The Implications of Rapid Economic Growth for Health-Related Behaviors and Chronic Metabolic Diseases: An Exploratory Study in Post-Earthquake West China

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Abstract
A devastating earthquake struck west China in 2008. Reconstruction efforts have focused on urbanization and modernization, hastening economic growth in the area. This rapid growth provides a unique opportunity to explore the potential impact of rapid environmental changes on metabolic disease risk. The study objective was to gather qualitative information from residents of a rapidly changing area in China to determine perceived changes in food- and physical activity-related aspects of the environment and their perceived effects on health. We conducted extensive interviews with 30 residents of an area where towns were rapidly rebuilt after being destroyed by the 2008 Wenchuan earthquake. Findings suggest that a longitudinal investigation of children and their families in this rapidly developing region may identify mechanisms by which environmental factors influence the development of diet-related chronic illnesses.
Introduction
Reconstruction efforts due to the 2008 Wenchuan earthquake in west China presented an opportunity to examine and document the health effects of accelerated changes in the environment on diet, physical activity and chronic stress. It is widely recognized that diet-related chronic conditions including obesity and diabetes have been increasing globally [1]. In China, the greater burden of diet-related chronic conditions has been borne by populations living in economically vibrant urban areas [2]. As China continues to experience rapid economic growth, rates of chronic metabolic conditions are expected rise steeply. Unless efforts to curb the increasing rates of chronic conditions are successful, the burden on society due to decreased economic productivity and increased health care costs will be staggering.

Many factors have been blamed for the global obesity crisis. Poor diets and sedentary lifestyles are obvious causes. Rapid economic development in countries such as China has been accompanied by a changing food environment that increasingly promotes the availability of processed and fast foods [3]. Excessive consumption of fast food has been linked to diets of poor nutritional quality and obesity [4]. Rapid economic development has also been accompanied by increased car ownership and decreased levels of physical activity. Increasing numbers of cars means increased air pollution; air pollution, like other chronic environmental stressors, may disrupt energy metabolism and hence how energy is utilized by the body [5-7].

In the aftermath of the earthquake, the central Chinese government committed one trillion yuan (approximately US$146.5 billion) to rebuilding areas affected by the earthquake. The local government of Shifang, a city hit hard by the earthquake, vowed to ‘recover energy in 1 year, complete reconstruction in 3 years, at least double pre-earthquake growth rates in 5 years, [and] build a modern city in 10 years’ [8]. It is expected that the face of the earthquake-stricken areas will be dramatically different than before, however, there is little discussion on how this change will affect health.

The immediate aim of this exploratory study was to gather qualitative information about people’s perceptions of the effects of reconstruction in Shifang on the food environment, transportation modes, individual-level diet and physical activity behaviors, and perceived chronic stressors including aspects of the social and physical environment that may influence the development of chronic metabolic conditions. The goal was to gather preliminary information helpful for designing and implementing a longitudinal investigation of individual and environmental factors that influence risk for chronic metabolic conditions (namely, obesity and diabetes) in a rapidly changing economy.

Methods
A convenience sample of adults affected by the Wenchuan earthquake was recruited with the assistance of provincial and local agencies. Participants comprised 25 women and 5 men, aged 27 to 53 years old, all of whom were present in Shifang when the earthquake struck on May 28th, 2008.

Six Chinese medical students were trained by researcher with expertise in qualitative research (JG) to conduct open-ended interviews using a semi-structured interview guide. The training took a day and covered not only interview techniques and the protocol for obtaining informed
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Consent, but also basic principles of qualitative research. The interviewers were all conversant in English; however, a bilingual medical student (HO) was present to translate to ensure that the interviewers fully understood the trainer. All interviewers practiced their interviewing skills in a simulated setting and were evaluated for their ability to pose unbiased questions and probe in appropriate ways (MW, HO).

The interview guide was developed by researchers with expertise in social and environmental determinants of health and nutrition in China, global health and/or qualitative research methods (MW, JG) with input from local Chinese researchers (including FY). It was translated into Chinese (HO), pretested for clarity of wording among Chinese medical students, and finalized.

The interview guide included the following two questions: “How do you think the environment in which you live, has changed in the past 10 years, especially in terms of food, transportation, and quality of life?”, and “Have you noticed changes in the environment in which you live, after the earthquake in May 2008, especially in terms of food, transportation and quality of life?” Table 1 lists the question categories and examples of specific probing questions used by interviewers.

To encourage participants to speak freely, the interviews were not tape-recorded; however, interviewers were trained to take detailed notes in Chinese. Each interview lasted 40 minutes to 1 hour.

Interview transcripts were coded for recurring themes by a Chinese bilingual qualitative researcher (CY). Themes were identified and synthesized by consistency and variability across interviews [9]. Participants’ narratives that were representative of an identified theme were translated into English and organized by theme.

The study protocol was approved by the Institutional Review Board at each of the three institutions involved – the University of California at Los Angeles, the University of California at Berkeley, and West China Second University Hospital, Sichuan University in Chengdu, China.

Results
Three themes emerged from responses on environmental changes that have occurred in the past 10 years: (a) increased food choice and availability; (b) increased pollution; and (c) increased awareness of the effects of lifestyle on health. Selected quotations from participants on these themes are presented in Table 2.

Increased food choice and availability
All participants reported seeing substantial environmental changes in the Shifang area over the past 10 years. One change noted was the increase in the variety and availability of food, most notably in meat. As described by a participant: “We ate meat once in a while, but now we can eat meat every day… You can buy anything you want to eat now”. (Female, Age 39)

Participants also noted the decline in food quality over the past few years, as indicated by “food lacks taste now.” Some attributed this lack of taste to increasing pollution and the use of lot feed for animals, and pesticides on fruits and vegetables.
Table 1: Interview question categories and probing questions

<table>
<thead>
<tr>
<th>Topic categories</th>
<th>Sample questions</th>
</tr>
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<tbody>
<tr>
<td>Food Environment</td>
<td>Have there been changes in the kinds of food available? Has the quality of food changed? In what ways? How do you think these changes have affected the way people eat? Specifically, how about children? Where you live, can you conveniently get fast food such as KFC? How about fresh fruits and vegetables?</td>
</tr>
<tr>
<td>Physical Activity environment</td>
<td>Have there been changes in the way people get around from place to place, that is, in transportation? How do you think this has affected how physically active people are? Are there places where people can conveniently go to, to exercise? Where do they go?</td>
</tr>
<tr>
<td>Physical Surroundings</td>
<td>Where do you currently live? I do not need to know the street address, just a general description of your neighborhood, and which town or village it is located in. How long have you lived here? (If subject lived in the current residence for less than 18 months) For what reason did you move to this place? Please tell me more about the place where you live. How close do you live to major roads or highways? What do you think is the quality of the air where you live? How about noise levels? Are you concerned about safety and crime issues where you live?</td>
</tr>
<tr>
<td>Post-earthquake</td>
<td>May I ask how the earthquake has affected you and your family? Are you currently living with other families? How many? Do you prepare dinner together or separately? How do you share kitchen facilities? How has the earthquake affected the foods that you (and your family) eat? Does your family eat dinner together? How about before the earthquake? Do you exercise? How often? How about your child? Has your exercise regimen changed after the earthquake? How well do you sleep? How about your child? Has your sleep changed after the earthquake? Do you work? Have you changed jobs after the earthquake? How far is your work place from you home? How do you get to work?</td>
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Increased pollution
There was resounding agreement among participants that in recent years, one of the greatest changes seen is increased pollution and contamination (food, air, water), with increasing number of cars and industrial factories having been major influences. One participant (Female, Age 41), whose opinion was representative of many, articulated that there are now “more cars on the street. You can smell the gasoline. There is more air pollution, and vegetables all have pesticide.” Another participant (Male, Age 37) noted that an increase in water pollution is evident by how “the small river [that runs through my village] used to be clean and you could see fish, but now it is all dirty”. Several participants linked pollution with diseases such as cancer and other “strange diseases” demonstrating awareness of the harmful health effects of environmental pollution.
Healthy lifestyle awareness
Besides having a general awareness of the relationship between pollution and health, participants also mentioned an increased awareness of the relationship between food, nutrition, and health. Some participants described a healthy lifestyle as one involving eating “green food” (i.e. food grown with less pesticide), eating more vegetables, and exercising more. Participants also noted that an unhealthy lifestyle involves eating red meat, and eating “outside” or away from home. Although participants recognize what constitutes a healthy and unhealthy lifestyle, some acknowledged that reality often overwrites what people know they should do; some participants specifically noted that this disconnect between knowledge and behavior may increase overweight risk.

Participants also noted that more physical activity is healthy, but admitted that people are less active compared to 10 years ago. One participant (Female, Age 39) said, “Before, most of my physical activities were farming and doing housework. Now, we use machines and we engage in less manual labor.” Most participants reflected that modern-day inventions like cars and computers provide convenience, but have lessened opportunities for physical activity. For one participant (Female, Age 32), physical activity consists of only shopping and karaoke. Another participant (Female, Age 42) observed that people are less physically active today because “People have a different value of consumption. You don’t have to do everything by yourselves, and you can buy services now.” She further observed that reduced physical activity leads to illnesses, “All your organs degenerate after owning a car. You easily gain weight, which can cause all kinds of illness, such as diabetes, and hypertension.”

With regard to changes in the environment and quality of life after the earthquake, the following themes emerged from participants’ responses: (a) Increased stress and anxiety after the earthquake; (b) increased car ownership; (c) change in outlook on life, with people stating that they want to ‘enjoy life’ more; and (d) increased food prices. Selected quotations from participants on these themes are presented in Table 3.

Increased stress and anxiety after the earthquake
The impact of the Sichuan earthquake was severe and changed many aspects of people’s lives. The local Chinese government and the international community responded by providing psychological resources to help people cope with the disaster. However, some participants indicated that the resources were not utilized, stating that ‘nobody cares’ and noting that psychiatrists are “too expensive”.
Table 2: Selected participants’ quotes on changes in Shifang in the past 10 years

(a) Increased food choice and availability

- “You definitely could eat a lot more than before. When you cook, you can put more oil. It was a luxury to eat meat and people usually bought meat with a lot fat, but now it is common to eat lean meat, and people buy snacks and bakery”. (Male, Age 35)
- “Compared to 10 years ago, overall material life is getting better, and we have more entertainment. There is no problem to get enough food, and you can buy anything you want to eat. 10 years ago, we rarely ate outside”. (Female, Age 35)

(b) Increased Pollution

Water Pollution
- “The quality of water is worse now. You couldn’t tell from your own eyes, and you need special equipment to detect those toxic materials in the water”. (Male, Age 42)
- “Water is contaminated. This small river was used to be clean, and you can see fish, but now it is all dirty. Those factories cause a lot of pollution”. (Male, Age 36)

Air Pollution
- “There are more factories, and air quality is getting worse. There are more cancer cases, such as breast cancer, lung cancer. They use a lot pesticide and I heard people get poisoned”. (Female, Age 39)
- “The environment is getting worse. Food and air are polluted. We live in a polluted environment. There are more cars on the street. People couldn’t find enough parking space and park everywhere”. (Female, Age 35)

Food Contamination
- “There are more strange diseases, which would be due to the food we eat. Food has more additive, and even eggs have chemicals. Environment is worse than before. River used to be very clean”. (Female, Age 27).
- “Food quality is not as good as before. Pigs eat feed, and can grow fat in a short period of time. Farmers use pesticide. There is more pollution, and a lot of people get cancer. Kids mature much earlier now, which is also due to the food they eat”. (Male, Age 36)

(c) Increased awareness of the effects of lifestyle on health

- “There are more strange diseases, which would be due to the food we eat. Food has more additive, and even eggs have chemicals. Environment is worse than before. River used to be very clean”. (Female, Age 27).
- “Food quality is not as good as before. Pigs eat feed, and can grow fat in a short period of time. Farmers use pesticide. There is more pollution, and a lot of people get cancer. Kids mature much earlier now, which is also due to the food they eat”.
- People are more aware of healthy lifestyle, such as eating “green” food (i.e. less pollution, less processed, less pesticide), paying more attention to a balanced diet for kids, eating less junk food, eating more vegetable and fruits. Having eaten outside more often. I’m too lazy to cook and would rather eat outside. The elderly are also aware of eating healthy, eating a variety of food, more nutrition, such as mushroom, less meat”. (Female, Age 40)
- “There are less physical activities, and all your organs degenerate after owning a car. You can easily gain weight, which can cause all kinds of illness, such as diabetes, hypertension”. (Female, Age 42)

Increased car ownership

The addition of a car to households after the earthquake produced a noticeable change in many people’s material lives. One participant (Male, Age 35) noticed a nearly 50% increase in cars on the streets after the earthquake. Other participants had similar views, indicating that a car provides personal convenience, a sense of security and mobility, especially after the earthquake, and can serve as a “mobile home”, if needed.

“We bought a car after the earthquake. We used to feel a car was not a necessity. Once the earthquake happened, you can sleep in the car and drive anywhere… There are more cars on the street after the earthquake. There are more people quitting physical activities after having a car.” (Female, Age 40)
### Table 3: Selected participants’ quotes on changes in post-earthquake Shifang, Sichuan, China

#### (a) Increased stress and anxiety after the earthquake
- “I feel much more anxious after the earthquake, because I feel I cannot afford to repair the house. I wake up in the middle of the night, afraid of another earthquake. I didn’t seek professional help, since people have seen too much, and nobody cares”. (Female, Age 39)
- “People feel scared after the earthquake. When you mention the earthquake, some people would cry. More people are doing exercises, especially after the earthquake. After the earthquake, I like to eat at home, and family would be together. I don’t like eat outside, not healthy”. (Female, Age 42)

#### (b) Increased car ownership
- “Many people bought cars after the earthquake. People feel if you have a car, you can go everywhere. It is convenient. I slept restless after the earthquake”. (Female, Age 32)
- “There are more cars on the street after the earthquake, at least 30%-50% increase”. (Male, Age 35)

#### (c) Change in outlook on life, with people stating that they want to ‘enjoy life’ more

- **Change in outlook on life**
  - “The restaurant business is great after the earthquake. More people eat outside now, and people under how to enjoy life after the earthquake. People start to feel a car is more useful than a house. Car is more like a mobile home”. (Female, Age 49)
  - “After the earthquake, people were more concerned about food safety. People are more aware of value of life, and begin to pay attention to food safety and quality and being healthy”. (Female, Age 42)

- **Enjoying life more**
  - “After the earthquake, renting is getting more expensive. More people, especially those affected by the earthquake, started to rent. People are more open after the earthquake, and start to have fun now (e.g., eat whatever you want to eat, buy whatever you want to buy)”. (Female, Age 32)
  - “We bought a car after the earthquake. We used to feel car was not a necessity. Once the earthquake happened, you can sleep in the car and drive to anywhere. People change their understanding of life after the earthquake and now know how to enjoy life. There are more cars on the street after the earthquake. There are more people quitting physical activities after having a car”. (Female, Age 40)

#### (d) Increased food prices
- “After the earthquake, there was a food shortage and the price went up. 3-4 months later, everything is back to normal”. (Female, Age 41)
- “Everything is getting more expensive after the earthquake, especially vegetable, even more expensive than Chengdu (capital city of Sichuan province). So we just bought less vegetable”. (Female, Age 39)

**Change in outlook on life**

Participants described a general change in the way people viewed life after the earthquake. “People changed their understanding of life after the earthquake and now know how to enjoy life,” (Female, Age 40). Another participant noted, “People changed their values after the earthquake, caring for life, and relationships more, and feeling that life is fragile.” (Female, Age 35). One participant (Female, Age 38) tried to explain this phenomenon, “People feel life is so vulnerable [after the earthquake], and that now they should take better care of themselves’. For some participants, enjoying life means eating out at restaurants more, and spending more frivolously, “Eat whatever you want to eat; buy whatever you want to buy.” (Female, Age 20)

Participants also noted an increased awareness of their surroundings. This heightened awareness of surroundings was defined very broadly and included increased ‘attention to the expiration dates on food’, increased time with the family, exercising more, and being more conscious of the nutritious properties of various foods.
Increased food prices
Lastly, participants mentioned that food prices increased temporarily as a result of the decreased supply of food following the earthquake, because “the rural areas were hit hard by the earthquake, which affected the supply of vegetables” (Female, Age 40). As a result of the price hikes, residents bought less vegetable during the months immediately following the earthquake, but ‘in three to four months, everything went back to normal’ (Female, Age 41). Fortunately, the short supply of vegetables and other goods in earthquake-hit areas was temporary.

Discussion
Overall, the semi-structured interviews conducted with a convenience sample of 30 residents of Shifang, an area deeply affected by the Wenchuan earthquake, provided special insight into perceived changes in the environment related to food, physical activity and health, preceding and following the earthquake. Participants’ comments on perceived changes in the few years preceding the earthquake have helped us to assess whether or not the earthquake changed the course of development in the area. Participants’ responses are discussed in terms of food consumption and supply, physical activity and transportation mode changes, environmental contamination and pollution, and direct effects of the earthquake.

Food consumption and supply
Study participants noticed an increase in meat availability and consumption over the past ten years. This is consistent with research findings on food consumption trends in China, which noted a 350% increase in energy intake per capita from meat consumption over the past two decades; this increase in meat consumption in China is higher than that of other countries. In Chinese society, as in many developing societies, meat is symbolic of prosperity [10]. Over the past two decades, China has also seen increases in the consumption of dairy products, wheat, fruits and vegetables (including potatoes), and decreases in the consumption of traditional staple foods such as rice, roots, and tubers [10].

Physical activity and transportation mode
As reflected in this data from Shifang, substantial changes in both food consumption and physical activity have occurred over the past two decades in China. As more people own cars and purchase modern conveniences to assist with household chores (such as washing machines), their lifestyles become more sedentary. One report estimated that the number of Chinese passenger vehicles more than quadrupled between 2003 and 2007 [11,12].

These changes in food consumption and physical activity patterns are expected to lead to an increase in diet-related chronic health conditions and illnesses. For example, obesity is rapidly becoming a major health concern in China among both adults and children. Adult overweight and obese prevalence rates are currently estimated at 17.5% and 5.7% respectively, while child overweight and obesity rates are estimated at 7.7% and 3.7%, respectively [13]. Of note is that there are considerable regional and urban-rural differences, and obesity rates tend to be highest in economically developed metropolitan regions such as Beijing and Shanghai, and in higher socioeconomic families [13-15]. Adult obesity is an established risk factor for cardiovascular disease, cancer and diabetes, and there is increasing evidence to show that child obesity is also associated with increased risk of these chronic conditions [16].
Environmental contamination and pollution

Another concern voiced loudly by participants is increased pollution and contamination of food, air and water and their effects on health. Chemical pesticide production and application on food crops in China is one of the highest in the world [17]. Pesticide run-off increases environmental pollution, and high levels of pesticide residue on food crops pose health risks to consumers and threaten the food export business [17-18]. For example, China lost US$30 million of sales in spinach to Japan in 2003 because chlorphyrifos levels from pesticide application exceeded Japan’s maximum residual limit [17]. Pesticide residues are commonly causes of food poisoning in China [19]. In addition, there has been a growing body of literature that ties pollutants from pesticides to hormone disruption, which may contribute to development of chronic metabolic conditions - obesity, dyslipidemia, insulin resistance and type 2 diabetes [19-22].

Air pollution is another serious environmental concern in China. Increasing car ownership contributes greatly to poor air quality in China, whose auto market is now the largest in the world. Chinese consumers bought an estimated 18 million cars in one year, breaking the record of most cars sold in one country in a year [23]. Car emissions, including carbon monoxide and nitrogen oxide, have dramatically increased, and their levels are many times higher than in other countries [24]. Several factors, including government incentives in the form of tax breaks for new car purchases and social pressure to display wealth, have contributed to the recent exponential increase in car ownership [25-26]. For Sichuan residents, an additional incentive is the personal convenience of not being dependent on public transportation, especially in times of disaster.

Driving regularly in chaotic traffic and walking on busy roads laced with car emissions may be considered chronic stressors that could lead to hormonal and metabolic changes implicated in the development of obesity and other metabolic-related health conditions. Gee and Takeuchi reported lower health status and increased anxiety and depressive symptoms among individuals living in areas with a high density of cars [27]. Chronic stress leads to hormonal and metabolic changes, and has been implicated as a possible cause of obesity and its associated syndromes such as diabetes and hypertension [5-7, 28].

These concerns of study participants are corroborated by reports from development agencies and efforts by the Chinese government to address environmental issues. For example, the World Bank estimated health costs resulting from air and water pollution at about 4.3% of China’s GDP [29]. Recently the Chinese government implemented policies to combat environmental contamination and pollution by supporting efforts to promote sustainable development, including the promotion of ‘green foods’ (i.e. agricultural food grown sustainably with less pesticide use [12]. However, Lin et al. pointed out that the relatively low quality and higher prices for green foods in China, and a lack of wide-distribution impede greater consumption [30].

Direct effects of the 2008 earthquake

Two months after the earthquake, post-traumatic stress disorder was prevalent, affecting an estimated 9.4% to 45.5% [31]. Psychosocial support and mental health services, in additional to medical services, were available. However, based on participants’ responses, utilization of psychosocial and mental health services was low, perhaps due to the stigma associated with mental health.
The earthquake also led to a change in residents’ outlook on life. Before the earthquake, people held on to traditional values of hard work and thrift. After the earthquake, people felt they could spend money freely on eating out at restaurants, and buying a car; they also paid more attention to their families and their own health. This response is not unusual; in fact, it has been described as a post-earthquake ‘carpe diem’ phenomenon. Others have postulated that this sudden change in view of life is a positive coping strategy, reflecting an effort to be optimistic. Taylor et al explains that optimism is a coping resource which enables one to manage stressful events and is associated with greater post-traumatic mental and physical well-being [32].

Take the example of purchasing a car in post-earthquake Shifang. As mentioned above there has been an increase in car sales nationally in China and this is partially due to the social status associated with car ownership. The devastating earthquake however disrupted and jolted people’s lives, changing their life views. For an earthquake victim, a car purchase maybe a mechanism for coping with stress.

Participants had put their own or had noticed others put their “carpe diem” attitude into action, resulting in changes in spending behavior, especially on luxury items such as a car. They explained that people were more willing to purchase a private car for practical reasons, a car can be a “mobile home”, and provides a convenient mode of transportation. Dr. Jacques Henry explains that disaster research maybe misguided in its overemphasis on discussing post-catastrophic changes in a community, and not paying enough attention to continuity using a pre- and post-disaster framework [33]. Before the earthquake, participants noticed that people were getting wealthier, and were able to purchase a greater variety of food and private cars. After the earthquake, participants noticed that people were purchasing more luxury items like private cars, perhaps as a coping mechanism. Our findings suggest that the Sichuan earthquake in 2008 may not have changed the course of urbanization, economic and social development in the area, but enhanced it. However, which elements of life are enhanced or changed, and if the change is short-term or permanent, requires longitudinal research.

In addition, there are conflicts between conceptions of healthy behavior and actual behavior. As explained above, participants realize that increase in car use leads to a decrease in physical activity and increased risk of obesity and other metabolic illnesses. Yet these conceptions are not enough to change behavior. This complex interplay of conceptions of healthy and unhealthy behavior and actual behavior is has important intervention implications, and requires more in-depth research.

Participants mentioned that there was a sudden hike in vegetable prices immediately post-earthquake. The prices however, did return to normal just a few months later. The increase in food prices immediately post-earthquake highlights how the community’s food consumption is inherently tied to the environment. Disasters, natural or man-made, can interrupt or even cut-off the food supply chain, thus limiting food availability and consumption, and may lead to starvation and malnutrition. On the opposite end, continued rapid industrialization and urbanization changes the built and food environment, and may lead to increased obesity, diabetes and other obesity-related illnesses [3].
This qualitative study provides deeper insight into how individual and societal changes in the context of post-earthquake Sichuan amidst rapid economic growth may influence people’s risk of developing chronic metabolic diseases such as obesity and hypertension. However, the limitations of the study include external validity, or the generalizability of the study. The subjects were recruited from only one community organization in Shifang, and the majority of our subjects were women. Moreover, although Shifang was one of the worst hit cities of the earthquake, it may not be representative of all post-earthquake areas in Sichuan.

With the central and local Chinese governments promising to speedily rebuild earthquake areas and heighten economic development, the Sichuan area may be experiencing an accelerated trajectory of urbanization and economic development, compared to other parts of west China. Such rapid urbanization and economic development presents an opportunity to investigate the effects of rapid social and physical environmental changes on the growth and development of children and on risk of metabolic conditions.

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