Review Article

Future food

Mark L Wahlqvist MD (Adelaide), MD (Uppsala), FRACP FAFPHM FAIFST FACN FTSE[1,2,3]

[1]*Institute of Population Health Sciences, National Health Research Institutes, Miaoli County, Taiwan*
[2]*School of Public Health, National Defense Medical Center, Taipei, Taiwan*
[3]*Monash Asia Institute, Monash University, Melbourne, Australia*

Food systems have changed markedly with human settlement and agriculture, industrialisation, trade, migration and now the digital age. Throughout these transitions, there has been a progressive population explosion and net ecosystem loss and degradation. Climate change now gathers pace, exacerbated by ecological dysfunction. Our health status has been challenged by a developing people-environment mismatch. We have regarded ecological conquest and innovative technology as solutions, but have not understood how ecologically dependent and integrated we are. We are ecological creatures interfaced by our sensoriness, microbiomes, shared regulatory (endocrine) mechanisms, immune system, biorhythms and nutritional pathways. Many of us are 'nature-deprived'. We now suffer what might be termed ecological health disorders (EHD). If there were less of us, nature's resilience might cope, but more than 9 billion people by 2050 is probably an intolerable demand on the planet. Future food must increasingly take into account the pressures on ecosystem-dependent food systems, with foods probably less biodiverse, although eating in this way allows optimal health; energy dysequilibrium with less physical activity and foods inappropriately energy dense; and less socially-conducive food habits. 'Personalised Nutrition', with extensive and resource-demanding nutrigenomic, metabolomic and microbiomic data may provide partial health solutions in clinical settings, but not be justified for ethical, risk management or sustainability reasons in public health. The globally prevalent multidimensional malnutritional problems of food insecurity, quality and equity require local, regional and global action to prevent further ecosystem degradation as well as to educate, provide sustainable livelihoods and encourage respectful social discourse and practice about the role of food.

Key Words: food systems, food security, econutrition, ecosystem health disorders (EHD), personalised nutrition, peopleless food outlets, clinical nutrition

INTRODUCTION

Our food systems and habits have changed progressively and greatly with migration out of Africa, and since, firstly, the advent of agriculture, then with mercantilism and colonialisation, followed by industrialisation, globalisation, market-driven economies, the digital age and, now, accelerating climate change. These shifts have been characterised by unrelenting population growth and punctuated with repeated conflict. We have been identified as Homo Sapiens sapiens for only about 150-200,000 years or about 8,000 generations and many of us had ancestors who left Africa about 50-60,000 years ago. We have been remarkably resilient in our homeland and on our travels, as omnivores, ultimately being more settled through agricultural practices. With that settlement came the beginnings of population explosion and an associated intrusion and transformation of ecosystems with the features of local livelihoods, namely those of habitat and shelter, water supply, food acquisition and production, textiles, healthcare and transport. Our education was community-based. Our social structures were ones of consent, but increasingly hierarchical. Our belief systems took account of the natural world and became systematised, often with religious formats. Step-by-step we have wanted more of our environment, of others and of ourselves. Each of these factors was likely to alter our food system and habits.[1] The foods which supported our socio-biological needs were varied, with a range of patterns, mainly from plants, along with fish and other aquatic creatures, eggs and birds, and occasional other animals. From earliest times we cooked, arguably what defined us, so that we rarely depend exclusively on raw food.[2] Our diet was related to a minimum need for physical activity, probably not less than 30-40 minutes of moderate activity most days.[3]

While the effects of agriculture on population expansion[4] and of industrialisation on ecosystem degradation and more, invoking the Anthropocene era,[5,6] are regarded as the most threatening and continuing challenge to food systems and habits, and to health, it is the acceleration of climate change now being experienced which is likely to irreversibly and adversely affect them.[7,8] We can expect that the consequent and increasing food and water insecurity will compromise the healthful properties of food and

Corresponding Author: Prof Mark L Wahlqvist, Institute of Population Health Sciences, National Health Research Institutes, No.35, Keyan Road, Zhunan, Taiwan.
Tel: 886-37-246-166 ext. 36366; Fax: 866-37-586-261
Email: mark.wahlqvist@gmail.com
Manuscript accepted 12 August 2016.
doi: 10.6133/apjcn.092016.01

beverage, even as we strive through socioeconomic and technological means to mitigate it.

In the meantime, FAO (the Food and Agricultural Organisation of the UN System) has produced guidelines as to how we might reconcile food choice and climate change.[9]

POVERTY AND HUNGER: ETHICS AND EQUITY

'Poverty and hunger' remains the world's most pressing nutritionally-related health problem, although it is increasingly accompanied by body compositional disorders which include overfatness with sarcopenia and the preventable nutritional problem of hypertension.[10,11] It is also associated with immunodeficiency and infection, which together account for most of the world's burden of disease.[12,13] Access to a biodiverse diet through home, school and community gardens and small amounts of animal-derived foods like eggs and dairy would make optimal dietary patterns possible. Short of this, more nutritious staples will help.[14] The UN System through the World Food Program provides for more immediate solutions with formula foods such as Fortified Blended Foods (FBFs) and Ready-to-Use Foods (RUFs).[15] Longer term solutions require integrated programs to allow overall socio-economic development with environmental sustainability.

P*oor governance, conflict and illiteracy (especially of women) have remained the greatest risks for hunger and poverty*[16] *– but to which climate change must now be added.*

Against this background, it is sobering to think that so many of us are focussed on finessing *our considerable relative health advantage, granted in the main by where we were born*, chasing particular nutrients or foods as the answer. Yet it must be acknowledged that, in an urbanised environment, the cost of a varied plant-based diet is greater than one that has less fruit and vegetable.[17,18] The fruit and vegetable consumption, however, is associated with less total medical costs.[19] Complex nutritional problems have emerged as the poor have been targeted with highly processed cheaper foods, still profitable to the manufacturers.[9,20] For the economically marginalised, the sustained availability of affordable nutritious food is a high priority. Coupled with maternal education and literacy, poverty and hunger would progressively be solved.[21] For the many, we are not talking about individual foods or nutrients, but about cooperative systems involving the environment, food, education, health, communication, transport and finance to deal not only with hunger and poverty, but with all nutritionally-related health problems.[22]

PERSONALISED NUTRITION

The advent of nutrigenomics and nutrigenetics, with the recognition that gene expression can be modulated by diet and that there is a host of polymorphisms which alter nutrient requirements, has encouraged consumers and food processors that health gains will follow.[23-29] At the individual clinical level, the promise is real, but with the caveat that risk-benefit analysis will apply as for pharmacotherapy. In the public health domain, multifactoriality is usual, benefit must be likely for the majority and risk must be negligible.

A problem with much contemporary food research is that it seeks *uni-ingredient approaches to a putative health benefit*, with little appreciation or assessment of risk. There is a proliferation of product with dubious risk-benefit in the market place, where much harm may accrue before it is recognised. This is even more so in Asian food cultures where the interface between food and medicine is blurred and where the regulatory framework is still evolving.

At the same time, for those and communities at high risk, *the health promotional capacity of foods in disease prevention* is an active and encouraging field of nutrition science.[30-62] Guidance is increasingly provided at the point of purchase on food labels,[63,64] but, in the future, should be available through smart phone connections to the internet.[65]

Nutritionally-relevant personal behaviours like physical activity, recreation, school and work-place practices,[42,66,67] adequate sunlight without skin damage,[1] avoidance of substance abuse,[68,69] sleep, social activity, and stress management must be invoked along with food habits to enhance food-related health and wellness benefit.

FOOD PROPERTIES: SENSORY, PHYSICAL, CHEMICAL, MICROBIOLOGICAL, NUTRITIONAL, SOCIAL, ECOLOGICAL

Nutrition and health care professionals tend to think about food properties narrowly, as those to do with nutrients, macro-, micro- and sometimes phyto-nutrients. This short-changes the characteristics of food and the appreciation of its biological effects. These are mediated jointly by its sensory, physical, chemical, microbiological, nutritional, social and ecological properties. For sensory, this means its appearance, touch, smell and taste, sound (eg crunch on eating). For physical, it means its structure, mouth feel, and bioavailabilities.[70] For chemical, there is a myriad of nutrient and 'non-nutrient' (function not presently known) sub-types, including peptides, lipids, oligosaccharides, nucleotides and polyphenols which may be monomeric or polymeric. For microbiological, we are more prokaryotic (cells without nuclei) than eukaryotic, in gut, skin, and in respiratory and reproductive systems; many food substances are transformed by gut microbes, which produce fuels and regulatory compounds for organs distant from the gut, as in the cardiovascular system[71] even brain,[72] and for energy metabolism in obesity and diabetes.[73,74] Probiotic and prebiotic foods are gaining much research attention.[75-78]

Food, with its many properties, plays a role in social discourse. Whatever they are, its availability, production and authenticity depends on ecological integrity.

DIETARY DIVERSITY, NUTRITIOUS FOODS AND STAPLES

The most consistent *dietary guidelines*, embedded in the FAO-WHO Cyprus declaration on Food based Dietary Guidelines (FBDGs) is to have a biodiverse diet,[79] duly adapted for the Asia Pacific region.[80] *Dietary diversity* is a measure of household food security[81] and a predictor of survival and health outcomes.[82-85] The struggle has been to achieve this, both in socioeconomically disadvantaged

communities and within even affluent societies. Migration and cultural diversification helps, as has been noted for countries like Australia. Some cultures like the Japanese and Chinese have food philosophies and culinary practices which encourage biodiversity[86-88]

As indicated above, *staples* like rice, wheat, millet, beans and potatoes can be bred for more nutritious properties,[14] but these as monocultures are susceptible to crop failure. Wheat is vulnerable to rust and to small increases in environmental temperature. For these reasons, in North-west China, attention is being given to other grains than wheat for the bread mantou.[89] Similar developments are seen with a wider range of products made from millet.[90]

THE ORIGIN OF FOOD AND FOOD SYSTEMS: LOCALITY, TRADE AND GLOBALISATION, PROCESSING, PACKAGING, STORAGE, TRACEABILITY

Food manufacture and preparation away from home creates uncertainty about what has happened to it from acquisition to the point of consumption. The problem is exacerbated by globalisation and extended food trade. It involves the unknowns in food processing, packaging and storage.[64,91-94] This need to know and to have an input into one's food system is a major factor in the anxiety about food safety and security. It also constitutes an added mandate for education and involvement of the family and community, especially women and children about food.[95]

Traceability of food back to its origin is an agreed strategy for food safety regulation, but it also could be available with bar codes or QQ smart phone photography to consumers. This could have rapid uptake in economic development where internet connectedness is overtaking landline communication. Such methodology could put consumers back in informed control of their food supply.

FOOD SAFETY AND SECURITY

Food safety is a dimension of food security.[96] *Peoples' worries about food* are generally mostly about its safety, even though regulatory bodies are charged with risk assessment and management. But risk communication is often inadequate and people may be unnecessarily concerned. On the other hand, ongoing research inevitably leads to re-evaluation of risk as methods change and their sensitivity improves. Also, as major public health risks are contained, more attention can be paid to less pressing and less prevalent problems.[97]

There are *food additives and contaminants* whose risk profile has changed substantially in recent years as the understanding of biomedicine and the nature of health patterns have changed. These include tastants, colorants, preservatives, food texture modifiers and packaging contaminants.[70] Among the most evident have been pre- and probiotics[98] and endocrine disruptors.[99] Where little has been known about biological effects and the factor presumed safe on historical or theoretical grounds, problems may also emerge. An example is that of microbial transglutamase enzymes, now known to be dissimilar to their endogenous counterparts, but used extensively and confidently in food processing to modify food properties in various ways, such as the cross-linking of proteins. They also open gut epithelial channels and allow the penetration of larger less digested molecules. It now appears that they contribute to the rising incidence of coeliac disease and of other auto-immune disease.[100]

Yet another area of major food safety and security concern is that of *multiple antibiotic resistance genes (ARGs)*. The inappropriate and unnecessary use of antibiotics as growth promotants in livestock has led to this problem in farm animals, especially in China.[101,102] Although cooked meat may not transmit ARGs, contaminated soil, water and farm-workers do.

Potable, clean and safe water is not available to large sectors of some recently industrialised countries, as in China where this applies to some 60% of rivers and streams. Microbiological safety can usually be achieved by boiling, as in the brewing of tea, but chemical safety cannot. Most water is used for agricultural purposes where the food produced may also be contaminated.[103] There is the added problem that plastic bottles may not be sufficiently food-grade and endocrine disruptive residues be leached, especially at high temperatures. There is considerable scope for innovative approaches to make water safe at the point of consumption or application. And, in terms of overall consumption, digitisation of water supplies for agricultural and domestic purposes, along with recycling is optimistically seen as a conservation measure.[103,104] Smart water systems which make agricultural use of water more efficient are being developed and implemented.[105]

Future foods and food systems will need to take account of these shifts in the nature of food safety and security.

Not just because of water, but because of *limiting soil nutrients, especially phosphorus*, in globally short supply and the quest for greater yields (whatever the growth potential, plant nutrients are essential) *soil contamination* and unfitness for agriculture; *dependence on pollinators (especially bees*) which are disappearing through loss of habitat, pesticide misuse and disease (some induced by pollutants like diesel fuel); *loss of food crop biodiversity* with less resilience to climate change; and *global warming* itself (for example , wheat is very temperature sensitive), food insecurity is an increasing threat and reality.

THE QUEST FOR NUTRITIONAL HEALTH: FOOD AND FUNCTION

It is reasonable to look to food and food intake patterns as a way of optimising health, provided other personal behaviours, like physical activity, sleep, stress management and substance abuse (as with alcohol, tobacco and drugs, legal and illegal) are also addressed. But neither nutrients nor other food components have single functions or act alone. Failure to understand this leads to extrapolations from nutritional biochemistry to food product where the risk-benefit profile may be unacceptable.[106,107] Isolated carotenoids are such an example.[108,109] Turmeric, more than curcumin, has properties relevant to health, with less risk, as with cognitive function.[110] Insofar as possible, it is food or food patterns rather than food components that should be the therapeutic strategy to maximise its broader benefits

Figure 1. A peopleless food outlet in Taiwan with no staff.

and minimise the risk.[111-113]

DIGITISATION, VIRTUALITY, PEOPLELESS SYSTEMS

Proximity and contact with our food supply allows a greater understanding and control of it. Chopsticks at least 3,000 years ago in China, and, probably later in Europe, forks, spoons and knives allowed us to distance ourselves from the food we ate at the table, and lose some of the appreciation of the touch and texture of food.[114] Shopping[115] and cooking[2] confer survival advantage. Food dispensing or vending machines are now common place in most urban settings. Yet digital technology is enabling us to distance ourselves from the food system even more effectively.[65,116,117] The smart phone allows the ordering, activation of cooking and food preparation, delivery and more to be remote. In Taiwan, peopleless shops provide ordering consoles for recipe selection and meal provision (Figure 1). Serious questions must be asked about the loss of the social role of food with these trends. We know that this role is associated with greater survival.[118-120]

THE MEANING OF FOOD: NEW AND CHANGING ROLES

Food is culturally symbolic and distinctive food habits persist in migrant groups for longer than most characteristics.[86,121] While, with time, they may undergo acculturation towards the host culture, the reverse also takes place. This is especially evident in culturally pluralistic immigrant societies like Australia, New Zealand, the USA and Canada. Future foods and habits will continue to be influenced in this way and affect nutritionally-related health patterns.[122,123]

Food is also *part of the art and design world*. Its presentation is highly developed in some cultures like China, Japan, France and Italy. In part this has to do with the importance attached to it, its aesthetic integration into life, power and hierarchy. By contrast, food may be described as 'fast' or 'convenient' meaning relatively little attention is paid to it. At worst, food is bought and eaten absent-mindedly from a moving vehicle, one hand on the steering wheel, while in a 'fast food' lane-way. Contrast this with a thoughtfully chosen and savoured home-cooked meal, prepared by someone we love or for someone about whom we care! Evidence from Bangladesh,[54] Korea,[66] and Japan[55] indicates that attention to a particular meal or pattern and its features can favourably influence overall nutrition and health risk .

Beyond this, food designers are now paying attention not only to packaging, but also to the added *social and aesthetic meaning* which may be given to food through its representation at purchase or the table, as well as through the dining set or eating equipment. Examples are seating, table colours and plate size, each of which can alter appetite, consumption and physiological responses.[124] These developments may assume wider currency as food itself is less obviously connected to its accustomed origins. The newly acquired ability to grow meat from stem cells without the animal is already challenging food designers as demonstrated by the World Design Capital Food Project in Taipei in 2016.[124] It may also spare livestock and decrease the risk of ARGs. Quite profound questions arise for food processors, consumers and regulators about this quantum leap in food culture. If present environmental pressures on the food supply exacerbate, we may find ourselves in much greater need of food and nutrition literacy to manage safely, sustainably and healthfully our food supply.[125]

Food design has begun to offer an outlet for protest about oil spillage in fishing zones, animal cruelty in food production and genetic modification for socially active food processors.

Yet again, encouraging the acceptability of unattractive *'grotesque' fruits and vegetables* has been popularised in France as a way of minimising food waste, because the nutritional value is not compromised by shape, even if retailers have aimed for uniformity and symmetry.[126]

These trends in food design are to be distinguished from '*food fashions'*, which may be based on 'hints' from food and nutrition science, but are spruiked and given marketing impetus by commodity growers, boards or investors. It could be argued that the boom in sales of 'ancient grains' like quinoa and vegetables like kale fall into this category. Basic to the evaluation of these trends is whether they actually contribute to overall dietary variety or, in sum, compromise it; and whether their place in the food system is sustainable and, for more than an elite, affordable.

ECOSYSTEMS, FOOD AND HEALTH

We are ecological creatures and not the environmentally discrete individuals we thought in describing ourselves as the human species.[1,127] We are connected with the inanimate environment through place, weather, seasons, our chemistry and natural disasters. We are connected with the animate environment through the food and beverage we ingest, our several microbiomes, our senses, our environmentally-derived hormonal profiles and more. Our wellbeing and health is linked to that of our social and physical environment.

When it comes to health, first we must endeavour to prevent disorder and disease. We may not be able to cure as we would like, especially so-called chronic disease, but we can always care- about who we are, our place of abode, and others. This means we will value nature's resources, especially our food supply. That some 30-50% of it is wasted is not sustainable.[128,129] Future food systems must minimise this waste.

As we search for a deeper understanding of our condition, we find that its dysfunction is often a reflection of ecosystem degradation or loss. Such degradation or loss is, perhaps unwittingly, that of ourselves- and our food system. How much more of this can we tolerate and survive?[1,7] How much is amenable to the way in which we develop the future food supply?

AUTHOR DISCLOSURES

The author has no conflict of interest in regard to this paper.

REFERENCES

1. Wahlqvist ML. Ecosystem Health Disorders - changing perspectives in clinical medicine and nutrition. Asia Pac J Clin Nutr. 2014;23:1-15. doi: 10.6133/apjcn.2014.23.1.20.
2. Chen RCY, Lee MS, Chang YH, Wahlqvist ML. Cooking frequency may enhance survival in Taiwanese elderly. Public Health Nutr. 2012;15:1142-9. doi: 10.1017/S13689 8001200136X.
3. Wen CP, Wai JP, Tsai MK, Yang YC, Cheng TY, Lee MC et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. Lancet. 2011;378:1244-53. doi: 10.1016/s0140-6736 (11)60749-6.
4. Wahlqvist ML. Critical nutrition events in human history. Asia Pac J Clin Nutr. 1992;1:101-05.
5. Steffen W, Richardson K, Rockstrom J, Cornell SE, Fetzer I, Bennett EM et al. Sustainability. Planetary boundaries: guiding human development on a changing planet. Science. 2015;347:1259855. doi: 10.1126/science.1259855.
6. Butler CD. Sounding the alarm: health in the anthropocene. Int J Environ Res Public Health. 2016;13:E665. doi: 10. 3390/ijerph13070665.
7. Hansen J, Sato M, Hearty P, Ruedy R, Kelley M, Masson-Delmotte V et al. Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2°C global warming could be dangerous. Atmos Chem Phys. 2016;16:3761-812. doi: 10. 5194/acp-16-3761-2016.
8. Lindsey R. 2015 State of the Climate: Highlights. [cited 2016/08/02]; Available from: https://www.climate.gov/ news-features/features/2015-state-climate-highlights#wows 1_3.
9. Fischer CG, Garnett T. Plates, pyramids, planet: developments in national healthy and sustainable dietary guidelines: a state of play assessment. Rome: Food and Agriculture Organization of the United Nations and the Food Climate Research Network at the University of Oxford; 2016.
10. Nierenberg D, Tozer E. Hunger doesn't take a summer vacation: 19 summer feeding programs for kids. [cited 2016/08/03]; Available from: http://foodtank.com/news/ 2016/08/hunger-doesnt-take-a-summer-vacation-19-summer -feeding-programs-for-kids.
11. World Health Organization. Global health risks. [cited 2016/08/11]; Available from: http://www.who.int/ healthinfo/global_burden_disease/global_health_risks/en/.
12. International Food Policy Research Institute. Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition and Sustainable Development. Washington, DC: International Food Policy Research Institute; 2015.
13. International Food Policy Research Institute. Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030. Washington, DC: International Food Policy Research Institute; 2016.
14. HarvestPlus. HarvestPlus: better crops, better nutrition. [cited 2016/08/09]; Available from: http://www.harvestplus. org/.
15. World Food Programme. Specialized nutritious food. [cited 2016/08/09]; Available from: https://www.wfp.org/ nutrition/special-nutritional-products.
16. Wahlqvist ML, Kouris-Blazos A, Savige GS. Food security and the Aged. In: Ogunrinade A, May JD, editors. Not by Bread Alone. Food Security and Governance in Africa. Toda Institute for Global Peace and Policy Research. South Africa: Witwatersrand University Press; 1999. pp. 206-21.
17. Lo YT, Chang YH, Lee MS, Wahlqvist ML. Dietary diversity and food expenditure as indicators of food security in older Taiwanese. Appetite. 2012;58:180-7. doi: 10.1016/j. appet.2011.09.023.
18. Lo YT, Chang YH, Wahlqvist ML, Huang HB, S. LM. Spending on vegetable and fruit consumption could reduce all-cause mortality among older adults. Nutr J. 2012;11:113. doi: 10.1186/1475-2891-11-113.
19. Lo YT, Wahlqvist ML, Chang YH, Kao S, Lee MS. Dietary diversity predicts type of medical expenditure in elders. Am J Manag Care. 2013;19:e415-23.
20. Monteiro CA. Nutrition and health. The issue is not food, nor nutrients, so much as processing. Public Health Nutr. 2009;12:729-31. doi: 10.1017/S1368980009005291.
21. United Nations. Sustainable Development Goals. [cited 2016/08/09]; Available from: https://sustainabledevelop ment.un.org/sdgs.
22. Gibson V, Zhu YG, Ge R, Wahlqvist ML. Preferred ecosystem characteristics: their food and health relevance to China's rapid urbanisation. Asia Pac J Clin Nutr. 2015;24: 556-74. doi: 10.6133/apjcn.2015.24.4.29.
23. Fahmida U, Htet MK, Adhiyanto C, Kolopaking R, Yudisti MA, Maududi A et al. Genetic variants of FADS gene

cluster, plasma LC-PUFA levels and the association with cognitive function of under-two-year-old Sasaknese Indonesian children. Asia Pac J Clin Nutr. 2015;24:323-8. doi: 10.6133/apjcn.2015.24.2.17.
24. Tanabe R, Kawamura Y, Tsugawa N, Haraikawa M, Sogabe N, Okano T, Hosoi T, Goseki-Sone M. Effects of Fok-I polymorphism in vitamin D receptor gene on serum 25-hydroxyvitamin D, bone-specific alkaline phosphatase and calcaneal quantitative ultrasound parameters in young adults. Asia Pac J Clin Nutr. 2015;24:329-35. doi: 10.6133/apjcn.2015.24.2.01.
25. Zhang S, Ma Y, Guo H, Wan W, Xue K. Diets high in carbohydrate may not be appropriate for rs328 G carriers with the metabolic syndrome. Asia Pac J Clin Nutr. 2015;24:546-54. doi: 10.6133/apjcn.2015.24.3.17.
26. Yang J, Gao Q, Gao X, Tao X, Cai H, Fan Y et al. Melanocortin-4 receptor rs17782313 polymorphisms are associated with serum triglycerides in older Chinese women. Asia Pac J Clin Nutr. 2016;25:213-9. doi: 10.6133/apjcn.2016.25.1.18.
27. Yeh J, Trang A, Henning SM, Wilhalme H, Carpenter C, Heber D, Li Z. Food cravings, food addiction, and a dopamine-resistant (DRD2 A1) receptor polymorphism in Asian American college students. Asia Pac J Clin Nutr. 2016;25:424-9. doi: 10.6133/apjcn.102015.05.
28. Yu F, Cui LL, Li X, Wang CJ, Ba Y, Wang L et al. The genetic polymorphisms in vitamin D receptor and the risk of type 2 diabetes mellitus: an updated meta-analysis. Asia Pac J Clin Nutr. 2016;25:614-24. doi: 10.6133/apjcn.092015.12.
29. Zhou GY, Ren LJ, Hou JX, Cui, L. X. , Ding Z, Cheng XM, Zhu JY, Cui RR, Ba Y. Endemic fluorosis in Henan province, China: ERα gene polymorphisms and reproductive hormones among women. Asia Pac J Clin Nutr. 2016;25:911-9. doi: 10.6133/apjcn.052016.10.
30. Li D. Omega-3 polyunsaturated fatty acids and non-communicable diseases: meta-analysis based systematic review. Asia Pac J Clin Nutr. 2015;24:10-5. doi: 10.6133/apjcn.2015.24.1.21.
31. Zheng JS, Wang L, Lin M, Yang H, Li D. BMI status influences the response of insulin sensitivity to diacylglycerol oil in Chinese type 2 diabetic patients. Asia Pac J Clin Nutr. 2015;24:65-72. doi: 10.6133/apjcn.2015.24.1.01.
32. Parthasarathy LS, Chiplonkar SA, Khadilkar AV, Khadilkar VV. Dietary modifications to improve micronutrient status of Indian children and adolescents with type 1 diabetes. Asia Pac J Clin Nutr. 2015;24:73-82. doi: 10.6133/apjcn.2015.24.1.04.
33. Qin LQ, Xu JY, Han SF, Zhang ZL, Zhao YY, Szeto IM. Dairy consumption and risk of cardiovascular disease: an updated meta-analysis of prospective cohort studies. Asia Pac J Clin Nutr. 2015;24:90-100. doi: 10.6133/apjcn.2015.24.1.09.
34. Hu J, Hu Y, Hu Y, Zheng S. Intake of cruciferous vegetables is associated with reduced risk of ovarian cancer: a meta-analysis. Asia Pac J Clin Nutr. 2015;24:101-9. doi: 10.6133/apjcn.2015.24.1.22.
35. Scherbaum V, Purwestri RC, Stuetz W, Inayati DA, Suryantan J, Bloem MA, Biesalski HK. Locally produced cereal/nut/legume-based biscuits versus peanut/milk-based spread for treatment of moderately to mildly wasted children in daily programmes on Nias Island, Indonesia: an issue of acceptance and compliance? Asia Pac J Clin Nutr. 2015;24:152-61. doi: 10.6133/apjcn.2015.24.1.15.
36. Titaley CR, Dibley MJ. Factors associated with not using antenatal iron/folic acid supplements in Indonesia: the 2002/2003 and 2007 Indonesia Demographic and Health Survey. Asia Pac J Clin Nutr. 2015;24:162-76. doi: 10.6133/apjcn.2015.24.1.10.
37. Chan WK, Tan AT, Vethakkan SR, Tah PC, Vijayananthan A, Goh KL. Low physical activity and energy dense Malaysian foods are associated with non-alcoholic fatty liver disease in centrally obese but not in non-centrally obese patients with diabetes mellitus. Asia Pac J Clin Nutr. 2015;24:289-98. doi: 10.6133/apjcn.2015.24.2.15.
38. Joo S, Ju S, Chang H. Comparison of fast food consumption and dietary guideline practices for children and adolescents by clustering of fast food outlets around schools in the Gyeonggi area of Korea. Asia Pac J Clin Nutr. 2015;24:299-307. doi: 10.6133/apjcn.2015.24.2.03.
39. Kim YJ, Park MY, Chang N, Kwon O. Intake and major sources of dietary flavonoid in Korean adults: Korean National Health and Nutrition Examination Survey 2010-2012. Asia Pac J Clin Nutr. 2015;24:456-63. doi: 10.6133/apjcn.2015.24.3.04.
40. Liu J, Arcot J, Cunningham J, Greenfield H, Hsu J, Padula D, Strobel N, Fraser DR. New data for vitamin D in Australian foods of animal origin: impact on estimates of national adult vitamin D intakes in 1995 and 2011-13. Asia Pac J Clin Nutr. 2015;24:464-71. doi: 10.6133/apjcn.2015.24.4.04.
41. Hou LQ, Liu YH, Zhang YY. Garlic intake lowers fasting blood glucose: meta-analysis of randomized controlled trials. Asia Pac J Clin Nutr. 2015;24:575-82. doi: 10.6133/apjcn.2015.24.4.15.
42. Sawada K, Murayama N, Takemi Y, Ishida H. Cohort study examining the association between vegetable consumption and weight gain in a single year among Japanese employees at a manufacturing company. Asia Pac J Clin Nutr. 2015;24:633-8. doi: 10.6133/apjcn.2015.24.4.08.
43. Jaacks LM, Du S, Mendez MA, Crandell J, Liu W, Ji L, Rosamond W, Popkin BM, Mayer-Davis EJ. Comparison of the dietary intakes of individuals with and without type 1 diabetes in China. Asia Pac J Clin Nutr. 2015;24:639-49. doi: 10.6133/apjcn.2015.24.4.03.
44. Ross AB, Colega MT, Lim AL, Silva-Zolezzi I, Mace K, Saw SM et al. Whole grain intake, determined by dietary records and plasma alkylresorcinol concentrations, is low among pregnant women in Singapore. Asia Pac J Clin Nutr. 2015;24:674-82. doi: 10.6133/apjcn.2015.24.4.19.
45. Lee MS, Wahlqvist ML, Peng CJ. Dairy foods and health in Asians: Taiwanese considerations. Asia Pac J Clin Nutr. 2015;24(Suppl 1):S14-20. doi: 10.6133/apjcn.2015.24.s1.03.
46. Wahlqvist ML. Lactose nutrition in lactase nonpersisters. Asia Pac J Clin Nutr. 2015;24(Suppl 1):S21-5. doi: 10.6133/apjcn.2015.24.s1.04.
47. Surono IS. Traditional Indonesian dairy foods. Asia Pac J Clin Nutr. 2015;24(Suppl 1):S26-30. doi: 10.6133/apjcn.2015.24.s1.05.
48. Kouris-Blazos A, Belski R. Health benefits of legumes and pulses with a focus on Australian sweet lupins. Asia Pac J Clin Nutr. 2016;25:1-17. doi: 10.6133/apjcn.2016.25.1.23.
49. Hod R, Kouidhi W, Ali Mohd M, Husain R. Plasma isoflavones in Malaysian men according to vegetarianism and by age. Asia Pac J Clin Nutr. 2016;25:89-96. doi: 10.6133/apjcn.2016.25.1.02.
50. Yao J, Chang L, Yuan L, Duan Z. Nutrition status and small intestinal bacterial overgrowth in patients with virus-related cirrhosis. Asia Pac J Clin Nutr. 2016;25:283-91. doi: 10.6133/apjcn.2016.25.2.06.
51. Widodo Y, Sandjaja S, Sumedi E, Khouw I, Deurenberg P. The effect of socio-demographic variables and dairy use on the intake of essential macro- and micronutrients in 0.5-12-year-old Indonesian children. Asia Pac J Clin Nutr. 2016;25:

356-67. doi: 10.6133/apjcn.2016.25.2.09.
52. Mark HE, Houghton LA, Gibson RS, Monterrosa E, Kraemer K. Estimating dietary micronutrient supply and the prevalence of inadequate intakes from national Food Balance Sheets in the South Asia regiona. Asia Pac J Clin Nutr. 2016;25:368-76. doi: 10.6133/apjcn.2016.25.2.11.
53. Sedaghat F, Jessri M, Behrooz M, Mirghotbi M, Rashidkhani B. Mediterranean diet adherence and risk of multiple sclerosis: a case-control study. Asia Pac J Clin Nutr. 2016;25:377-84. doi: 10.6133/apjcn.2016.25.2.12.
54. Andersen AB, Schmidt L, Faurholt-Jepsen D, Roos N, Friis H, Kongsbak K, Wahed MA, Thilsted SH. The effect of daily consumption of the small fish Amblypharyngodon mola or added vitamin A on iron status: a randomised controlled trial among Bangladeshi children with marginal vitamin A status. Asia Pac J Clin Nutr. 2016;25:464-71. doi: 10.6133/apjcn.092015.11.
55. Adachi C, Yamanaka-Okumura H, Katayama T, Taketani Y, Takeda E. Single vegetable meal content equivalence as an alternative to fat for satiety: a randomised trial in Japanese women. Asia Pac J Clin Nutr. 2016;25:478-86. doi: 10.6133/apjcn.092015.25.
56. Baek HI, Ha KC, Kim HM, Choi EK, Park EO, Park BH et al. Randomized, double-blind, placebo-controlled trial of Ficus carica paste for the management of functional constipation. Asia Pac J Clin Nutr. 2016;25:487-96. doi: 10.6133/apjcn.092015.06.
57. Ma X, Chen Y, Huang F, Luo Q, Lv H, Long H. Food intolerance prevalence in active ulcerative colitis in southwest China. Asia Pac J Clin Nutr. 2016;25:529-33. doi: 10.6133/apjcn.102015.04.
58. Xie Y, Huang S, He T, Su Y. Coffee consumption and risk of gastric cancer: an updated meta-analysis. Asia Pac J Clin Nutr. 2016;25:578-88. doi: 10.6133/apjcn.092015.07.
59. Park S, Choi HS, Bae JH. Instant noodles, processed food intake, and dietary pattern are associated with atopic dermatitis in an adult population (KNHANES 2009-2011). Asia Pac J Clin Nutr. 2016;25:602-13. doi: 10.6133/apjcn.092015.23.
60. Kim SH, Lee JH, Ly SY. Children with atopic dermatitis in Daejeon, Korea: individualized nutrition intervention for disease severity and nutritional status. Asia Pac J Clin Nutr. 2016;25:716-28. doi: 10.6133/apjcn.092015.31.
61. Fujimori A, Yamashita T, Kubota M, Saito H, Takamatsu N, Nambu M. Comparison of the prevalence and characteristics of food hypersensitivity among adolescent and older women. Asia Pac J Clin Nutr. 2016;25:858-62. doi: 10.6133/apjcn.092015.39.
62. Liu ZH, Tang Z, Zhang KQ, Shi L. Salty food preference is associated with osteoporosis among Chinese men. Asia Pac J Clin Nutr. 2016;25:871-8. doi: 10.6133/apjcn.102015.06.
63. Dunford EK, Guggilla RK, Ratneswaran A, Webster JL, Maulik PK, Neal BC. The adherence of packaged food products in Hyderabad, India with nutritional labelling guidelines. Asia Pac J Clin Nutr. 2015;24:540-5. doi: 10.6133/apjcn.2015.24.3.08.
64. Miller LM, Cassady DL. The effects of nutrition knowledge on food label use. A review of the literature. Appetite. 2015;92:207-16. doi: 10.1016/j.appet.2015.05.029.
65. Lau E, Goh HJ, Quek R, Lim SW, Henry J. Rapid estimation of the energy content of composite foods: the application of the Calorie Answer. Asia Pac J Clin Nutr. 2016;25:18-25. doi: 10.6133/apjcn.2016.25.1.14.
66. Suh HJ, Jung EY. Effect of food service form on eating rate: meal served in a separated form might lower eating rate. Asia Pac J Clin Nutr. 2016;25:85-8. doi: 10.6133/apjcn.2016.25.1.12.
67. Oba S, Oogushi K, Ogata H, Nakai H. Factors associated with irregular breakfast consumption among high school students in a Japanese community. Asia Pac J Clin Nutr. 2016;25:165-73. doi: 10.6133/apjcn.2016.25.1.05.
68. Lu S, Du S, Zhang Q, Hu X, Chen S, Wang Z, Lu L, Ma G. Alcoholic beverage preferences and associated drinking patterns by socioeconomic status among high-school drinkers in three metropolises of China. Asia Pac J Clin Nutr. 2016;25:184-94. doi: 10.6133/apjcn.2016.25.1.20.
69. Nakahata NT, Takada AN, Imaeda N, Goto C, Kuwabara KH, Niimura H, Arai Y, Yoshita K, Takezaki T. Validity of a food frequency questionnaire in a population with high alcohol consumption in Japan. Asia Pac J Clin Nutr. 2016;25:195-201. doi: 10.6133/apjcn.2016.25.1.10.
70. Wahlqvist ML. Food structure is critical for optimal health. Food Funct. 2016;7:1245-50. doi: 10.1039/c5fo01285f.
71. Lopez-Legarrea P, Fuller NR, Zulet MA, Martinez JA, Caterson ID. The influence of Mediterranean, carbohydrate and high protein diets on gut microbiota composition in the treatment of obesity and associated inflammatory state. Asia Pac J Clin Nutr. 2014;23:360-8. doi: 10.6133/apjcn.2014.23.3.16.
72. Smith PA. The tantalizing links between gut microbes and the brain. Nature. 2015;526:312-4. doi: 10.1038/526312a.
73. Parekh PJ, Balart LA, Johnson DA. The Influence of the Gut Microbiome on Obesity, Metabolic Syndrome and Gastrointestinal Disease. Clin Transl Gastroenterol. 2015;6:e91. doi: 10.1038/ctg.2015.16.
74. Wahlqvist ML, Chang HY, Chen CC, Hsu CC, Chang WC, Wang WS, Hsiung CA. Is impaired energy regulation the core of the metabolic syndrome in various ethnic groups of the USA and Taiwan? BMC Endocr Disord. 2010;10:11. doi: 10.1186/1472-6823-10-11.
75. Agustina R, Lukito W, Firmansyah A, Suhardjo HN, Murniati D, Bindels J. The effect of early nutritional supplementation with a mixture of probiotic, prebiotic, fiber and micronutrients in infants with acute diarrhea in Indonesia. Asia Pac J Clin Nutr. 2007;16:435-42. doi: 10.6133/apjcn.2007.16.3.07.
76. Brunser O, Figueroa G, Gotteland M, Haschke-Becher E, Magliola C, Rochat F et al. Effects of probiotic or prebiotic supplemented milk formulas on fecal microbiota composition of infants. Asia Pac J Clin Nutr. 2006;15:368-76.
77. Lukito W, Malik SG, Surono IS, Wahlqvist ML. From 'lactose intolerance' to 'lactose nutrition'. Asia Pac J Clin Nutr. 2015;24(Suppl 1):S1-8. doi: 10.6133/apjcn.2015.24.s1.01.
78. Chen L, Liu R, Qin C, Meng Y, Zhang J, Wang Y, Xu G. Sources and intake of resistant starch in the Chinese diet. Asia Pac J Clin Nutr. 2010;19:274-82. doi: 10.6133/apjcn.2010.19.2.18.
79. Food and Agriculture Organization of the United Nations. Food-based dietary guidelines – Cyprus. [cited 2016/08/09]; Available from: http://www.fao.org/nutrition/education/food-based-dietary-guidelines/regions/countries/cyprus/en/.
80. Wahlqvist ML, Kouris-Blazos A, Crotty P, Worsley T, Harvey P, Tieru H, Cavalli-Sforza LT. Development of Food-Based Dietary Guidelines for the Western Pacific Region. Manila: World Health Organization; 1999.
81. Hoddinott J, Yohannes Y. Dietary diversity as a food security indicator. Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development; 2002.
82. Lee MS, Huang YC, Su HH, Lee MZ, Wahlqvist ML. A simple food quality index predicts mortality in elderly

Taiwanese. J Nutr Health Aging. 2011;15:815-21. doi: 10.1007/s12603-011-0081-x.
83. Mirmiran P, Azadbakht L, Esmaillzadeh A, Azizi F. Dietary diversity score in adolescents - a good indicator of the nutritional adequacy of diets: Tehran lipid and glucose study. Asia Pac J Clin Nutr. 2004;13:56-60.
84. Hodgson JM, Hsu-Hage B, Wahlqvist ML. Food variety as a quantitative descriptor of food intake. Ecol Food Nutr. 1994;32:137-48. doi: 10.1080/03670244.1994.9991395.
85. Hatloy A, Torheim LE, Oshaug A. Food variety--a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. Eur J Clin Nutr. 1998;52:891-8. doi: 10.1038/sj.ejcn.1600662.
86. Wahlqvist ML. Asian migration to Australia: food and health consequences. Asia Pac J Clin Nutr. 2002;11(Suppl 3):S562-8. doi: 10.1046/j.1440-6047.11.supp3.13.x.
87. Melby MK, Utsugi M, Miyoshi M, Watanabe S. Overview of nutrition reference and dietary recommendations in Japan: application to nutrition policy in Asian countries. Asia Pac J Clin Nutr. 2008;17(Suppl 2):394-8. doi: 10.6133/apjcn.2008.17.s2.02.
88. Food and Agriculture Organization of the United Nations. Food-based dietary guidelines – Japan. [cited 2016/08/10]; Available from: http://www.fao.org/nutrition/education/food-based-dietary-guidelines/regions/countries/japan/en/.
89. Hu X, Sheng X, Liu L, Ma Z, Li X, Zhao W. Food system advances towards more nutritious and sustainable mantou production in China. Asia Pac J Clin Nutr. 2015;24:199-205. doi: 10.6133/apjcn.2015.24.2.21.
90. Shobana S1, Krishnaswamy K, Sudha V, Malleshi NG, Anjana RM, Palaniappan L, Mohan V. Finger millet (Ragi, Eleusine coracana L.): a review of its nutritional properties, processing, and plausible health benefits. Adv Food Nutr Res. 2013;69:1-39. doi: 10.1016/B978-0-12-410540-9.00001-6.
91. Worsley T. Food habits and beliefs in transitional societies. Asia Pac J Clin Nutr. 1998;7:287-92.
92. Worsley T, Scott V. Consumers' concerns about food and health in Australia and New Zealand. Asia Pac J Clin Nutr. 2000;9:24-32. doi: 10.1046/j.1440-6047.2000.00130.x.
93. Worsley A. Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? Asia Pac J Clin Nutr. 2002;11(Suppl 3):S579-85. doi: 10.1046/j.1440-6047.11.supp3.7.x.
94. Miyoshi M, Tsuboyama-Kasaoka N, Nishi N. School-based "Shokuiku" program in Japan: application to nutrition education in Asian countries. Asia Pac J Clin Nutr. 2012;21:159-62. doi: 10.6133/apjcn.2012.21.1.23.
95. Wahlqvist ML. Connected Community and Household Food-Based Strategy (CCH-FBS): its importance for health, food safety, sustainability and security in diverse localities. Ecol Food Nutr. 2009;48:457-81. doi: 10.1080/03670240903308596.
96. Wahlqvist ML. Why food in health security (FIHS)? Asia Pac J Clin Nutr. 2009;18:480-5. doi: 10.6133/apjcn.2009.18.4.02.
97. Wahlqvist ML, Kuo KN. Securing health through food systems: an initiative of the nutrition consortium of the National Health Research Institutes in Taiwan and Asia Pacific regional partners as a network. Asia Pac J Clin Nutr. 2009;18:472-9. doi: 10.6133/apjcn.2009.18.4.01.
98. Sanchez B, Delgado S, Blanco-Miguez A, Lourenco A, Gueimonde M, Margolles A. Probiotics, gut microbiota and their influence on host health and disease. Mol Nutr Food Res. 2016. doi: 10.1002/mnfr.201600240. (In Press)
99. Diamanti-Kandarakis E, Bourguignon JP, Giudice LC, Hauser R, Prins GS, Soto AM, Zoeller RT, Gore AC. Endocrine-disrupting chemicals: an Endocrine Society scientific statement. Endocr Rev. 2009;30:293-342. doi: 10.1210/er.2009-0002.
100. Lerner A, Matthias T. Changes in intestinal tight junction permeability associated with industrial food additives explain the rising incidence of autoimmune disease. Autoimmun Rev. 2015;14:479-89. doi: 10.1016/j.autrev.2015.01.009.
101. Zhu YG, Johnson TA, Su JQ, Qiao M, Guo GX, Stedtfeld RD, Hashsham SA, Tiedje JM. Diverse and abundant antibiotic resistance genes in Chinese swine farms. Proc Natl Acad Sci U S A. 2013;110:3435-40. doi: 10.1073/pnas.1222743110.
102. Liu YY, Wang Y, Walsh TR, Yi LX, Zhang R, Spencer J et al. Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study. Lancet Infect Dis. 2016;16:161-8. doi: 10.1016/s1473-3099(15)00424-7.
103. Wahlquist AK. Water and its role in food and health security--the importance of water to food production. Asia Pac J Clin Nutr. 2009;18:501-6. doi: 10.6133/apjcn.2009.18.4.06.
104. Wahlquist A. Thirsty Country: options for Australia. Crows Nest, NSW: Allen & Unwin; 2008.
105. Fujisaki M. Japan venture makes irrigation 'smart'. The China Post. 2016/08/01 [cited 2016/08/09]; Available from: http://www.chinapost.com.tw/life/science-technology/2016/08/01/473989/Japan-venture.htm.
106. Wahlqvist ML. National food fortification: a dialogue with reference to Asia: policy in evolution. Asia Pac J Clin Nutr. 2008;17(Suppl 1):24-9. doi: 10.6133/apjcn.2008.17.s1.06.
107. Wahlqvist ML. Antioxidant relevance to human health. Asia Pac J Clin Nutr. 2013;22:171-6. doi: 10.6133/apjcn.2013.22.2.21.
108. MacLennan R, Macrae F, Bain C, Newland RC, Russell A, Ward M, Wahlqvist ML, the Australian Polyp Prevention Project. Effect of fat, fibre, and beta carotene intake on colorectal adenomas: Further analysis of a randomized controlled dietary intervention trial after colonoscopic polypectomy. Asia Pac J Clin Nutr. 1999;8:S54-8.
109. Satia JA, Littman A, Slatore CG, Galanko JA, White E. Long-term use of beta-carotene, retinol, lycopene, and lutein supplements and lung cancer risk: results from the VITamins And Lifestyle (VITAL) study. Am J Epidemiol. 2009;169:815-28. doi: 10.1093/aje/kwn409.
110. Lee MS, Wahlqvist ML, Chou YC, Fang WH, Lee JT, Kuan JC et al. Turmeric improves post-prandial working memory in pre-diabetes independent of insulin. Asia Pac J Clin Nutr. 2014;23:581-91. doi: 10.6133/apjcn.2014.23.4.24.
111. Wahlqvist ML. Food as therapy. In: Wahlqvist AMM, ed. Current Problems in Nutrition Pharmacology & Toxicology. London: John Libbey & Co Ltd; 1988. pp. 1-15.
112. Mohamad A, Azlan A, Adon MY, Khoo HE, Razman MR. Polychlorinated biphenyl and heavy metal exposures among fishermen in the Straits of Malacca: neurobehavioural performance. Asia Pac J Clin Nutr. 2015;24:515-24. doi: 10.6133/apjcn.2015.24.3.06.
113. Wen JG, Liu XJ, Wang ZM, Li TF, Wahlqvist ML. Melamine-contaminated milk formula and its impact on children. Asia Pac J Clin Nutr. 2016;25:697-705. doi: 10.6133/apjcn.072016.01.
114. Cosman MP. A feast for Aesculapius: historical diets for asthma and sexual pleasure. Annu Rev Nutr. 1983;3:1-33. doi: 10.1146/annurev.nu.03.070183.000245.
115. Chang YH, Chen RC, Wahlqvist ML, Lee MS. Frequent shopping by men and women increases survival in the older

Taiwanese population. J Epidemiol Community Health. 2012;66:e20. doi: 10.1136/jech.2010.126698.
116. Hyeon JH, Gwak JS, Hong SW, Kwon H, Oh SW, Lee CM. Relationship between bone mineral density and alcohol consumption in Korean men: the Fourth Korea National Health and Nutrition Examination Survey (KNHANES), 2008-2009. Asia Pac J Clin Nutr. 2016;25:308-15. doi: 10.6133/apjcn.2016.25.2.17.
117. Feng RN, Du SS, Chen Y, Li Z, Zhang YF, Sun CH, Jiang YS. An internet-based food frequency questionnaire for a large Chinese population. Asia Pac J Clin Nutr. 2016;25:841-8. doi: 10.6133/apjcn.092015.26.
118. Welin L, Tibblin G, Svardsudd K, Tibblin B, Ander-Peciva S, Larsson B, Wilhelmsen L. Prospective study of social influences on mortality. The study of men born in 1913 and 1923. Lancet. 1985;1:915-8.
119. Clausen T, Wilson AO, Molebatsi RM, Holmboe-Ottesen G. Diminished mental- and physical function and lack of social support are associated with shorter survival in community dwelling older persons of Botswana. BMC Public Health. 2007;7:144. doi: 10.1186/1471-2458-7-144.
120. Sahyoun NR, Jacques PF, Dallal GE, Russell RM. Nutrition Screening Initiative Checklist may be a better awareness/educational tool than a screening one. J Am Diet Assoc. 1997;97:760-4. doi: 10.1016/s0002-8223(97)00188-0.
121. Wahlqvist ML, Lee MS. Regional food culture and development. Asia Pac J Clin Nutr. 2007;16(Suppl 1):2-7. doi: 10.6133/apjcn.2007.16.s1.02.
122. Solomons NW. Diet and long-term health: an African Diaspora perspective. Asia Pac J Clin Nutr. 2003;12:313-30.
123. Lee WP, Lingard J, Bermingham M. Change in diet and body mass index in Taiwanese women with length of residence in Australia. Asia Pac J Clin Nutr. 2007;16:56-65.
124. World Design Capital. Edible Tales [cited 2016/08/04]; Available from: thefoodproject.com.tw.
125. Subasinghe AK, Thrift AG, Evans RG, Arabshahi S, Suresh O, Kartik K, Kalyanram K, Walker KZ. Novel dietary intake assessment in populations with poor literacy. Asia Pac J Clin Nutr. 2016;25:202-12. doi: 10.6133/apjcn.2016.25. 1. 19.
126. Cliff M. Forget the ugli fruit, meet the ugly fruit bowl! French supermarket introduces lumpy and misshapen fruit and vegetables - sold at a 30% discount - to combat food waste. Mail Online. 2016/02/01. [cited 2016/08/09]; Available from: http://www.dailymail.co.uk/femail/food/article-2693000/Forget-ugli-fruit-meet-ugly-fruit-bowl-French-supermarket-introduces-lumpy-misshapen-fruit-vegetables-sold-30-discount-combat-food-waste.html.
127. Wahlqvist ML. Evolution. Species. Ecology. Who, what and why are we. World Nutrition. 2014;5:1061-6.
128. Huang ST. A recycling index for food and health security: urban Taipei. Asia Pac J Clin Nutr. 2010;19:402-11. doi: 10.6133/apjcn.2010.19.3.15.
129. Lin AY, Huang ST, Wahlqvist ML. Waste management to improve food safety and security for health advancement. Asia Pac J Clin Nutr. 2009;18:538-45. doi: 10.6133/apjcn.2009.18.4.12.

Review Article

Future food

Mark L Wahlqvist MD (Adelaide), MD (Uppsala), FRACP FAFPHM FAIFST FACN FTSE[1,2,3]

[1]*Institute of Population Health Sciences, National Health Research Institutes, Miaoli County, Taiwan*
[2]*School of Public Health, National Defense Medical Center, Taipei, Taiwan*
[3]*Monash Asia Institute, Monash University, Melbourne, Australia*

未來糧食

糧食系統隨著人類定居和農耕、工業化、貿易、移民以及現今的數位時代而明顯改變。這些轉型的過程中，出現人口漸增至爆炸，及生態系統的淨流失與崩壞。氣候變遷由於生態系統的失衡而加速惡化。我們的健康狀況已受到一個發展中的人類-環境不搭的挑戰。我們將生態征服及創新技術當作解決方案，但是還不了解我們如何對生態的依賴及我們是一個完整的體系。人類是生態的生物，其介面為我們的感官、腸道微生物群、共享的調節(內分泌)機制、免疫系統、生物時鐘及營養路徑。我們許多人是「自然剝奪」者。我們可能正面臨名為「生態健康失調」(EHD)的困境。如果不是那麼多人，自然的應變能力可能足以因應，但是面臨 2050 年超過 90 億的人口，地球可能無法負荷這個需求。未來的糧食需逐漸增加考量糧食系統對生態系統依賴所造成的壓力，導致糧食的有較少的生物多樣性，儘管這樣吃可以有較佳的健康；較少運動與食物不當的能量密度所造成的能量失衡；以及較少有利於社會的飲食習慣。「個人化營養」，包括資源需要很高的營養基因體學、代謝體學以及腸道微生物資料，可能可提供臨床上的部分健康解答，但對公共衛生的倫理、風險管理或是永續使用並不具正當性。糧食不安全、品質及平等是全球盛行的多面向營養不良問題，需要在地、區域或是全球的行動，以預防更進一步的生態系統崩壞；並教育提供永續生計以及鼓勵尊重糧食相關的社會論述及作法。

關鍵字：糧食系統、糧食安全、生態營養、生態系統健康失調、個人化營養、無人食物商場、臨床營養