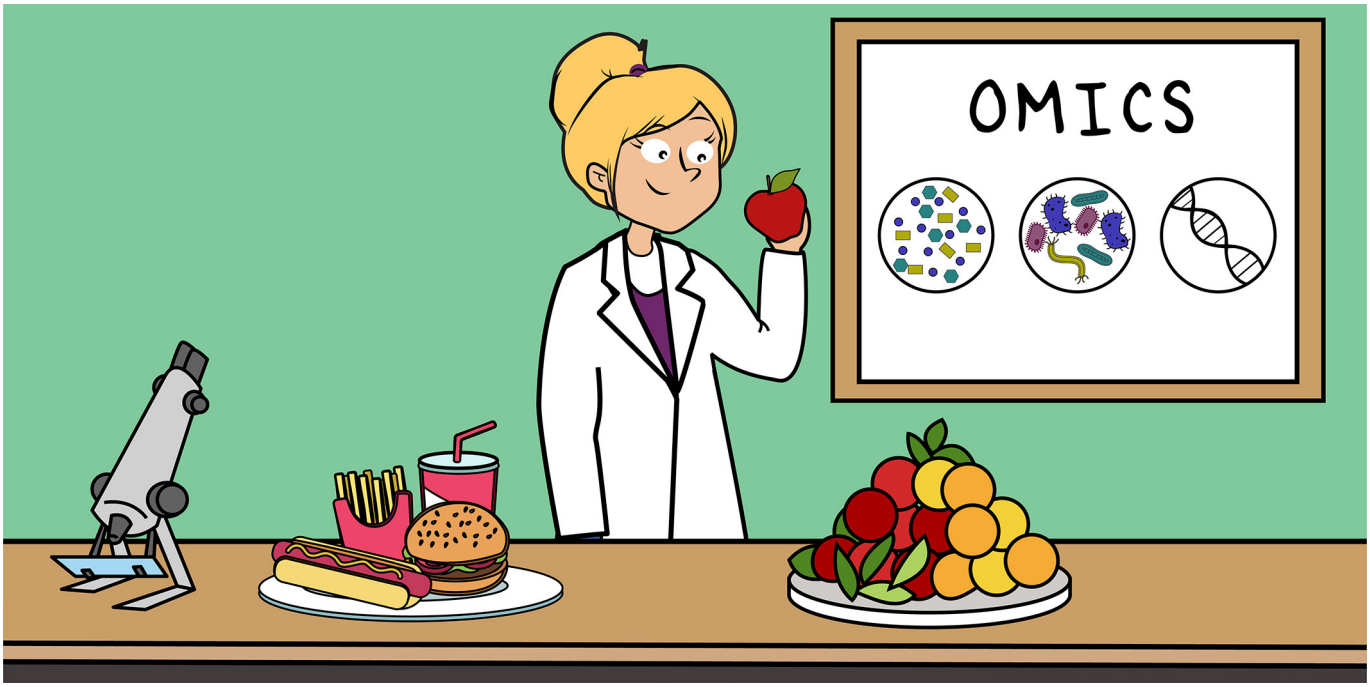
frontiers FOR YOUNG MINDS

HUMAN HEALTH
Published: 15 April 2022
doi: 10.3389/frym.2022.738922



HOW CAN NEW PERSONALIZED NUTRITION TOOLS IMPROVE HEALTH?

***Katherine J. Li*[1,2*], *Kathryn J. Burton-Pimentel*[2], *Elske M. Brouwer-Brolsma*[1], *Guy Vergères*[2] and *Edith J. M. Feskens*[1]**

[1] *Division of Human Nutrition and Health, Department of Agrotechnology and Food Sciences, Wageningen University & Research, Wageningen, Netherlands*

[2] *Agroscope, Bern, Switzerland*

YOUNG REVIEWERS:

ABHAY
AGE: 10

ELLE
AGE: 12

JOSI
AGE: 9

KAVISH
AGE: 9

All living creatures need to eat. Eating a variety of different healthy foods in moderate amounts is important. How do we know which foods are healthy? Researchers can compare the foods consumed by healthy and unhealthy people by asking what and how much they eat. Unfortunately, people cannot always remember what and how much they eat, which makes it difficult to figure out which foods are healthy. Recently, researchers discovered that a group of research tools called omics could help. When people eat, the building blocks of food are broken down into small compounds called metabolites. With laboratory equipment, researchers can measures these metabolites in food and in the body, to help them get a better idea of which foods are healthy or unhealthy. Researchers can also use omics tools to find the best foods for each unique person so that we can all stay healthy and happy.

MEASURING WHAT WE EAT

Food gives us the energy to move, and nutrients to help us grow. Nowadays, many people are interested in what they should eat to prevent disease and live long and healthy lives. But how do we know which foods are healthy? To tell people what they can eat to stay healthy, researchers must first understand what healthy and unhealthy people eat. Currently, we do this by asking people questions about what they eat, how much, and how often they eat various foods. We could ask them what they ate yesterday, or what they normally eat. We can also ask people to write down exactly what they eat, like a food diary. To find out about what people normally eat, we often use a questionnaire with questions like, "How many times do you eat fish in a month?" Collecting information about foods in a person's diet over a certain period of time is called a dietary assessment [1]. Researchers link this information with food composition tables (which contain information about the types and amounts of nutrients inside a particular food, including carbohydrates, protein, fat, fiber, sugars, salt, vitamins, and minerals) to calculate the amount of energy and nutrients that person gets from his or her diet.

INVESTIGATING THE LINK BETWEEN FOOD AND HEALTH

NUTRITIONAL EPIDEMIOLOGY

A field of research that studies the relationships between a nutrient, food, or diet and the health of a large population of people.

After figuring out what and how much people eat, researchers who study **nutritional epidemiology** want to know if diet (or a certain food or nutrient in the diet) influences the chances of people getting sick. These researchers are like detectives: they ask the right questions to gather the evidence (data), and they use it to figure out if a food is linked to a crime scene (the disease) (Figure 1). Imagine that you are a researcher given the task of figuring out whether eating fish can help prevent heart attacks. What would you do? First, you might want to gather information from many people, asking them if they eat fish and how often (dietary assessment). Second, you would need to find out whether those people have had heart attacks (health assessment). You may also want to collect information on each person's age, sex, and job, as this information could give you clues about the people's health or which foods they tend to choose. You could also collect blood samples to measure early signs of a heart attack, like blood cholesterol levels. Then, you could analyze the data using math to see if there are differences in the health of people who eat a lot of fish and people who eat very little fish. If you do this, you are doing an observational study. Researchers in nutritional epidemiology look at data collected from lots of observational studies to make links between foods and health. The government can then use this information as evidence to help create dietary guidelines, which are a set of recommendations for the public on what they should eat if they want to be healthy.

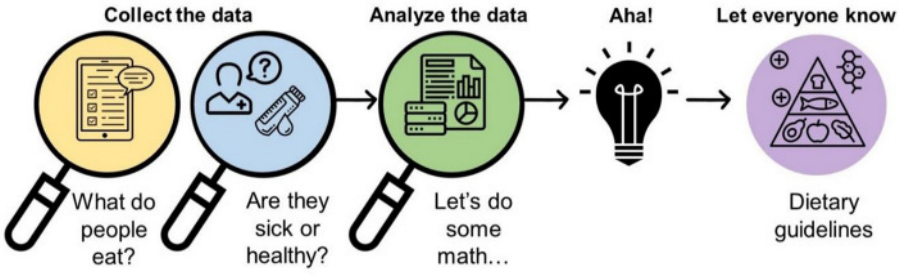


Figure 1

How researchers in nutritional epidemiology investigate links between food and health.

MISTAKES AND MISSING INFORMATION LEAD TO CONFUSING EVIDENCE

This may sound like a straightforward path: collect information on what people eat and their health, see if there is a link between what people eat and whether they get a certain disease, and use this information to advise people on what to eat. But unfortunately, it is not so simple. Often the evidence researchers find does not seem to fit together very well, and it is difficult for researchers and the government to decide which type of diet to advise. One reason for this difficulty is that the dietary assessment used in these studies relies on people telling researchers what they ate, which is not always a good strategy. Can you remember *exactly* what you ate yesterday? How about last month? Sometimes, people simply forget what they ate. Estimating *how much* they eat can be even more difficult, because different people might have different ideas about what portion sizes of various foods should be. Your idea of one piece of fish may be much larger or smaller than someone else's! Other times, people may lie about eating certain foods because they feel embarrassed about what they ate. We often underestimate how often we eat junk foods and overestimate how often we eat healthier foods like fruits and vegetables. In all these situations, scientists' dietary data already contain a lot of mistakes, even before these data are linked to disease data.

Another reason for the confusing evidence about which foods to eat is that researchers actually know very little about what is inside of foods. Each food is made up of many different compounds that are like the building blocks of the food (Figure 2). When we digest food, some of these building blocks are further broken apart into small compounds called **metabolites**. Currently, food composition tables contain information on about 150 compounds that are important nutrients in the human diet, including carbohydrates, protein, fat, fiber, sugars, salt, vitamins, and minerals [2]. But there are over 26,000 compounds found in foods, and this number is still growing! Researchers also do not know very much about the many metabolites that are generated from the compounds in foods once they are eaten.

METABOLITES

Small compounds that are produced when the body breaks down foods or larger compounds in the body. Some metabolites are necessary to provide energy, or to maintain health.

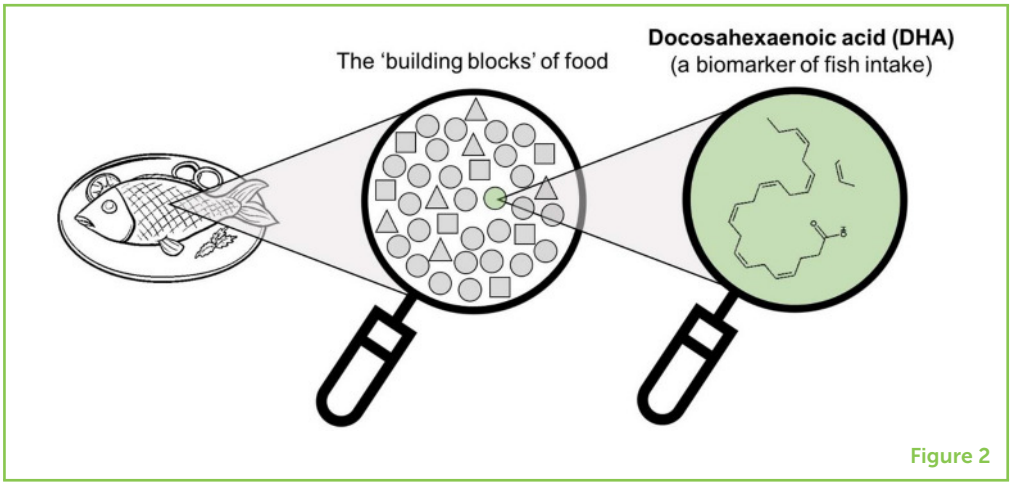


Figure 2

Foods are the source of thousands of compounds and metabolites (the building blocks), each of which can have a different role on human health. Some compounds can act as biomarkers of food intake, which are signals that researchers can measure in the body that can tell them more about what which foods people ate. Docosahexaenoic acid (DHA) is a biomarker for fish intake.

Each of these compounds and their metabolites can have its own effects on human health.

NEW TOOLS THAT CAN IMPROVE OUR UNDERSTANDING OF BOTH FOODS AND HEALTH

Recently, researchers have discovered some new ways to uncover more clues about how foods affect health. As a group, these are called omics tools (Figure 3A). One of these tools is called **metabolomics**. Using laboratory equipment, researchers can measures thousands of metabolites from a food at once! Metabolomics can help us to get a better idea of which foods are healthy or unhealthy. Researchers can also use metabolomics to measure metabolites in the human body, such as in the blood, urine, hair, or even toenails! Some of these metabolites can act as **biomarkers**, which is short for biological markers. Biomarkers are signals in the body that can help researchers understand both food intake and disease. Biomarkers of food intake can be used to help confirm what people ate, and correct mistakes in dietary assessment in our observational studies [1]. Docosapentaenoic acid (DHA) is an example of a food biomarker (Figure 2). It can be found in the fat tissues of people who eat fish [3].

METABOLOMICS

An area of study that measures all of the small molecules (metabolites) in our foods and in our body.

BIOMARKER

A signal that researchers can measure in the blood or other body fluid or tissue that can tell them more about which foods people ate, and if people's bodies are working well.

BUT IT IS COMPLICATED

Sometimes, two people could eat the same things, but one person could be healthier than the other. How can this be? Since we are all unique, each person can have a different health response to the same foods. This is partly influenced by a person's individual genes. Another tool called **nutrigenomics** can help researchers better understand how diet influences which genes are turned on or off, and also how genes can affect the way a person's body reacts to foods and nutrients. Foods and genes are constantly playing a poking game—foods that "poke" a person's genes can change which genes are turned on or off

NUTRIGENOMICS

An area of study that analyzes the relationships between genes, diet, and health.

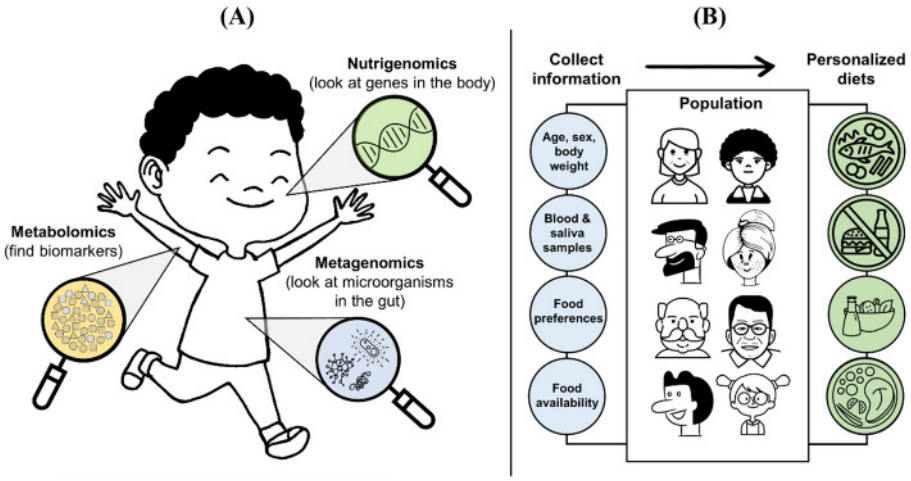


Figure 3

(A) New omics tools in food and nutrition research help researchers to understand how genes and diet influence each other, how the gut microbiota can impact health, and which biomarkers can help measure food intake more accurately. **(B)** To introduce personalized nutrition to a population, researchers must first collect information from them, including age, sex, and body weight, as well as information on which foods they prefer and which foods are available. Researchers could also measure biomarkers from blood samples and collect genetic data from saliva samples. This information can be used to help personalize people's diets.

GUT MICROBIOTA

The entire community of microorganisms (including bacteria) that live in the gut.

METAGENOMICS

An area of study that analyzes all of the genes of the microorganisms from a (bio)sample. Metagenomics can be used to analyze the gut microbiota from a fecal sample.

PERSONALIZED NUTRITION

A field of research that aims to find the best diet for each unique person, to keep that person healthy or help him or her prevent, manage, and treat disease.

and impact health, while genes can "poke" back to influence the body's response to a food.

Different people also have different microorganisms living in their bodies. After food is chewed and swallowed, it travels down the digestive tract to the gut. There, the food is greeted by *millions* of microorganisms that can help to further break down the food. The whole community of microorganisms in the gut is called the **gut microbiota**. Each person has a unique gut microbiota. Researchers can measure the microbiota (and their genes) using a new tool called **metagenomics**. Since these microbes break down foods, they can also produce metabolites, which can affect health. The gut microbiota can even affect a person's risk of getting diseases such as a heart attack [4].

Every person is unique. Our uniqueness is why dietary recommendations for the public sometimes do not work for everybody. By using omics tools in research, researchers can find out how people respond differently to the foods they eat. Then, we can help individuals or groups of people who are at risk for certain diseases, such as heart attacks, by offering them **personalized nutrition** advice (Figure 3B) [5].

THE FUTURE OF FOOD AND HEALTH IS PERSONALIZED!

It is an exciting time for researchers! We have always known that the human body is unique and complex, and that finding the link between food and health is not simple task. But with new omics tools, we are starting to learn more about the role of various food components, as well as genes, microbiota, and metabolites, for preventing certain diseases. We still have a lot of work to do, especially in regards to how diets should be personalized and making sure that personalized

nutrition is available to everyone, but there is a lot of promise. Imagine going into a grocery store in the future, where you can choose foods off the shelves based on your age, body weight, and maybe even your genes or gut microbiota—how cool would that be? The challenge in the future may be finding the right balance, so that we can eat the foods our bodies need to eat to stay healthy, but still have the joy of sharing a meal with our friends and family.

REFERENCES

1. Brouwer-Brolsma, E. M., Brennan, L., Drevon, C. A., van Kranen, H., Manach, C., Dragsted, L. O., et al. 2017. Combining traditional dietary assessment methods with novel metabolomics techniques: present efforts by the food biomarker alliance. *Proc. Nutr. Soc.* 76:619–27. doi: 10.1017/S0029665117003949
2. Barabási, A. L., Menichetti, G., and Loscalzo, J. 2020. The unmapped chemical complexity of our diet. *Nat. Food.* 1:33–7. doi: 10.1038/s43016-019-0005-1
3. Saadatian-Elahi, M., Slimani, N., Chajes, V., Jenab, M., Goudable, J., Biessy, C., et al. 2009. Plasma phospholipid fatty acid profiles and their association with food intakes: Results from a cross-sectional study within the European Prospective Investigation into Cancer and Nutrition. *Am. J. Clin. Nutr.* 89:331–46. doi: 10.3945/ajcn.2008.26834
4. Trøseid, M., Andersen, G. Ø., Broch, K., and Hov, J. R. 2020. The gut microbiome in coronary artery disease and heart failure: current knowledge and future directions. *EBioMedicine*. 52:102649. doi: 10.1016/j.ebiom.2020.102649
5. Mathers, J. C. 2019. Paving the way to better population health through personalised nutrition. *EFSA J.* 17:e170713. doi: 10.2903/j.efsa.2019.e170713

SUBMITTED: 09 July 2021; **ACCEPTED:** 22 March 2022;
PUBLISHED ONLINE: 15 April 2022.

EDITOR: Jorge Galindo-Villegas, Nord University, Norway

SCIENCE MENTORS: Patricia Welch Saleeby and Karishma S. Kaushik

CITATION: Li KJ, Burton-Pimentel KJ, Brouwer-Brolsma EM, Vergères G and Feskens EJM (2022) How Can New Personalized Nutrition Tools Improve Health? Front. Young Minds 10:738922. doi: 10.3389/frym.2022.738922

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

ABHAY, AGE: 10

I am a fourth-grader who loves movies and reading. I am a big fan of movie franchises such as Marvel and Star Wars and book collections such as Geronimo Stilton. You will almost always find me with a book. The favorite ways I like to spend my time doing are making family trees, drawing, reading, and watching tv. My ambition when I grow up is to become a fashion designer.

ELLE, AGE: 12

My name is Elle, and I just turned 12 years old. I love cats, and wish I had one of my own. I love to dance, write, sing, read, and draw. I would like to become a lawyer when I am older. My favorite subjects in school have always been ELA and history. I have participated in the science fair all of my life, and I enjoy watching videos and reading articles to better understand the world around me. Fashion is a passion of mine too.

JOSI, AGE: 9

My name is Josi. I love to read and write stories. My favorite animals are pigs because they are really cute. Pink is my favorite color. Science is one of my favorite subjects along with math. For my science project this year, I explored the physics of a scooter because riding my scooter is a favorite activity of mine.

KAVISH, AGE: 9

I am a curious, fun-loving, little fourth grader who is interested in various topics. I like to spend my time writing stories and poems, drawing, singing and dancing. But I love playing above all of them. I love Science and dogs, though my parents don't allow pets. I enjoy observing, experimenting, and discussing all aspects of nature. I would like to become a scientist when I grow up and help the mankind.

AUTHORS

KATHERINE J. LI

Katherine Li is a Ph.D., candidate at Wageningen University & Research and Agroscope. Originally a food toxicologist from Canada, she was introduced to metabolomics during her graduate studies in Colorado and was fascinated with how this tool is able to capture the complexity of food, metabolism, and health. Currently, she is using metabolomics to identify and validate biomarkers of fermented food intake. She is particularly interested in how these biomarkers could eventually be used in personalized nutrition, as well as to improve our understanding of the impact of (fermented) foods on chronic diseases. *katherine.li@wur.nl

KATHRYN J. BURTON-PIMENTEL

Kathryn Burton-Pimentel is a registered dietitian and nutritional researcher who works at Agroscope (Switzerland). Her research uses nutrigenomic tools like metabolomics to help understand why foods can affect people differently. She is particularly interested in how microbes found in some foods (like fermented foods)

and microbes found in the gut interact to affect our health. When she is not behind a computer, she enjoys running, swimming, and hiking.

ELSKE M. BROUWER-BROLSMA

Elske Brouwer-Brolsma is an assistant professor at the Division of Human Nutrition and Health at Wageningen University in The Netherlands. Elske started her career as a dietitian, but soon realized she wanted to dive more into the theory and pursued an M.Sc., in nutritional epidemiology and Ph.D., in nutrition and aging. During that period, Elske became more aware of the caveats of research on nutrition and health, particularly in terms of dietary assessment. As a consequence, Elske decided to dedicate her work to the innovation of dietary assessment methods to improve the quality of research on nutrition and health.

GUY VERGÈRES

Guy Vergères is a Swiss researcher trained in biochemistry whose interest has always been on discovering molecules in foods and how they can promote health. His career path has naturally led him to investigate the interaction of nutrients and foods with the human body. Vergères is a research group leader at Agroscope in Bern, Switzerland. He also teaches nutrigenomics, the modern version of nutrition research, at the ETH in Zurich as well as at the University of Lausanne, Switzerland.

EDITH J. M. FESKENS

Edith Feskens is a professor in nutrition and health at Wageningen University in The Netherlands. She was trained in nutrition and epidemiology and worked for a long time at the National Institute of Public Health in The Netherlands. She is interested in the role of nutrition in the prevention of disease and also in the role of nutrition during pregnancy and growth of children. She is also interested in environmental aspects of nutrition. Her work includes research in South-East Asia and Africa, where both over-nutrition and under-nutrition occur.