Post-Earthquake Psychological Functioning in Adults with Attention-Deficit / Hyperactivity Disorder: Positive Effects of Micronutrients on Resilience

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The September, 2010, 7.1 magnitude earthquake in Christchurch, New Zealand, provided an opportunity to study the after-effects of a major earthquake where death and injury were absent. It created a natural experiment into the protective effects on well-being of taking EMPowerplus (EMP+), a micronutrient supplement, in a group of 33 adults diagnosed with ADHD who had been assessed prior to the earthquake. Fortuitously, 16 were currently taking the supplement as part of on-going research at the time of the quake, while 17 were not (they had completed their trial of EMP+ or were waiting to begin consumption). The Depression Anxiety and Stress Scale (DASS-42) which had been administered at varying times before the earthquake on recruitment into the micronutrient study was re-administered by telephone 7-10 and again 14-18 days post-earthquake to volunteer, earthquake-exposed participants. A modified Brinley plot analysis of the individual DASS-42 scores showed that the 16 participants on the nutritional supplement were more resilient to the effects of the earthquake than the 17 individuals not taking the supplement. This effect was particularly marked for Depression scores.

On 4th September, 2010, at 4.35am local time, a 7.1 magnitude earthquake struck the Canterbury region of New Zealand (Quigley et al., 2010), with its epicentre about 40 kms from the South Island's major city, Christchurch (population ~380,000). Despite the large magnitude of the earthquake, there were no deaths and only two serious injuries. This is remarkable (Royal Society of New Zealand, 2010), especially compared with other recent urban earthquakes of similar or lesser magnitude, where considerable loss of life was experienced (e.g., L'Aquila, Italy, April, 2009: Magnitude 5.8, 308 deaths and 1500 serious injuries; Haiti, January 2010: Magnitude 7, 222,570 deaths and 300,000 injuries; www.usgs.gov/earthquakes/recenteqsww/Quakes/, but cf Bodvarsdottir & Elklit, 2004).

Christchurch and its region did, however, suffer extensive damage to land, watercourses, buildings, roads, and other infrastructure, with damage estimated to exceed NZ$4 billion (Quigley et al., 2010). Following the initial earthquake were numerous aftershocks: 935 in total in the first two weeks, with 10 of magnitude 5 or greater, and 105 greater than magnitude 4 (see www.geonet.co.nz).

Earthquakes and their aftershocks are unpredictable, uncontrollable, aversive events, and events of this nature are known to induce a variety of debilitating psychological consequences (Soames-Job, 2002).

Consistent with this, research has shown increased levels of psychological distress in survivors of major earthquakes, but the focus of much of this research has been on the severe end of the distress spectrum, especially post-traumatic stress disorder (PTSD; for reviews see Bonanno, Brewin, Kaniasty, & La Greca, 2010; Neria, Nandi, & Galea, 2007). The Christchurch earthquake provided a rare opportunity to study the psychological effects of an earthquake but without the effects of death and injury affecting the responses of survivors. Recent research (see Bonanno et al., 2010) has suggested that distinctive individual trajectories of response are evident after a disaster such as an earthquake.

A minority of survivors (rarely more than ~30% of the affected population) show immediate or delayed severe symptoms of distress, including full PTSD, and a second minority group (typically ~ 20 to 25%) experience moderate to severe symptoms initially, but recover relatively rapidly thereafter. The majority of survivors (typically 50% or more) display *psychological resilience*, defined by Bonanno et al., as evidencing a stable pattern of few or mild symptoms of distress throughout the post-disaster period, operationalised as reporting no more than one symptom of PTSD in the six months after a disaster (Bonanno, Galea, Bucciarelli, & Vlahov, 2006).

Interestingly, anecdotal reports from mental health professionals and services suggest that those with pre-existing mental health conditions were particularly vulnerable to post-quake exacerbation of their distress (e.g., *Rehab use up tenfold after quake*, The Press, 25th January, 2011). Logistically, this is a difficult issue to research but the Attention-Deficit/Hyperactivity Disorder (ADHD) Diagnostic Assessment and Research Unit at the University of Canterbury was able to study this for one particular diagnostic group, namely adults with ADHD. Prior research has suggested that individuals diagnosed with ADHD are generally vulnerable to experiencing high levels of stress (Lackschewitz, Huther, & Kroner-Herwig, 2008), suggesting that they are likely to be among those most vulnerable to enhanced distress in the wake of disasters, although we are unaware of any research confirming this.

There is, however, a growing body of research showing that nutritional supplements such as EMPowerplus (EMP+) have benefits, specifically for those with ADHD (Rucklidge, Johnstone, & Kaplan, 2009) and more generally (Carroll, Ring, Suter, & Willemsen, 2000; Schlebusch et al., 2000), in promoting resistance to stress. Furthermore, Yesilyaprak, Kisac, and Sanlier (2007), researching the aftermath of an earthquake in Turkey, reported a link between poor nutrition post-earthquake and levels of stress in survivors, suggesting that nutrition may have a part to play in vulnerability or resilience to a natural disaster.

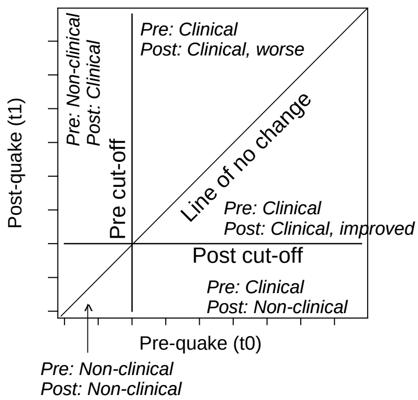
Fortuitously, the ADHD research group had a number of participants who had been, or were scheduled to be, participants in studies of the effects of a micronutrient supplement on mood stability (Rucklidge, Taylor, & Whitehead, 2010). All the participants had completed their assessments and had received the diagnosis prior to the earthquake. Some were no longer taking the micronutrient at the time of the earthquake either because they had completed a trial of the supplement or had yet to begin, while others were currently taking the supplement. All, therefore, had a pre-quake formal psychological diagnosis of ADHD and pre-quake assessment of levels of anxiety, depression, and stress, but formed two groups (on or off the supplement) exposed to the same natural experiment, the earthquake. Rucklidge, Johnstone, Harrison, and Boggis (2011) report a group-based statistical analysis of the data from this study.

The purpose of this report is to examine the results reported by Rucklidge et al. (2011) at the level of individual responses, consistent with the emphasis by Bonanno et al. (2010) on considering individual differences in disaster responses. It also serves to introduce a relatively novel way of analysing such data, using modified Brinley plots (Blampied, 2007; Brinley, 1965).

Brinley plots were developed (Brinley, 1965) as a way of displaying data from cognitive psychology experiments, where different groups, such as men vs women, or young vs old, were exposed to the same conditions in one or more experiments. For each experimental condition, therefore, a coordinate pair comprising the average performance of each group in each condition could be plotted in a scatter-plot. If there were no systematic differences between the groups, the data points would lie on or randomly about the diagonal, but if there was a systematic effect of group identity on mean performance, this would be seen in systematic deviations of the points above or below the diagonal.

Despite their utility for visually displaying systematic effects of group membership, Brinley plots are not widely used in psychology (for a contemporary example, see Dye, Green, & Bavelier, 2009), but Blampied (2007) noted, in the context of single-case research, that they had considerable potential for detecting systematic effects of interventions while preserving the identity of each individual participant in the visual display.

When time-series data are available for individuals, with a baseline measure and one or more post-intervention measures, then systematic effects will be observed in a scatter plot of baseline versus post-intervention scores as deviations from the diagonal, the line of no effect (if baseline score = intervention score, the data point lies on the diagonal). In essence, this is a form of visual cluster analysis that has the benefit over group mean data of displaying both systematic effects and the full range and variability of individual responses (see also Sobell, Sobell, & Gavin, 1995). If lines are placed on the graph to indicate clinical cut-off scores, then the graph space is partitioned into clinically meaningful domains, as illustrated in Figure 1, and the clinical significance of the outcomes for individuals is readily apparent.



▲**Figure 1**: The partitioning of the Brinley plot graph space so as to indicate the clinical meaning of observed changes, based on reduction in the dependent variable score indicating clinical improvement, and showing established cut-off scores on the DASS-42 for "normal to mild" versus more severe levels of distress (based on Lovibond & Lovibond, 1995 a,b).

Method

Participants

Thirty-three individuals (ages 16 years and over), all of whom were resident in Christchurch at the time of the earthquake, were recruited from among a larger number of individuals who had been or were currently participating in research into a EMPowerplus, a micronutrient supplement consisting of 36 ingredients: 14 vitamins, 16 minerals, 3 amino acids and 3 antioxidants.

Those (n = 17, 9 men, 8 women) who (a) had been assessed and confirmed as having ADHD and completed all baseline measures, and (b) were not taking EMP+ or any other psychotrophic medication at least two weeks prior to and during the assessment period after the earthquake constituted the control individuals.

The remainder of the recruits (n = 16, 11 men, 5 women) (a) had begun taking EMP+ at least two weeks prior to the earthquake, (b) were taking at minimum at least 50% of the optimal dose, and (c) were not currently taking any psychotrophic medication (with one exception; see Rucklidge et al., 2011); these were the micronutrient group.

The diagnosis of ADHD was based in all cases on the participants having met the Connors' Adult ADHD Diagnostic Interview for DSM-IV (Epstein et al., 2004). Participants also had to have shown elevations on at least one of the DSM-IV subscales of the Connors' Adult ADHD Rating Scales (Connors et al., 2003; see Rucklidge et al., 2011, for more details). Various analyses (see Rucklidge et al., 2011) indicated that there were no substantive differences in age, marital status, socio-economic status or intelligence between the two groups, nor were there differences in their experience of (generally mild to moderate) adversity from the earthquake. The majority reported Pākehā (New Zealand European) ethnicity.

Measure

Psychological distress was assessed using the full Depression, Anxiety and Stress Scale (DASS-42; Crawford & Henry, 2003; Lovibond & Lovibond, 1995a, b). This is a 42-item questionnaire, with items rated from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time) relative to the past week.

The DASS-42 has good psychometric properties (Cronbach's alphas range from .84 to .97 across the scales and across studies), and with high correlations (typically > .60) between the separate DASS-42 scales and other validation measures (e.g., Beck Depression Inventory; Crawford & Henry, 2003; Lovibond & Lovibond, 1995a, b).

Scores less than 13, 10, and 18 for Depression, Anxiety, and Stress respectively are classified as indicating no more than 'mild' levels of distress (Crawford & Henry, 2003; Lovibond & Lovibond, 1995a, b).

Procedure

Participants in the micronutrient group were taking EMP+ according to the standard protocol for the research programme. They were given the capsules every two weeks, and adherence was monitored by daily diary records and weekly pill counts. Optimum dosage was defined as fifteen capsules/day, in three equally divided doses, taken with food and water. Any adverse effects were assessed at regular visits to the research clinic, and participants were monitored by the team psychiatrist.

Baseline (t0) - pre earthquake: At the time of initial recruitment into the micronutrient study, all participants had undergone extensive psychological assessment, including formal diagnosis of ADHD, and had completed the DASS-42 at various times [averaging 1.13 (SD = .78) years for the control participants and 0.83 (SD = .64) years for the micronutrient participants; the difference is not statistically different] before the earthquake (Time zero; t0). Recruitment and data-gathering for the present study were all done by telephone contact.

Time one (t1) – 7-10 days post-earthquake: Participants were contacted by telephone. In the ensuing interview they first gave informed consent, and then reported on any damage to their home, personal injuries, or any such events affecting those close to them. Current medication use and EMP+ adherence (where relevant) were assessed. Then the DASS-42 items were completed.

Time two (t2) – 14-18 days post-earthquake: A second telephone call re-administered the DASS-42.

Results

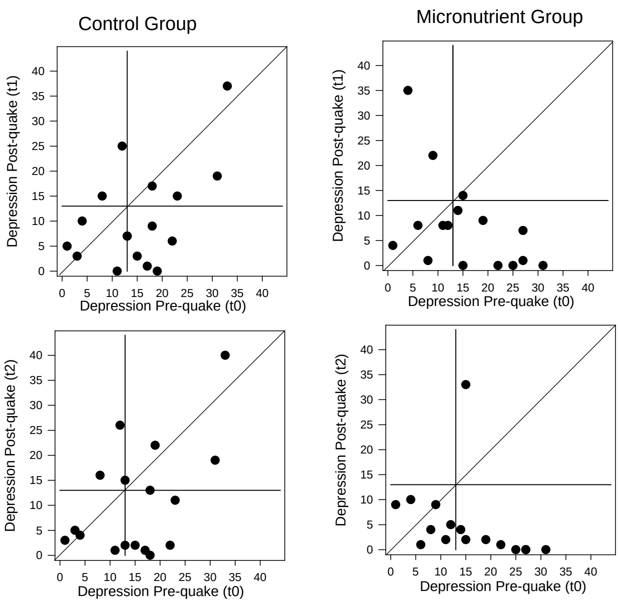
The focus of this report is on individual levels of anxiety, depression, and stress as measured before the earthquake, and then at approximately one and two weeks afterwards. For each person we had nine scores, representing their pre-quake (t0), week 1 (t1), and week 2 (t2) scores for each of anxiety, depression, and stress. Additionally, Table 1 (adapted from Rucklidge et al., 2011) shows the means and standard deviations for each group and across time, the results of paired-sample t-tests, and the Cohen's-d effect sizes for each condition and measure across time.

Figures 2, 3, and 4 show, respectively, the DASS-42 depression, anxiety, and stress levels for the participants as the scores changed over time. The left panels in each figure show the individual data for the control participants while the right panels show the individual data for the participants who were taking EMP+ at the time of the earthquake and for the two following weeks. The top row in each figure compares t1 against t0 and the second row compares t2 against t0 (the t1 versus t2 comparisons were done, but do not add anything much to the analysis). For the t0-t1 and t0-t2 comparisons, if the earthquake had no effect on the individual, then their data points will lie on or close to the diagonal, irrespective of where they lie in the distribution of scores on the measure. If, over that time period, their level of depression, anxiety or stress has increased, their data point will lie above the diagonal, and if their respective scores have decreased, they will lie below the diagonal. Fig 1 indicates how changes can be categorised relative to the cut-off scores reported by Crawford and Henry (2003) and Lovibond and Lovibond (1995a, b).

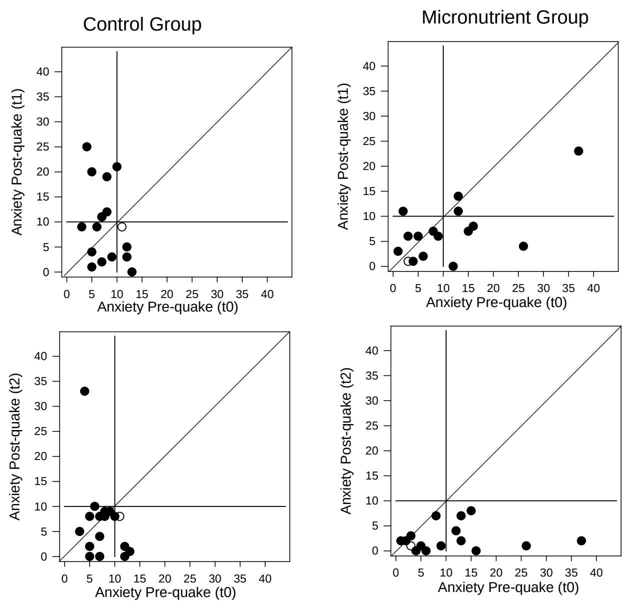
Group	N	Baseline		Time 1		Time 2		Baseline-Time 1			Baseline-Time 2		
		Mean	SD	Mean	SD	Mean	SD	Paired t-test	Effect size[1]	% from baseline	Paired t-test	Effect size[1]	% from baseline
Control	**17**												
Depression		15.35	8.92	10.53	9.90	10.71	11.20	2.13*	0.51	-31.40%	1.89	0.45	-30.20%
Anxiety		7.76	3.01	9.65	7.66	6.76	7.68	-0.85	-0.21	24.40%	0.45	0.11	-12.90%
Stress		19.12	7.71	18.18	9.53	17.47	10.96	0.42	0.1	-5.90%	0.66	0.16	-8.60%
DASS total		43.41	14.34	38.35	22.73	34.94	26.29	0.83	0.2	-11.70%	1.27	0.31	-19.50%
Micronutrient	**16**												
Depression		15.38	9.00	8.00	9.46	5.13	8.17	1.85	0.46	-48.00%	2.92*	0.73	-66.60%
Anxiety		10.81	9.60	6.88	5.84	2.56	2.61	2.1	0.52	-36.40%	3.39**	0.84	-76.30%
Stress		23.5	9.81	14.19	10.03	10.56	7.76	2.38*	0.59	-39.60%	4.01**	1	-55.10%
DASS total		49.81	24.53	29.06	19.54	18.25	16.12	2.50*	0.63	-41.70%	4.03**	1.01	-63.40%

Notes to Table 1: *p<.05, 2-tailed, **p<.01, 2-tailed, Baseline: represents entry point into the study, a time before the earthquake and before consumption of micronutrients that varied across participants, Time 1: one week post-earthquake, Time 2: two weeks post earthquake, Control group = those participants who were not consuming micronutrients two weeks prior to and through the assessment period post-earthquake, Micronutrient group = those participants consuming micronutrients at least two weeks prior to and through the assessment period post-earthquake, DASS = Depression Anxiety and Stress Scale, [1]Effect size is based on Cohen's d, calculated as the difference in mean symptom severity at Baseline and at Time 1 (Time 2), divided by the standard deviation of the differences across participants.

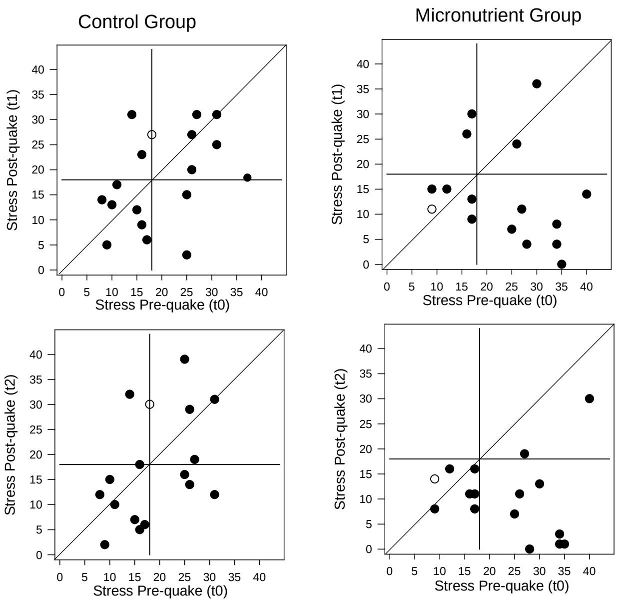
▲**Table 1**: Group depression, anxiety and stress scores across time and between groups, showing means, standard deviations, *t*-values, effect size (Cohen's *d*), and percent change from baseline



▲ **Figure 2**: Depression scores compared pre-earthquake (t0) and at time 1 and time 2 after the earthquake. Control individuals' data are shown in the left panels and treated individuals' data in the right panels. Cut-offs are those published for the DASS-42 by Lovibond and Lovibond (1995 a, b).



▲ **Figure 3**: Anxiety scores compared pre-earthquake (t0) and at time 1 and time 2 after the earthquake. Other features are as for Fig 2.



▲ **Figure 4**: Stress scores compared pre-earthquake (t0) and at time 1 and time 2 after the earthquake. Other features are as for Fig 2.

Depression

The distribution of depression scores prior to the earthquake was similar for the control and micronutrient groups, and equivalent numbers (~50%) fell above the clinical cut-off. In the control group, three individuals, ranging from one with a very low score to one with a high score did not change their score when assessed at t1, two individuals, both of whom had been non-depressed before the earthquake now reported clinical levels of depression, and the rest reported reduced levels, although two remained above the clinical cut-off. The pattern of change was somewhat similar for the micronutrient group. Two individuals who had been below the cut-off pre-quake reported moderate to high levels of depression post-quake but, notably, of those above the cut-off pre-quake all but one had reduced scores and were now in the non-clinical range, and the one exception was on the cut-off border.

When assessed at t2 the control group had split into two groups. One group was characterised by low post-quake depression scores while the others had scores close to or above the cut-off, and for these the general pattern was for their scores to have increased at t2. The pattern was conspicuously different for those taking micronutrients. In this group only one individual remained depressed. All the rest were now substantially in the non-depressed range, and with large degrees of change shown by those reporting high levels of pre-quake depression, representing the continuation of the downward trend evident at t1.

Anxiety

Prior to the earthquake, the majority of individuals in both groups reported low levels of anxiety, but while similar numbers in each group reported anxiety levels above the clinical cut-off, the range of anxiety was considerably higher in the micronutrient group. In the week after the quake (t1) anxiety levels rose for approximately half of the individuals in the control group, most into the clinical range, with four reporting moderate to severe anxiety. This was a transient response for all but one individual, and at t2 low levels of anxiety again characterised the control group. The group taking EMP+ showed a different pattern of response. Only one individual reported an increase in anxiety immediately post-quake (t1) and that only to the border of clinical levels. The rest showed either little change in anxiety, or reductions, with the reductions especially evident in those who had reported high anxiety pre-quake. This pattern of continuing reductions to low levels of anxiety continued at t2, at which time nobody in this group scored above the clinical cut-off.

Stress

Before the earthquake, the range of stress levels reported by individuals in the two groups was similar, although the highest levels were reported in the micronutrient group. In the control group, immediately after the earthquake approximately equal numbers reported increases and decreases in stress and eight individuals reported clinical levels of stress. In the micronutrient group, only four reported increases in stress immediately after the quake, and notably, seven individuals who had reported clinical levels of stress pre-quake now reported lower levels of stress sufficient to move them into the non-clinical range. The pattern did not change much for the control group at t2, but the pattern of general reduction in stress continued to be evident at t2, and four previously highly stressed individuals now reported very low stress levels.

Discussion

These results are the outcome of a natural experiment in which the impact of a common event, the earthquake, was assessed in two groups who shared a common diagnosis of ADHD, but were different in that one group was taking micronutrients at the time of the earthquake and the other group was not (although some had taken the supplement at an earlier time). Because the experiment is natural rather than contrived, there are some threats to inference that need to be acknowledged.

First, participants were not randomly assigned to treatment conditions. Rather, the micronutrient and the control participants were recruited at varying times before the earthquake, with the control participants having been recruited earlier (approximately 3.5 months earlier on average). Changes over time since recruitment and initial assessment may have generated individuals who, although not substantively different in demographic and other measured factors, may have been differentially resilient for unknown reasons with these different individuals ending up in the two groups in such proportions between the earlier and later assessed as to produce a seeming, but pseudo, treatment effect. While not impossible, this seems unlikely.

Second, and again because of the differences in recruitment time, individuals in the micronutrient condition had less exposure to various challenges and vicissitudes of life prior to the second assessment (at t1), and therefore had, presumably, less opportunity to change their initial scores, for better or for worse. Control group scores, therefore, could have been more variable in consequence, though not necessarily with any systematic trend; however, the SDs shown in Table 1 suggest otherwise. In addition, factors such as regression to the mean (McDonald, Mazzuca, & McCabe, 1983) may have had greater opportunity to influence t1 scores for the control individuals relative to the micronutrient participants. These effects, if they occurred, cannot be documented, and so any systematic effects they may have had on the data remain undetermined. It seems unlikely, however, that they have unduly and systematically biased the data so as to suggest an effect of micronutrients where there was none.

A further substantive issue is that there is no direct control for placebo effects, in that the control participants were not receiving any treatment at the time of the earthquake (although some had taken the micronutrient treatment for a time prior to the earthquake and others were waiting to have their first experience with the supplement – it depended on their particular history of recruitment into the research programme), while the micronutrient group were taking daily pills. Differences between the two sets of participants might be due to a placebo effect (Hrobjartsson & Gotzsche, 2001) engendering resilience to the earthquake arising from the fact of consuming the supplement, independent of any specific nutritional effect. While a general placebo effect involving expectations of resilience to stress or challenge cannot be ruled out, it is unlikely that any participant had any expectation, covert or overt, that taking a nutritional supplement would specifically render them resilient to the effects of an earthquake, since as at September, 2010, few if any residents of Christchurch had any expectancies related to direct earthquake experience.

These limitations notwithstanding, the data clearly showed different patterns of change in DASS-42 scores from before the earthquake compared with a period of approximately two weeks after the earthquake for those individuals taking the supplement at the time of the earthquake as opposed to those not taking it. We hope that the utility of the modified Brinley plots for displaying such data is clear. We make a general inference here that low scores on a measure of depression, anxiety, and stress are indicative of positive well-being and resilience, although no direct measure of well-being was made, and conclude that the overall pattern of changes within and between the two groups of participants indicates that those taking the nutritional supplement benefited from it, in that with few exceptions, their depression, anxiety and stress decreased over time. Their well-being and resilience were enhanced during an extremely stressful time. While our data are consistent with Bonanno et al.'s (2006; 2010) general conceptualisation of resilience, we did not use a measure nor assess over a sufficient time period to permit the exact application of their operational definition of resilience to our study.

It is important to note that the measures taken were sensitive enough to detect dynamic changes over time, so that the data are not just a static representation of pre-quake differences between the two groups of participants, however those differences may have arisen. This is especially evident in the DASS-42 anxiety scores for the control participants, where a transient upward pulse of anxiety is evident in the data at t1, but not at t2. This pulse is absent in the data from those taking the nutritional supplement at either time. Differences between the two groups of participants are also particularly evident over time for depression scores, with the graphic analysis showing very clear differences at t2. The modified Brinley plots permit these dynamic changes over time to be clearly displayed.

Overall, therefore, the data reported here (and complimented by Rucklidge et al., 2011) are consistent with the growing body of evidence that nutritional supplementation with nutrients of the kind found in EMP+ are beneficial to those with ADHD during a stressful period such as a natural disaster. Only by additional research, particularly using placebo controls, will enlighten us about the specificity of these beneficial effects. The second, and much more catastrophic earthquake of 22 February, 2011 has permitted us to partially replicate this study, but with individuals representative of the general population of Christchurch (rather than with those having a psychiatric diagnosis), and with comparison to an over-the-counter supplement (Berocca ™) that has been shown to be better than a placebo in three RCTs to date for the reduction of stress and anxiety in the general population (Carroll et al., 2000; Kennedy et al., 2010; Schlebusch et al., 2000). When these data are analysed, some of the issues surrounding the data presented in this study will be clearer. Meantime, the evidence (from this and previous studies) is that encouraging adults with pre-existing vulnerabilities (such as ADHD) facing stressful life events to improve their nutrition by means such as EMP+ at least fulfils the ancient principle of the helping professions – *primum non nocere;* first, do no harm – and it may well be beneficial in enhancing personal resilience in stressful times, to the benefit of the individual and their community.

References

Blampied, N. M. (2007, August). *Single-case research designs: Adaptations for the analysis of group data.* Paper presented at the Association for Behavior Analysis International Conference, Sydney, NSW, Australia.

Bodvarsdottir, I., & Elklit, A. (2004). Psychological reactions in Icelandic earthquake survivors. *Scandinavian Journal of Psychology, 45*, 3 – 13.

Bonanno, G.A., Brewin, C.R., Kaniasty, K., & La Greca, A. M. (2010). Weighing the costs of disasters: Consequences, risks, and resilience in individuals, families, and communities. Psychological Science in the Public Interest, 11, 1 – 49.

Bonanno, G. A., Galea, S., Bucciarelli, A., & Vlahov, D. (2006). Psychological resilience after disaster: New York city in the aftermath of the September 11th terrorist attack. *Psychological Science, 17*, 181 – 186.

Brinley, J. F. (1965). Cognitive sets, speed and accuracy of performance in the elderly. In A. T. Welford & J. E. Birren (Eds.), *Behavior, ageing, and the nervous system: Biological determinants of speed of behavior and its changes with age* (pp. 114-149). Springfield, IL: Charles C Thomas.

Caroll, D., Ring, C., Suter, M., & Willemsen, G. (2000). The effects of an oral multivitamin combination with calcium, magnesium, and zinc on psychological well-being in healthy young male volunteers: A double-blind, placebo-controlled trial. *Psychopharmacologia* (Berlin), *150*, 220 – 225.

Conners, C. K., Erhardt, D., & Sparrow, M. A. (2003). Conners' Adult ADHD rating scales (CAARS). *Archives of Clinical Neuropsychology, 18*, 431 – 437.

Crawford, J. R., & Henry, J. D. (2003). The Depression Anxiety Stress Scales (DASS): Normative data and latent structure in a large non-clinical sample. *British Journal of Clinical Psychology, 42*, 111–131.

Dye, M. W. G., Green, C. S., & Bavelier, D. (2009). Increasing speed of processing with action video games. *Current Directions in Psychological Science, 18*, 321 – 331.

Epstein, J., Johnson, D., & Conners, C. (2002). Conner's adult diagnostic interview for DSM-IV TM (CAADID): Technical Manual. New York, NY: MHS.

Hrobjartsson, A., & Gotzsche, P.C. (2001). Is the placebo powerless? *New England Journal of Medicine, 344*, 1594 – 1602.

Kennedy, D. O., Veasey, R., Watson, A., Dodd, F., Jones, E., Maggini, S., et al. (2010). Effects of high-dose B vitamin complex with vitamin C and minerals on subjective mood and performance in healthy males. *Psychopharmacology, 211*, 55-68.

Lackschewitz, H., Huther, G., & Kroner-Herwig, B. (2008). Physiological and psychological stress responses in adults with attention-deficit/hyperactivity disorder. *Psychoneuroendocrinology, 33*, 612 – 624.

Lovibond, S.H., & Lovibond, P.F. (1995a). *Manual for the Depression Anxiety Stress Scales* (2nd ed.). Sydney, Australia: Psychological Foundation.

Lovibond, P. F., & Lovibond, S. H. (1995b). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research & Therapy, 33*, 335 – 343.

McDonald, C. J., Mazzuca, S. A., & McCabe, G.P. (1983). How much of the placebo 'effect' is statistical regression. *Statistics in Medicine, 2*, 417 – 424.

Neira, Y., Nandi, A., & Galea, A. (2007). Post-traumatic stress disorder following disasters: A systematic review. *Psychological Medicine, 38*, 467 -480.

Quigley, M., Villamor, P., Furlong, K., Beavan, J., van Dissen, R., Litchfield, N., Stahl, T., Duffy, B., Bilderback, E., Noble, D., Barrell, D., Jongens, R., & Cox, S. (2010). Previously unknown fault shakes New Zealand's South Island. *Eos, 91*(49), 469 – 488.

Royal Society of New Zealand. (2010). *The Canterbury Earthquakes: Answers to critical questions about buildings.* Downloaded from http://www.royalsociety.org.nz/media/information_paper-earthquake_engineering_christchurch.pdf

Rucklidge, J. J., Johnstone, J.M., & Kaplan, B. J. (2009). Nutrient supplementation approaches in the treatment of ADHD. *Expert Review of Neurotherapy, 9*, 461 – 476.

Rucklidge, J. J., Johnstone, J. M., Harrison, R., & Boggis, A. (2011). Micronutrients reduce stress and anxiety following a 7.1 earthquake in adults with Attention-Deficit/Hyperactivity Disorder. *Psychiatry Research, 189*, 281-287. DOI:10.1016/j.psychres.2011.06.016

Rucklidge, J. J., Taylor, M, & Whitehead, K. (2010). Effect of micronutrients on behaviour and mood in adults with ADHD: Evidence from an 8-week open label trial with natural extension. *Journal of Attention Disorders*. Published on-line on 13 January, 2010. DOI 10.1177/1087054709356173.

Schlebusch, L., Bosch, B. A., Polglase, G., Kleinschmidt, I., Pillay, B.J., & Cassimjee, M. H. (2000). A double-blind, placebo-controlled, double-centre study of the effects of an oral multivitamin-mineral combination on stress. *South African Medical Journal, 90*, 1216 – 1223.

Soames-Job, R. F. (2002). The effects of uncontrollable, unpredictable aversive and appetitive events: Similar effects warrant similar, but not identical, explanations. *Integrative Physiological & Behavioral Science, 37*, 59 – 81.

Sobell, M. B., Sobell, L. B., & Gavin, D. R. (1995). Portraying alcohol treatment outcomes: Different yardsticks of success. *Behavior Therapy, 26*, 643 – 669.

Soldatos, C. R., Paparrigopoulos, T. J., Pappa, D. A., & Christodoulou, G. N. (2006). Early post-traumatic stress disorder in relation to acute stress reaction: An ICD-10 study among help seekers following and earthquake. *Psychiatry Research, 143*, 245 – 253.

Yesiliyaprak, B., Kisac, I., & Sanlier, N. (2007). Stress symptoms and nutritional status among survivors of the Maramara regions earthquakes in Turkey. *Journal of Loss & Trauma, 12*, 503-597.

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