to identify dietary and lifestyle factors in the development of obesity and diabetes in the context of various cultures and populations and thereby, contribute to the development of preventive strategies and public policies that can potentially reverse current global trends of obesity and diabetes. Another important goal of our research is to enhance our understanding of the biological mechanisms through which diet and lifestyle factors influence obesity and diabetes by integrating biomarkers and genetics into population-based epidemiologic research.

**Q** To what extent does sedentary behavior impact on the onset of diabetes & also disease progression?

Sedentary behavior, in particular prolonged TV watching, has been strongly associated with an increased risk of obesity and Type 2 diabetes. We have found that prolonged TV watching is associated with increased caloric intake and also unhealthy eating patterns: people who watch a lot of TV tend to consume more calories in the form of snacks and sugary foods and drink more soda. Sedentary behavior can also accelerate the progression from prediabetes to diabetes, as well as the progression from diabetes to cardiovascular disease. Therefore, this is clearly one of the most important modifiable risk factors for the prevention of obesity, diabetes, and cardiovascular disease.

**Q** Do you feel a strong sense of responsibility when your research directly impacts on individuals' lives & offers advice on lifestyle choices?

The twin epidemics of obesity and Type 2 diabetes have become one of the defining issues of our time. I do feel a strong sense of urgency and responsibility to find effective solutions to reverse the global trends. I hope that our research can

help to guide individual dietary and lifestyle choices and influence public policies.

**Q How have your findings contributed to public health recommendations or policies?**

I think the most important task for us is to build the strongest possible evidence base to ensure resulting recommendations and policies are solid and reliable. We need three types of evidence: epidemiologic evidence that links specific dietary and lifestyle factors with obesity and diabetes; clinical trial evidence that demonstrates the efficacy of specific dietary interventions; and cost-effectiveness evidence that shows that the interventions can be scaled up, especially in developing countries. I'm pleased to see that our research has made an impact on dietary guidelines, nutritional policies, and public health recommendations for obesity and diabetes prevention.

**Q Which interventions do you believe to be most effective in preventing Type 2 diabetes?**

There is convincing evidence that diet and lifestyle modifications are more effective than medication/pharmacological means in terms of preventing Type 2 diabetes, both at the individual level and in the population as a whole. Many lifestyle improvements can be made, but weight control is the most effective approach for preventing diabetes. In terms of diet quality, the types of fat and carbohydrates are probably more important than the total amount. Substitution of unsaturated fat for saturated and trans fats and of whole grain foods for refined grain foods are effective and important strategies to reduce the risk of diabetes. A diet rich in fruits, vegetables, legumes, whole grains, healthy sources of protein (poultry and fish) and with unsaturated vegetable fats as the main source of fat, but low in red and processed meats, refined grains, and sugar-sweetened beverages can offer significant protection against Type 2 diabetes.

Physical activity is as important as diet for diabetes prevention; increasing physical activity reduces diabetes risk by helping to maintain a healthy body weight and by improving insulin sensitivity. Even moderate activities, for example, regular walking, offer substantial benefits.

**Q What has been your greatest achievement to date?**

Well this is a tough question! I feel that my main job is to build the evidence base for public health recommendations and policies to be based on

and I believe that our research has contributed substantially to the evidence base. In a paper we published in *New England Journal of Medicine* in 2001, we found that a healthy diet, together with regular physical activity, maintenance of a healthy weight, moderate alcohol consumption and avoidance of smoking, could nearly eliminate Type 2 diabetes [6]. That study has laid the foundations for the justification of using diet and lifestyle as the primary strategy for reducing the risk of Type 2 diabetes in the general population. I feel proud of that work because it has shaped the way we think about and approach diabetes prevention.

**Q As principal investigator of the diabetes component of the Nurses' Health Study, can you describe the main aims & diabetes-related results of the study?**

The diabetes component of the Nurses' Health Study includes several broad aims. The first is to identify diet and lifestyle determinants of Type 2 diabetes. The second aim is to identify novel biological and genetic markers of Type 2 diabetes. The third aim is to study gene-environment interactions in the development of diabetes. We have investigated many dietary and lifestyle factors, some of which are well known, such as moderate alcohol consumption being beneficial for diabetes, regular consumption of coffee being associated with a lower risk of diabetes, and increased consumption of red, processed meat, or sugary beverages being associated with an increased risk of diabetes. Our initial focus in the area of nutritional and lifestyle epidemiology of obesity and diabetes has grown into an examination of disease mechanisms through the study of biochemical and genetic risk factors for these conditions. We have examined the role of inflammatory cytokines and related genes as links between diet, obesity, and diabetes. We have also conducted a genome-wide association study aiming to identify novel genetic markers of diabetes and investigating the complex interactions between genetic and environmental factors. Recent advances in genomics, metabolomics, and epigenetics technology have provided us with unprecedented opportunities to integrate novel biomarkers into traditional epidemiologic research.

**Q What is the mission of the Program in Obesity and Epidemiology and Prevention at Harvard where you serve as co-director?**

I co-direct the Obesity Program with my colleague Steve Gortmaker, who is a childhood

obesity expert. The program's main goal is to train the next generation of researchers in the areas of obesity epidemiology and prevention. This is a school-wide program, and graduate students from multiple departments of the school are eligible to join this program. To fulfill the requirements of the program, the students need to take several courses related to obesity epidemiology and prevention and their thesis topics need to be broadly related to obesity. We have a regular journal club for students who are enrolled in the program. This program provides a platform for interdisciplinary training and also acts as a very useful network for the students and faculty from different areas to interact and develop potential collaborations.

**Q** In summary, where do you think the main focus of your research will be over the next 5 years?

Our research will continue in two main areas: one area is the identification of dietary and lifestyle factors for Type 2 diabetes and related complications in both the US population and in developing countries. The second area is the integration of novel biochemical and genetic markers into epidemiologic studies. In addition, we have also initiated several nutritional intervention studies in China, India, and other countries to test the effects of substituting whole grains (e.g., brown rice) for refined grains (e.g., white rice) on diabetes and metabolic risk factors. This is a new area that we will continue to develop in the next few years.

**Q** What challenges remain in the field as a whole?

I think there are two main challenges: the first challenge is that the diabetes epidemic is moving fast, especially in developing countries, and thus we need to develop long-term large population-based studies to track the epidemic. In addition, we need to track evolving risk factors, such as rapid changes in diet and lifestyle. Our understanding of the biological mechanisms underlying the relationships between dietary and lifestyle factors and the risk of diabetes is still limited, despite several decades of research. However, the omics and high throughput technologies may help us better integrate biology with epidemiology. The second main challenge is how to translate knowledge into public health practice and policies. Right now, there is still a wide gap between what we know and public health practice; how to narrow that gap remains a major public health challenge. To curb the global obesity and diabetes epidemics, we need fundamental changes in public policies, the food and built environments, and health systems.

#### Financial & competing interests disclosure

*FB Hu has no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.*

*No writing assistance was utilized in the production of this manuscript.*

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