Evolution of Well-Being and Happiness After Increases in Consumption of Fruit and Vegetables

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Objectives. To explore whether improvements in psychological well-being occur after increases in fruit and vegetable consumption.

Methods. We examined longitudinal food diaries of 12 385 randomly sampled Australian adults over 2007, 2009, and 2013 in the Household, Income, and Labour Dynamics in Australia Survey. We adjusted effects on incident changes in happiness and life satisfaction for people's changing incomes and personal circumstances.

Results. Increased fruit and vegetable consumption was predictive of increased happiness, life satisfaction, and well-being. They were up to 0.24 life-satisfaction points (for an increase of 8 portions a day), which is equal in size to the psychological gain of moving from unemployment to employment. Improvements occurred within 24 months.

Conclusions. People's motivation to eat healthy food is weakened by the fact that physical health benefits accrue decades later, but well-being improvements from increased consumption of fruit and vegetables are closer to immediate.

Policy implications. Citizens could be shown evidence that "happiness" gains from healthy eating can occur quickly and many years before enhanced physical health. (*Am J Public Health.* 2016;106:1504–1510. doi:10.2105/AJPH.2016.303260)

Fruits and vegetables are known to provide important health benefits.[1,2] Yet, in Western society, the typical citizen eats an unhealthy diet (US data are available at http://www.cdc.gov/brfss and European data at http://www.eufic.org). The difficulty of persuading people to consume more fruits and vegetables remains a serious one.[3–7]

In this study, we explored a new approach to the problem. The article is designed partly for the scientific researcher and partly for the public health practitioner. It uncovers evidence consistent with a longitudinal connection between the consumption of certain foods (especially fruits and vegetables) and later subjective well-being, and a channel that appears to be independent of long-run health.

In disciplines beyond public health research, the study of happiness and well-being has generated a large modern literature.[8,9] The potential influence of food has been virtually ignored. Traditional research on well-being has focused upon the role of economic, personal, and political influences,[9–11] and in character has been steadily moving in emphasis from cross-sectional to longitudinal analysis.[12] That the scholarly literature has developed in the way described is perhaps unsurprising. First, most data sets do not record information on the foods eaten by individuals; second, the main contributors to the happiness and well-being literature have been researchers from the classic social science disciplines. Hence, it is perhaps understandable that the role of food in the list of determinants of well-being has so far been given little attention, even though, in an important line of work, researchers have, within a different literature, drawn attention to the potential social significance of diet.[13]

We used a representative panel of 12 000 individuals to trace the potential linkages running from diet to later life satisfaction and happiness. The study is intended as a complement to the aforementioned literature on socioeconomic influences. In its style, the study fits within an emerging panel-data literature on human well-being. The analysis was first done by following individuals between 2007 and 2009. Just as the project was completed, however, new data were released, which made it possible to check the calculations also for the period 2009 to 2013 (these replication findings are reported in Tables A, B, and C, available as supplements to the online version of this article at http://www.ajph.org).

There are precursors to this article. Innovative research by Tamlin Conner and collaborators[14] has found—using data on daily food diaries on 281 students tracked over a 3-week period—that a high level of fruit and vegetable consumption appears to be predictive of greater emotional well-being on the following day. Various cross-sectional papers have also pointed to the possible existence of a statistical connection between psychological well-being and the amount of fruits and vegetables eaten, and have shown that this correlation survives the inclusion of a large number of covariates.[15]

There is also a small longitudinal literature that suggests there may be positive benefits from a high intake of fruits and vegetables, although, crucially, that literature has not been able to control for some of the key confounders such as individuals' levels of income.[16–19] There have also been 3 important small randomized controlled trials on nutritional counseling and on the provision of healthy food and snacks,[20–22] which find some evidence that a higher intake of fruits

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and vegetables may be associated with improved psychological health (as well as physical health). Another set of writings has tried to understand obesity and its links to subjective well-being.[23,24] These suggest that there is an inverse—although relatively small—correlation between body mass index (BMI; defined as weight in kilograms divided by the square of height in meters) and mental well-being.

This article documents not cross-sectional patterns but rather the longitudinal (the so-called "change-on-change") linkages between fruit and vegetable consumption and mental well-being; such an approach helps ensure that any observed relationship is not merely a spurious cross-sectional pattern caused by omitted confounding factors such as personality, background wealth, or family upbringing. Cognizant of the work of others,[25] we examined whether the level of fruit and vegetable consumption today is predictive of the level of later well-being, while inquiring into reverse-causality concerns hitherto unaddressed in the happiness literature.

METHODS

The main data in this study come from waves 7 and 9 (years 2007 and 2009) of the Household, Income, and Labour Dynamics in Australia (HILDA) Survey, a nationally representative panel survey that began in 2001. The HILDA Survey collects annual longitudinal information from members of Australian households who are aged 15 years and older. It provides information on a total of 13 969 individuals from 7682 different households interviewed since the first wave. Data are collected each year by face-to-face interviews and self-completion questionnaires. The former technique is mainly used to gather the demographic and socioeconomic information, and the latter is adopted to measure health and lifestyle choices.

After we excluded respondents with missing information on the key outcome and control variables, the total sample available for this study consisted of 12 389 individuals (aged 15–93 years) and 20 136 person-year observations. No observations were deliberately dropped. As would be expected, however, the sample sizes vary slightly across the different well-being measures.

Two questions relating to fruit and vegetable consumption were available in waves 7 and 9. The corresponding questionnaires asked: "Including tinned, frozen, dried and fresh fruit, on how many days in a usual week do you eat fruit?" and "Including tinned, frozen and fresh vegetables, on how many days in a usual week do you eat vegetables?" with possible responses ranging from 0 ("do not eat any fruit or vegetables in a usual week") to 7 days per week. For individuals who responded with some positive frequency to these questions, the following was also asked: "On a day when you eat fruit, how many serves of fruit do you usually eat?" and "On a day when you eat vegetables, how many serves of vegetables do you usually eat?"

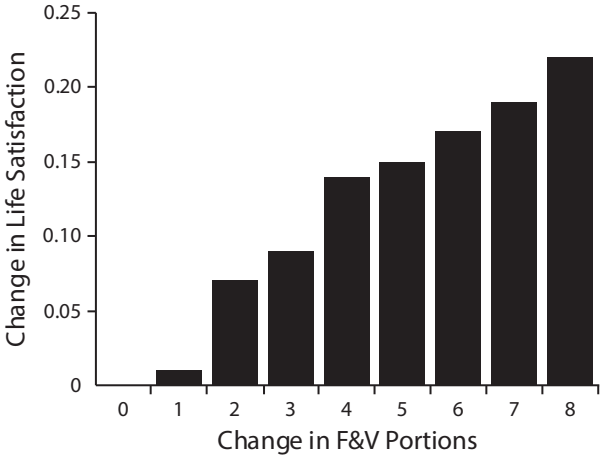
The survey respondents were shown flashcards to visually define a serving size or portion (photographs of these are given as Figures A and B, available as supplements to the online version of this article at http://www.ajph.org), with possible answers ranging from "1" to "6 or more" portions. This visual approach is for simplicity and clarity.[26] We multiplied the responses to the previously mentioned paired (frequency and quantity) questions to form a weekly consumption amount of fruits and vegetables, respectively. We then divided each resulting product by 7 to arrive at the average daily amount. We then added the average intake of fruit by survey respondents to their average intake of vegetables to compute the combined average daily consumption of fruits and vegetables. The mean value was 3.84 servings per day with a standard deviation of 2.01. Some respondents said they did not consume any fruits or vegetables in a typical week. This group forms the "none" or "zero" consumption category. Approximately 85% of respondents had fewer than 3 daily servings of fruit; 60% consumed fewer than 3 daily servings of vegetables. A small fraction of people consumed, on average, both more than 5 servings of fruit (1.83%) or vegetables (7.75%) each day. Table D, available as a supplement to the online version of this article at http://www.ajph.org, contains more detailed summary statistics on the separate fruit and vegetable intake measures.

The first dependent variable examined is self-reported life satisfaction, derived from the question, "All things considered, how satisfied are you with your life?" Respondents were told to "Pick a number between 0 and 10 to indicate how satisfied you are," and that "the more satisfied you are the higher number you should pick." Overall, the mean score for the sampled individuals in Australia was 7.91 with a standard deviation of 1.41. About two thirds of respondents reported a life satisfaction score of more than 7 out of 10. As an additional check, we used a second measure. A generic health variable available in the HILDA data set is the Medical Outcomes Short Form (SF-36) Questionnaire. The SF-36 is one of the most widely used and validated self-completion measures of health status available, consisting of 36 items or questions; 35 of them are used to derive 8 health subscales or indices. The respondent is asked, "How much of the time in the past 4 weeks" did he or she experience particular types of feelings or symptoms, including "been a happy person." The resulting response distribution for the latter question is as follows: 1% (none of the time); 4.8% (a little of the time); 13.9% (some of the time); 19.5% (a good bit of the time); 51.9% (most of the time); 8.9% (all of the time). The individuals' responses were coded from 1 (none of the time) to 6 (all of the time), with a mean happiness score of 4.43 out of 6.

RESULTS

Figure 1 is a simple graphical illustration of the study's key result for life satisfaction. A similar histogram holds also for happiness data. The plot in Figure 1 is based on a so-called fixed-effect regression equation. It depicts the (uncorrected) longitudinal relationship—the change-on-change relationship—between people's subjective well-being and 9 different levels of fruit and vegetable consumption. Further descriptive information is provided in the material available as a supplement to the online version of this article at http://www.ajph.org. Alternative kinds of scatter plots are given as Figures C and D in that material.

The regression analyses reported in Table 1 provide formal evidence. These correct for other influences following sources.[8,29] The key coefficient in the first column of Table 1 is 0.03 (B = 0.03; 95% confidence interval [CI] = 0.01, 0.04; $P = .002$). This implies that a change from the lowest levels to the highest levels of fruit and vegetable consumption



Note. Fixed-effects regression equation with 9 banded dummy variables for each level of fruit and vegetable (F&V Portions) daily consumption. Horizontal axis: 0 = < 1 portion of fruit and vegetables per day; 1 = > 1 portion but < 2 portions per day; and 8 = 8 or more portions a day.

FIGURE 1—Longitudinal Changes in Fruit and Vegetable Consumption and Longitudinal Changes in Satisfaction With Life in Australian Individuals (n = 12 385): Household, Income, and Labour Dynamics in Australia Survey, 2007 and 2009

would, on average, be associated with a rise in life satisfaction of approximately 0.24 life-satisfaction points.

The implied effect size is substantial. At first glance, the number 0.24 might be thought to indicate that the consequences of fruit and vegetable intake are minor. That interpretation is mistaken; it stems from a blurring of the distinction between interperson variance and intraperson variance. As in much of the longitudinal public health research, in this study we tried to understand not the (inevitably high) cross-sectional variation in human well-being but instead intraperson changes that might be capable of being influenced by public interventions. In column 1 of Table 1, this requires that a number such as 0.24 (which is 8 times the coefficient of 0.03) has to be added to the number 7.81. As can be seen from models 2 and 3 in Table 1, the effect is the equivalent in absolute size to (a negative direction) that of becoming unemployed or approximately half the size of the emotional consequence of marital separation. Such an effect size is large.

If model 1 of Table 1 were the only regression result available, it would be plausible to believe that the relationship is spurious. It might be being driven by omitted variables—for example, someone becoming richer through time and becoming happier and simultaneously eating in a healthier way because they could now afford it, or divorcing a spouse and becoming less happy and also eating in a less healthy way. However, models 2 and 3 in Table 1 imply that such interpretations would be incorrect. The analyses here include extra covariates: the natural logarithm of household income, age, education, whether working, marital status, health, children, alcohol and food patterns, BMI, and exercise (for a detailed specification of these variables see Tables D and E, available as supplements to the online version of this article at http://www.ajph.org). In Table 1, there is no detectable influence from BMI. Table F in the supplemental material, however, is consistent with the existence of an inverse relationship between current BMI and future well-being.

Figure 1 uses coefficients from longitudinal estimates. Fixed-effect estimation is equivalent here to a first-difference estimator,[28] so they emerge, in effect, from regressing the change in well-being between 2007 and 2009 on the change over that period in variables such as food consumption, income, marital status, and so on. This is why, in Table 1, attributes such as gender and ethnicity are omitted; they are unchanging and thus have automatically been differenced out. Table 2 repeats the calculations for the alternative dependent variable of feeling happy. Results are similar.

An open scientific issue is whether diet might have slow-acting effects on mental well-being. The analyses reported in Table 3 explore this. They treat the data as if from a prospective setting. Here the regression equations reveal that fruit and vegetable consumption in the current year is predictive of higher well-being—measured either as life satisfaction or as happiness—in the future even after control for current well-being (as well as control for the list of covariates in the tables). Hence, in the life-satisfaction equation in Table 3, for example, where the dependent variable is life satisfaction measured in period $t+1$, a variable for fruit and vegetable consumption in period t is statistically significant at the 99.9% confidence level (B = 0.03; 95% CI = 0.01, 0.04; $P < .001$), while holding constant life satisfaction in period t, which itself enters, as would be expected, with a large positive coefficient. Similar results are found for happiness in Table 3. Tables F and H, available as supplements to the online version of this article, provide the equation specifications.

Such prospective analysis is subject to a potential objection. It is that some form of correlation might run in both directions simultaneously. To check for this, we did a form of Granger causality test, and it is given in the supplemental material. Tables I and J test whether fruit and vegetable consumption in the future can be predicted from the level of life satisfaction or happiness in the current period. In neither case is there evidence for such reverse-causality; the effect does not achieve statistical significance in either of the tables. In Table I, in fact, the variable has the wrong point-estimate sign (B = –0.003; 95% CI = –0.03, 0.02; $P > .250$).

We checked whether the findings can be reproduced on a new round of the panel data set, which was released toward the end of our project, for the year of 2013. The paper's key results can be replicated; the findings are presented in Tables A, B, and C, available as supplements to the online version of this article at http://www.ajph.org. It can be seen in Tables A, B, and C that the coefficients remain essentially identical to those presented in the main body of the paper.

We also did a test for whether fruits and vegetables should be separated into 2

TABLE 1—Life Satisfaction Equations: Fixed-Effects Regression Models of Changes in Life Satisfaction on Changes in Fruit and Vegetable Consumption and Covariates, Longitudinal Survey Data on 12 385 Adults: Household, Income, and Labour Dynamics in Australia Survey, 2007 and 2009

Independent Variable	Model 1 (No Covariates)	Model 2 (Partial Set of Covariates)	Model 3 (Full Set of Covariates)
Fruit and vegetable portions/d, B (95% CI)	0.03 (0.01, 0.04)	0.03 (0.01, 0.04)	0.02 (0.01, 0.04)
Log of household income, B (95% CI)		0.02 (−0.03, 0.06)	0.02 (−0.03, 0.06)
Age, B (95% CI)		−0.01 (−0.05, 0.04)	−0.01 (−0.06, 0.04)
Age-squared/100, B (95% CI)		0.01 (−0.04, 0.05)	0.01 (−0.04, 0.06)
Education, B (95% CI)			
Master's or doctorate		−0.31 (−0.86, 0.24)	−0.32 (−0.87, 0.23)
Bachelor's or honors		−0.07 (−0.48, 0.35)	−0.05 (−0.46, 0.36)
Graduate diploma or certificate		−0.18 (−0.51, 0.16)	−0.17 (−0.51, 0.17)
Advanced diploma		−0.09 (−0.46, 0.27)	−0.10 (−0.47, 0.27)
Professional qualification		−0.01 (−0.30, 0.28)	−0.02 (−0.31, 0.27)
Year 12 high school		−0.21 (−0.41, −0.01)	−0.20 (−0.40, 0.00)
Employment status, B (95% CI)			
Full-time student		−0.01 (−0.15, 0.13)	0.00 (−0.15, 0.14)
Unemployed		−0.21 (−0.43, 0.01)	−0.22 (−0.44, 0.00)
Not in the labor force		−0.02 (−0.13, 0.09)	−0.04 (−0.15, 0.07)
Marital status, B (95% CI)			
Married		−0.01 (−0.18, 0.16)	−0.01 (−0.18, 0.16)
Separated		−0.57 (−0.89, −0.26)	−0.58 (−0.89, −0.26)
Divorced		−0.32 (−0.63, −0.01)	−0.33 (−0.64, −0.02)
Widowed		−0.45 (−0.99, 0.09)	−0.46 (−1.00, 0.08)
Long-term health condition, B (95% CI)		−0.14 (−0.22, −0.07)	−0.14 (−0.22, −0.07)
Children, B (95% CI)			
No. aged ≤4 y		−0.01 (−0.10, 0.08)	−0.01 (−0.09, 0.08)
No. aged 5–14 y		0.06 (−0.02, 0.14)	0.06 (−0.01, 0.14)
Drink alcohol, B (95% CI)			
2 or 3 d/mo			−0.01 (−0.11, 0.09)
1 or 2 d/wk			0.02 (−0.09, 0.14)
3 or 4 d/wk			−0.03 (−0.17, 0.10)
5 or 6 d/wk			−0.04 (−0.20, 0.12)
Every day			−0.14 (−0.34, 0.06)
Nonsmoker, B (95% CI)			0.04 (−0.09, 0.17)
Eating patterns, B (95% CI)			
Never eat red meat			0.20 (−0.16, 0.55)
Never eat fish			−0.09 (−0.20, 0.02)
Eat breakfast regularly			0.11 (0.03, 0.18)
Drink low-fat or skim milk			−0.04 (−0.12, 0.04)
Avoid fatty foods			−0.05 (−0.12, 0.01)
BMI, B (95% CI), *P*			0.01 (0.00, 0.01)
Exercise regularly, B (95% CI)			0.09 (0.03, 0.14)
Constant	7.81 (7.74, 7.88)	7.90 (6.80, 9.00)	7.75 (6.65, 8.85)
Overall R^2	0.02	0.03	0.03
No. of individuals	12 385	12 385	12 385
No. of observations	20 127	20 127	20 127

Note. BMI = body mass index (weight in kilograms divided by the square of height in meters); CI = confidence interval. Dependent variable is life satisfaction (range = 0–10). Further details of the data set are available in Watson and Wooden.[27] With 2 waves of data, a fixed-effects estimator is equivalent to a first-difference estimator; see, for example, Liker et al.[28]

TABLE 2—Happiness Equations: Fixed-Effects Regression Models of Changes in "Been a Happy Person" on Changes in Fruit and Vegetable Consumption and Covariates. Longitudinal Survey Data on 12 385 Adults: Household, Income, and Labour Dynamics in Australia Survey, 2007 and 2009

Independent Variable	Model 1 (No Covariates)	Model 2 (Partial Set of Covariates)	Model 3 (Full Set of Covariates)
Fruit and vegetable portions/d, B (95% CI)	0.02 (0.01, 0.03)	0.02 (0.01, 0.04)	0.02 (0.003, 0.03)
Log of household income, B (95% CI)		0.02 (–0.02, 0.05)	0.02 (–0.02, 0.05)
Constant, B (95% CI)	4.35 (4.30, 4.40)	4.29 (3.40, 5.17)	4.31 (3.42, 5.20)
Other covariates included	No	Yes (a partial set)	Yes (a full set)
Overall R^2	0.02	0.01	0.03
No. of individuals	12 360	12 360	12 360
No. of observations	20 054	20 054	20 054

Note. CI = confidence interval. Dependent variable is "been a happy person" (range = 1–6). The full estimation results (with a complete set of control variable coefficient estimates) are available in Table G, available as a supplement to the online version of this article at http://www.ajph.org.

independent variables—rather than combined into the number of daily fruit and vegetable portions variable that has been traditional in research on physical health. The results (not reported) suggested that for happiness and life-satisfaction equations it was appropriate to combine them into a single fruit-and-vegetable variable. We could not reject the null hypothesis of an identical well-being gradient for fruit intake and vegetable intake.

Last, we made another effort, in addition to the Granger causality tests, to tackle the inevitably complex issue of causality. To do so, we exploited a public campaign that was designed to encourage healthy eating in Australia. Scientifically, the advantage of such a campaign is that, from a researcher's point of view, an advertising campaign of this kind could be seen as an exogenous positive "shock" to people's motivation to eat a greater number of portions of fruit and vegetables. Hence it offers the possibility of a form of natural experiment: as the campaign came in, with different timings in different states, it might be expected that it would shift people's consumption decisions at these particular points in time. Any consequences for mental well-being and physical well-being might then go on to be detectable.

Known as the "Go for 2&5 Campaign," this initiative began in the state of Western Australia in the year 2004. It spread, at different speeds, into most of the other Australian states. Two-stage least squares estimation can then be done.[30] The instrumental variable estimates are provided in Tables K through N, available as supplements to the online version of this article at http://www.ajph.org.

In this form of inquiry, we exploited the fact that different Australian states had different number of years over which they systematically promoted the consumption of fruits and vegetables. Victoria did so for zero years; New South Wales for 2 years; Tasmania for 4 years; South Australia for 4 years; Queensland for 5 years; the Northern Territories for 7 years; Australian Capital Territory for 7 years; and Western Australia for 10 years. Thus, we created a variable for intensity of campaign. This adds up the length (i.e., number of years) that a state had previously had a campaign. We thereby gave all states in our analysis an integer-valued entry, from 0 for Victoria to 10 for Western Australia, as a measure of the different intensities of the public fruit-and-vegetable campaign in the different states. In plainer English, the citizens of each region can be thought of as having a different level of "publicly sponsored push" to eat in a healthy way. That policy variable can be viewed as an extraneous influence upon later state levels of consumption of fruit and vegetables.

Analytically, we then took 2 steps. The first was to estimate a consumption of fruit plus

TABLE 3—Prospective Analyses of Life Satisfaction and Happiness on Lagged Fruit and Vegetable Consumption: Household, Income, and Labour Dynamics in Australia Survey, 2007 (Period *t*) and 2009 (Period *t+1*)

Independent Variable	Life Satisfaction $_{t+1}$	Been a Happy Person $_{t+1}$
Fruit and vegetable portions/d $_t$, B (95% CI)	0.03 (0.01, 0.04)	0.02 (0.01, 0.03)
Life satisfaction $_t$, B (95% CI)	0.49 (0.47, 0.50)	
Been a happy person $_t$, B (95% CI)		0.45 (0.43, 0.47)
Log of household income $_t$, B (95% CI)	0.03 (0.00, 0.07)	0.03 (0.00, 0.05)
Constant	3.98 (3.55, 4.41)	2.36 (2.04, 2.68)
Full set of other covariates	Yes	Yes
Adjusted R^2	0.31	0.26
No. of observations	7742	7694

Note. CI = confidence interval. First dependent variable is life satisfaction (range = 0–10) in period *t+1* (year 2009). Second dependent variable is "been a happy person" (range: 1–6) in period *t+1* (year 2009). Period *t* denotes the year 2007. The full estimation results (with a complete set of control variable coefficient estimates) are available in Tables F and H, available as supplements to the online version of this article at http://www.ajph.org. The table's title uses the term "prospective" for simplicity; it would be possible to object to this on strict semantic grounds; we obtained the data after the wave-2 information on year 2009 had been collected.

vegetables equation (not a well-being equation) for the year 2013. We then tested whether a variable for campaign intensity came in positively in that equation. We found that it did, with a statistically significant coefficient. Hence, there is evidence that the Australian healthy-eating campaign had an effect on fruit and vegetable intake. Then, in the second stage of our 2-stage least-squares estimation, we estimated a set of instrumented well-being regression equations for the year 2013. The purpose was to correct for simultaneity bias and the possibility of reverse causality. After doing so, we found an instrumented variable for fruit and vegetable consumption to enter positively in a well-being equation (as in Table K, available as a supplement to the online version of this article at http://www.ajph.org). Hence, there is some evidence that the Australian healthy-eating campaign may have improved people's levels of life satisfaction and happiness. Nevertheless, it is not possible statistically to be certain of that conclusion. As is often found in the statistical literature on 2-stage least-squares estimation, the level of statistical power here was insufficient for us to obtain truly small standard errors in the second-stage equations. The study's confidence levels did not exceed 75% when we used this final form of statistical method.

DISCUSSION

These findings are consistent with the idea that eating certain foods is a form of investment in future happiness and well-being. The implications of fruit and vegetable consumption are estimated to be substantial and to operate within the space of 2 years—too quickly to be a reflection of the physical advantages of diet for outcomes such as cardiovascular disease documented by earlier researchers.[2] Moreover, as shown in Table O, available as a supplement to the online version of this article at http://www.ajph.org, the fruit-and-vegetables effect is still visible if the regression equation includes an extra covariate for self-reported health.

In this study, we examined data on the lives of a nationally representative sample of approximately 12 000 individuals between 2007 and 2009. We are able to check, and replicate, its main findings for additional newly released data over the period 2009 to 2013. We also did prospective analysis and Granger causality tests. By using information on the Australian "Go for 2&5 Campaign," we also attempted to offer instrumental-variable estimates.

In a sense, this article offers a new possibility for future public-policy programs to encourage healthy eating—the possibility that citizens in western society could be given evidence that happiness gains from healthy eating may occur much more quickly than any long-distant improvement to people's physical health. If individuals weigh the likely benefits of fruit and vegetables in their diet, and set that against any perceived costs, both pecuniary and nonpecuniary, of doing so, then scientific evidence of extra psychological gains from a healthy diet might help to persuade people to raise their intake of fruit and vegetables.

Two main issues remain to be tackled. First, although at the end of this study we attempted to address the causality problem by using instrumental variable methods, a huge randomized trial would lead to a natural form of scientific evidence. The well-being research literature is, however, far from such a point; a randomized trial would have its own inherent difficulties, because a double-blind procedure would not be feasible, so placebo effects would be hard to disentangle; and large-scale longitudinal studies, of the sort described in this study, would still be required as part of a body of persuasive evidence. Second, the channels from eating certain food types to subjective well-being remain to be properly understood. Other studies discuss a variety of intriguing possibilities.[18,31] These include a potential influence from vitamin B12 upon the eventual production of human serotonin, as well as the idea of a role for folate deficiency.[32] A further potential channel[33] is that microbiota may modulate brain chemistry. Lastly, it may be possible eventually to link the current research to a new literature on antioxidants that is suggestive of a connection between human optimism and carotenoid in the blood.[34] Further connections between the biology and practical public health policy of healthy eating[35] remain to be forged. Such issues demand attention. AJPH

CONTRIBUTORS

R. Mujcic had the idea for the study, led the study, and wrote the first results. A. J. Oswald made suggestions for changes. Both authors designed the research, analyzed the data, and revised the draft. A. J. Oswald wishes to record that the main credit for this work is due to R. Mujcic.

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Note. The findings and views reported in this article are those of the authors and should not be attributed to either the Australian Government Department of Social Services or the Melbourne Institute.

HUMAN PARTICIPANT PROTECTION

Ethical approvals were gained by the original data collection team.

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