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THE RELATIONSHIP BETWEEN HEALTH RELATED QUALITY OF LIFE AND DIETARY SUPPLEMENTATION IN BRITISH MIDDLE MANAGERS: A DOUBLE BLIND PLACEBO CONTROLLED STUDY

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In order to examine the influence of dietary supplements on health related quality of life (QOL), a double blind controlled trial was carried out with 95 middle managers. After an eight week trial, those taking dietary supplements, in comparison to participants in the placebo condition, showed more significant improvements in vigour-activity on the Profile of Mood States (POMS), and on the overall strain sub-scales of the Multi-modal Stress questionnaire (MMSQ). For those on a relatively poor diet only, there was a significant difference between those taking dietary supplements and those in the placebo condition on the sub-scales of tension-anxiety, anger-hostility, vigour-activity, confusion-bewilderment and on overall mood on the POMS. There was also a more significant improvement on the sub-scales of physical strain, behavioural strain, cognitive strain and on overall strain on the Multi-Modal stress questionnaire. It is concluded that for those on a relatively poor diet, dietary supplements may improve health related quality of life.

KEY WORDS: Quality of life; stress; mood; dietary supplements; middle managers.

INTRODUCTION

As a number of commentators have observed (e.g. Fava, and Magnani, 1988) interest in Quality of Life (QOL) has increased dramatically over recent years, until it now constitutes one of the largest areas of social science research. Yet there is still

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controversy over the definition of quality of life (Gersen, 1976; Walker and Rosser, 1992) and disagreements have arisen over suitable methods of assessment (Fava and Magnani, 1988; Salamon 1988). Following on from a consensus meeting held in 1986 (Walker and Assher, 1986) which established the six components of quality of life as physical, cognitive, affective, social, economic and ego function factors (PCASEE), Bech (1991) and Joyce (1987) have distinguished between information obtainable at the health status and quality of life level. The former is assessed by observer rating scales, and the latter, defined as 'Health Related Quality of Life', is assessed by self report, and 'has in its inner essence the concept of well-being' (Bech 1990: 78). Whilst a number of indexes exist to measure both subjective well-being and health related quality of life, a number of authors (Aaronson, Bullinger and Ahmredzai, 1989; Larsens, Diener and Emmons, 1985) have argued that a major problem with existing research is the utilisation of single measures, and consequently battery .approaches for measurement of quality of life are increasingly being adopted (ie Croog, Levine and Testa 1986).

Much of the quality of life research to date has focused on clinical populations, in particular on QOL as an outcome variable in trials of medical interventions (Spilker, 1990) However, there has recently been a growth in research investigating quality of life in non-clinical populations, following on from the focus on health, rather than illness, in clinical research and practice (WHO, 1980), and the growing emphasis on QOL as a measure of well-being (Bech 1990). Thus in non-clinical populations researchers have examined the relationship between QOL and variables such as occupation (Fabian, 1989), educational status (Bryant and Marquez, 1986), personality (Emmons, 1986), gender (Kaplan, Anderson and Wingard, 1991), socio-economic status (Haring, Stock and Okun, 1984) and social interactions or activities (Guinot and Wesnes, 1985). There has also recently been a growing interest in the relationship between aspects of QOL and diet.

Quality of life and diet

Whilst much is know about the long term effects of malnutrition on QOL, research examining the relationship between diet and QOL in non-clinical populations is still in its infancy (Spring, 1986). Yet there are a number of ways in which diet may affect QOL in the general population. Dietary deficiences have a negative effect on the immune system (Chandra and Scrimshaw, 1988), and call lead to a range of physical illnesses – bacterial, viral, parasitic and fungal (Chandra, 1983), which significantly reduce feelings of well being, and QOL. It has also been suggested that poor nutrition can be a result of illness (Hodkinson, 1990), or a result of stress (Sahey and Birkner, 1988) acting to exacerbate existing symptomatology, and further reduce QOL. Increased alcohol intake, which is often associated with stress (Lefebvre and Sandford, 1985), can also lead to nutritional deficiencies (Passmore and Eastwood, 1986), with similar consequences. Deficencies in specific vitamins can result in a range of physical and psychological symptoms (Lipton, Mailman and Nemeroff, 1979), outlined in figure one.

Figure 1 Somatic and Psychological symptoms associated with vitamin deficiencies (Lipton *et al.* 1979).

Thiamin (B1)	poor appetite, constipation, edema, heart failure, atony of gastrointestinal tract; depression, anxiety, apathy, irritability, Korsakoff' s psychosis .
Riboflavin	cheilosis (cracks at corner of lips, scaly desquamation around nose and ears, sore tongue and mouth, burning and itching of eyes, photophobia.
Niacin (B3)	Glossitis, diarrhoea, dermatitis, pellagra, depression, anxiety, hyperirritability, mania, memory deficits, delirium, emotional lability, apathy.
Pyridoxine (B6)	Weakness, abdominal pain, cutaneous lesions, lymphocytopenia, nervous irritability.
Folic Acid	Anaemia, forgetfulness, insomnia, apathy, irritability, depression, psychosis, delirium, dementia .
Ascorbic Acid (C)	We akened cartilages and capillary walls, cutaneous haemorrhage, sore & bleeding gums, anaemia, poor wound healing, poor bone and tooth development, lassitude.
Vitamin B12	Macrocytic anaemia, irritability, confusion.

The mechanisms by which vitamin deficiences may produce psychological symptoms is complex (Hodkinson, 1990) and much is still uncertain (Spring, 1986). One suggestion is nutritional deficits may produce changes in neurotransmitter function, receptor sensitivity, or endocrine function, resulting in reduction in feelings of well-being, or in extreme cases depression (Reynolds and Stramentinoli, 1983) or schizophrenia (Lipton *et al* 1979). This has led to the claim that vitamin supplementation can be beneficial in treating a range of psychological disorders such as schizophrenia, alcoholism and autism (see Lipton *et al. 1979*). However, the research findings are inconsistent, suggesting that these claims must be viewed with caution. For example, whilst a number of controlled trials have shown a benefical effect of vitamin supplementation in treating schizophrenia (Denson, 1962; Hoffer 1962), others have reported no benefical effects at all (Wittenborn, Weber and Brown, 1973; Anath, Vacaflor, Kekhwa, Sterlin and Ban, 1972).

Quality of life and dietary supplementation

The fact that clinicians are advocating attention to diet and use of dietary supplements as part of interventions to improve quality of life is evidenced by a recent report by Liberty (1987), who argued that information on nutrition and on dietary supplementation is essential for those counselling individuals with an aim to improving QOL, particularly those involved in rehabilitation work. However, the question of whether dietary supplementation can improve QOL is a source of some speculation.

Researchers have examined the relationship between dietary supplements and intelligence and brain function (Benton and Roberts, 1988; Benton and Butts, 1990; Schoenthaler, Amos, Doraz, Kelly and Wakefield, 1991), performance (Schoenthaler, Amos, Eysenck, Peritz and Yudkin, 1991), and institutional violence and antisocial behaviour (Schoenthaler, 1986), suggesting positive benefits. However, others have

failed to replicate the findings of a positive relationship between vitamin supplements and intelligence (Nelson, Naismith, Burley, Gatenby and Geddes, 1990; Crombie, Todman, McNeill, Florey, Menzies and Kennedy, 1990). This line of research has provoked much controversy (see Benton, 1992; Sanders, 1992, Eysenck, 1992), and it must be concluded that the findings are as yet equivocal.

There have been reports that vitamin and mineral supplementation can be beneficial in reducing stress and anxiety (Lettko and Meuer, 1990; Tundo and Saraceni, 1986; Wiley, 1987; Brown, Blum, Trachtenberg, 1990; Sahey and Birkner, 1988), and the lay belief that vitamins can alleviate stress is supported by a recent study which reported that individuals experiencing stress increase their intake of vitamin supplements (Spillman, 1990). These findings may have important implications for those working in a number of areas of Health Psychology. However, as there have been no double blind placebo controlled trials of the effects of dietary supplements on QOL in a non-clinical population, no firm conclusions can be drawn.

Present study

The present study was designed as a double blind placebo controlled study to assess the effects of a dietary supplement on health related QOL in a non clinical population. As previous research on QOL in non-clinical groups has been criticised for concentrating on students (Campbell, 1981), and as the aim was to examine the effects of dietary supplementation in individuals who would not be expected to be malnourished, the population chosen for investigation in the present study were middle managers, working in Britain. It was predicted that individuals in the experimental condition, those taking dietary supplements, would show a greater improvement following the study period in health related QOL, as measured by a battery of instruments, than those in a placebo condition.

METHOD

Design

Each participant was randomly assigned to one of two parallel groups: (a) Experimental (participants taking dietary supplements), and (b) Placebo (participants taking placebo capsules). There was no significant difference between groups on the baseline measures of QOL, suggesting that randomisation was sucessful. A double blind procedure was used, whereby neither the participants not the research assistant administering the questionnaires were aware of which condition a particular participant had been assigned to. Participants completed the battery of tests, and took two capsules daily for eight weeks, before completing the battery of tests again.

Subjects

A total of 180 middle managers employed in manufacturing industry in Britain were recruited for the study. The inclusion criterion were that subjects be employed as a

middle manager (defined as having management responsibility for a number of individuals, not at board level), have no major health problems, and not be clinically overweight or underweight, as defined by the Body Mass Index norms. Weight and height were assessed by self report. The average age of the participants who completed the trial was 39 years (s.d. 10.2). The average BMI score for women was 21.97 (s.d. 2.22, range 19–25), and for men 24.10 (s.d. 2.22, range 20–29). There was no difference across condition assignment.

95 participants completed the study successfully, 53 men and 42 women. The recruitment in the experimental condition was 83, completion 42 (51%), 21 women and 21 men; in the placebo condition the recruitment was 97, the completion 53 (55%), 21 women and 32 men. The overall drop out rate was 47% (n=85). There was no significant difference between drop-outs and completers in diet, or in baseline scores.

There were various reasons why participants failed to complete, or were excluded from, the study. These included not remembering to take the capsules on a regular basis (39), forgetting to complete the second form in time (9), moving house (3), deciding after reflection not to be involved in the study (13), pregnancy (1), being pressurised into taking part by a manager and then deciding not to comply (8), and redundancy from work, which resulted in exclusion (12). None of the subjects who failed to complete reported any side effects from taking the capsules.

Instruments

Health related QOL was measured through a battery of standardised self report instruments which measured a number of factors previously associated with QOL: positive and negative affect, stress, satisfaction with life, and self esteem (Emmons and Diener, 1985; Vermunt, Spaans, and Zorge, 1989; Costa, Macrae and Zonderman, 1987; Spilker, 1990).

1. Profile 0f Mood Scale (POMS) (McNair, Lorr and Dropplemen 1971)
The POMS is a 65 item adjective rating scale designed to measure multiple dimensions of positive and negative affect economically and rapidly. It measures six identifiable states: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigour-Activity, Fatigue-Inertia, Confusion-Bewilderment and general mood. It has been used by a number of researchers as a sole measure of QOL, (Spilker, 1990) and as a measure of subjective well-being (Emmons and Diener, 1985).

2. The Multi-Modal Stress Questionnaire (MMSQ) (Lefebvre and Sandford, 1985)
The Multi-Modal Stress Questionnaire (MMSQ) consists of 48 items measuring three dimensions of stress: physical, behavioural, and cognitive strain. It is also possible to compute a composite score for overall stress. It has advantages over previous scales as it examines the three components of stress identified by Selye (1976), rather than focusing on one component, such as physical or behavioural stress.

3. The Satisfaction With Life Scale (SWLS) (Diener, Emmons, Larsens, and Griffin. l985).
The Satisfaction with Life scale is a five item scale measuring general satisfaction with

life, the cognitive component of subjective well-being (Emmons and Diener, 1985; Vermunt, *et al.* 1989), on a single dimension.

4. General Affect Questionnaire (Campbell, Converse, and Rodgers, 1976)
The General affect questionnaire consists of 10 items with a 7 point scale between two polar adjectives. It is free of any specific domain content and serves as a basis for analyzing relationship between general satisfaction and domain satisfaction (Campbell, 1976). The scale differs from the POMS in that it measures feelings about the individuals life rather than about themselves. The General Affect questionnaire has two components, affect and stress.

5. The Self Esteem Questionnaire (Rosenberg, l965)
The Rosenberg self esteem questionnaire consists of 10 questions divided into 6 'Scale Items', resulting in one overall score for self esteem.

In addition, subjects were asked for information on general health: including weight and height, whether they experienced any illness or health difficulties, how much alcohol they drank per week (in units) and diet. The questions on diet consisted of asking subjects to indicate which of a range of foods they ate on a regular basis: meat, fish, bread, rice, pasta, potatoes, fruit, vegetables, pulses, beans, cakes, salt, chocolate, sweets, crisps, snacks.

Dietary supplement

The dietary supplement used in the study contained a combination of vitamins, minerals and ginseng. The contents are described in figure two. Previous research has suggested that the combination of vitamins, minerals and ginseng contained in the supplement used in the trial is efficacious in improving cognitive and intellectual performance (Revers, 1976) and improving psychophysical parameters (Lillo, 1987) in the elderly, improving work performance in middle aged men (Tesch, 1987), enhancing anabolic processes during convalescence (Mor, 1988) and improving physical and intellectual performance in professional and amateur sportsmen (Murano, 1984). The dietary supplement and placebo were provided in gelatine capsule form. They were identical in appearance, being opaque and dark in colour, the only difference being that the placebo did not hold the substance within which the vitamins, minerals and ginseng were contained; the placebo contained a neutral substance.

Procedure

Participants were recruited through the board level of each company, and each participant was asked to volunteer to take part 'in a study examining the effects of dietary supplements on general well being'. Participants were .not given any information about what the expected effects of the supplements would be. It was explained that there would be two conditions, and that participants would be allocated randomly. All participants who agreed to take part received the battery of measures in the form of a single pre-intervention questionnaire. When the questionnaire was

Figure 2 Contents of dietary supplement.

Each capsule contained:		
Ginseng extract gll5	40.0	mg
Dimethylaminoethanol bitartrate	26.0	mg
Vitamin A (Retinol INN)	4000.0	IU
Thiamine mononitrate (Vit B1)	2.0	mg
Riboflavine (vit B2)	2.0	mg
Pyridoxine Hydrochloride (vit B6)	1.0	mg
Cyanocobalamine (Vit B12)	1.0	mcg
Ascorbic Acid (vit C)	60.0	mg
Calciferol (Vit D2)	400.0	IU
dl-alpha-Tocopherol acetate (vit E)	10.0	mg
Nicotinamide Ph. Eur	15.0	mg
d-Calcium pantothenate Ph. Eur	10.0	mg
Rutin (Rutoside INN)	20.0	mg
Dried ferous sulphate (Fe 10.0 mg)	33.0	mg
Calcium phos. dibasic (Ca 90.3 mg, P70.0 mg)	307.5	mg
Calcium fluoride (F 0.2 mg)	0.4	mg
Copper sulphate anhydr. (Cu 1.0 mg)	2.8	mg
Potassium sulphate anhydr. (K 8.0 mg)	18.0	mg
Manganese sulphate anhydr. (Mn l.Omg)	3.1	mg
Magnesium sulphate anhydr (Mg 10.0 mg)	71.0	mg
Zinc Oxide (Zn 1.0 mg) Ph Eur	1.3	mg
Choline, inositol, linoleic acid & linolenic acid (lecithin)	55.0	mg

completed there was a two month period in which they took the vitamin mineral and ginseng supplement (experimental condition), or took the placebo capsules (placebo condition). At the end of this two month period a post-intervention questionnaire (containing the same battery of instruments as the pre-intervention questionnaire) was administered. Participants were telephoned after one month to ensure that they were taking the capsules daily. Each participant was asked to guarantee in writing at the end of the study that they had actually done so. Those that did not comply were excluded from the final analysis. Participants were fully debriefed in writing following completion of the study.

RESULTS

Using a dyadic component index (Feinstein, 1987), the principle underlying data analysis was to look for an improvement in the responses of participants to the post-intervention questionnaire in relation to the pre-intervention questionnaire. For all subjects the difference between a particular pre-questionnaire response and a particular post-intervention response was calculated. The size of these differences (or change scores) was then compared across the two conditions, with a greater positive difference or change predicted in the experimental condition than in the placebo condition. A positive difference was defined as an increase in positive mood states (POMS), in self esteem (self esteem questionnaire), in positive affect (General Affect Questionnaire)

and in satisfaction with life (SWLS), and a reduction in stress (MMSQ and General Affect Questionnaire).

Table 1 shows the mean pre-intervention scores, and the mean change scores, for the two conditions for each instrument. A series of two tailed *t*-tests confirmed that prior to intervention there were no statistically significant differences between scores obtained by participants in the experimental condition and those in the placebo condition for any of the dimensions measured by the instruments. To examine whether the change score for each instrument was greater in the experimental condition than in the placebo condition, the two scores were compared with a one tailed *t*-test. For the POMS the only significant difference was for the vigour-activity dimension $t\,(90)=2.27$, $p<.02$, although the score for overall mood change approached significance $t\,(85)=1.47$, $p<.08$. For the MMSQ there was a significant difference for overall stress $t\,(79)=1.74$, $p<.05$. None of the differences for the three individual MMSQ dimensions were significant, although those for physical stress $t\,(83)=1.43$, $p<.08$, and cognitive stress $t\,(89)=1.49$, $p<.08$ approached significance. There were no significant differences for the Satisfaction with Life scale, the General Affect Questionnaire, or the Self Esteem questionnaire.

Table 1 Mean pre-intervention and change scores for each condition

	Pre-Intervention		Change	
	Placebo	Experiment	Placebo	Experimental
POMS	x (S.D)	x (S.D)	x (S.D)	x (S.D)
Tension-anxiety	11.42	11.83	0.61 (9.27)	2.70 (6.68)
Depression-dejection	9.55	10.46	–0.80 (10.28)	1.64 (8.81)
Anger-hostility	9.98	11.96	–0.06 (8.94)	2.74 (7.66)
Vigour-activity*	16.02	15.15	1.00 (6.06)	3.78 (5.49)
Fatigue-inertia	11.57	9.83	1.69 (7.90)	2.53 (5.71)
Confusion-bewilderment	7.72	8.27	0.27 (4.63)	1.48 (4.65)
Overall mood	66.24	67.93	3.73 (38.03)	14.55 (28.14)
MMSQ				
Physical stress	50.73	50.95	2.94 (9.35)	6.08 (10.80)
Behavioural stress	24.41	23.97	1.35 (4.11)	1.86 (3.95)
Cognitive stress	14.14	14.89	0.62 (3.94)	2.00 (4.86)
Overall stress*	89.29	89.82	4.98 (14.05)	11.09 (17.57)
SWLS				
Satisfaction with liie	20.00	19.26	0.91 (6.75)	1.89 (6.41)
GAQ				
General affect	41.83	41.28	0.28 (6.47)	1.84 (5.14)
Stress	8.25	8.05	–0.02 (2.27)	0.30 (1.59)
Self Esteem	17.96	19.03	1.19 (3.75)	1.33 (3.24)

* Significant difference between change scores in the placebo and experimental conditions ($p<.05$)

Effects of dietary supplements on health related quality of life in individuals with a relatively poor diet.

When the distribution of the overall difference scores were scrutinised (table 2), it was observed that in the experimental condition, but not the placebo condition, there was a marked positive skew. This suggested that in the experimental condition alone there may have been a marked improvement for a limited number of participants. Given that the use of dietary supplements would have affected the nutritional balance of diet, it seemed plausible that QOL may have improved for only those participants in the experimental condition who had a relatively poor diet, or those who had a relatively higher intake of alcohol. It was therefore decided to examine differences between pre and post intervention scores in relation to two additional variables: alcohol intake and diet.

To examine the effects of alcohol, the amount of alcohol consumed per week was calculated, and subjects were divided into two groups, above/equal to and below the median of 10 units. There was no significant difference between the two groups on any of the measures on the basis of alcohol intake.

To examine the effects of diet, subjects were divided into those with a relatively good or a relatively poor diet. This was achieved by examination of the diet details collected when the pre-intervention questionnaire was administered. Subjects were given a point for each of the following foods that they indicated that they often eat: meat, fish, bread, rice/pasta, potatoes, fruit, vegetables, pulses/beans. Then a point was subtracted for each of the following foods which they indicated that they often ate: cakes, salt, chocolate, sweets, crisps, snacks. This gave a final score for each participant ranging from –6 for the poorest diet to +8 for the best diet. The median score for diet was 4, and the subjects were divided into those with a score at or above the median (good diet) and those with a score below the median (poor diet). The number of subjects in the resulting cells were placebo/poor diet 17, placebo/poor diet 36, experimental/poor diet 17, and experimental/good diet 25.

Profile of Mood States

The mean difference scores across the two conditions for good and bad diet participants are shown in table two. There was no significant difference in baseline QOL scores between the two groups. To examine whether there was a significant interaction between conditions (placebo versus experimental condition) and diet, a series of two-way independent measure ANOVAs were carried out. For only one mood dimension, vigour-activity, was there a main effect for condition F (1,84)=4.14, $p<.05$, and there were no main effects for quality of diet. However, there was a significant interaction between quality of diet (good versus poor) and condition (experimental versus placebo), for four of the six individual mood dimensions, tension-anxiety F (1,84)=5.86, $p<.02$, anger-hostility F (1,84)=8.12, $p<.01$, vigour-activity F (1,84)=5.94, $p<.02$, and confusion-bewilderment F (1,83)=5.45, $p<.03$; and also for overall mood F (1,83)=8.17, $p<.01$.

This relationship was investigated further by examining the simple effect of condition for participants on a relatively poor diet only. These results suggest that for

Table 2 Profile of mood States mean change in mood scores as a function of condition and diet

	Placebo x	S.D.	Experimental x	S.D.
Tension-anxiety*				
Poor diet	-3.81	(9.81)	4.25	(6.61)
Good diet	2.63	(8.41)	1.67	(6.67)
Depression-dejection				
Poor diet	-3.25	(13.01)	4.53	(8.37)
Good diet	0.31	(8.75)	-0.17	(8.76)
Anger-hostility**				
Poor diet	-2.38	(11.05)	6.81	(7.35)
Good diet	1.00	(7.67)	-0.09	(6.65)
Vigour-activity*				
Poor diet	-1.63	(5 .49)	5.00	(4.20)
Good diet	2.17	(6.00)	2.96	(6.12)
Fatigue-inertia				
Poor diet	0.88	(8.16)	3.31	(4.44)
Good diet	2.06	(7.87)	2.00	(6.47)
Confusion-bewiderment*				
Poor diet	-1.25	(5.21)	3.13	(5.73)
Good diet	0.97	(4.24)	0.38	(3.49)
Overall mood**				
Poor diet	-11.44	(40.01)	26.53	(24.61)
Good diet	11.09	(35.32)	6.74	(28.00)

*=p<.05 **p<.0 1
Significant interaction between experimental conditions and diet

participants on a relatively poor quality diet only, dietary supplements had a positive effect on tension-anxiety F (1,86)=7.41, p<.01; depression-dejection F (1,86)=5.09, p<.03; anger-hostility F (1,86)=9.79, p<.01; vigour-activity F (1,86)=10.63, p<.005; confusion-bewilderment F (1,85)=6.45, p<.02; and overall mood F (1,85)=10.59, p<.005.

Multi-modal Stress Questionnaire

The mean mood difference scores across the two conditions for good and bad diet participants are shown in table three. To examine whether there is a significant interaction between conditions and diet, a series of two-way independent measure ANOVAs were carried out. There were no main effects for condition, or for diet, but for two of the three stress dimensions, behavioural strain F (1,77)=6.52, p<.02 and cognitive strain F (1,77)=6.99, p<.02, and for overall strain F (1,77)=6.57, p<.02, there was an interaction between conditions and diet. There was a near significant interaction for physical strain F (1,77)=3.40, p<0.07. Examination of the simple effect of condition for poor diet participants only demonstrated that for those participants dietary supplements had a positive effect on physical strain F (1,79)=5.34 p<.05; behavioural strain F (1,79)=8.25, p<.01; cognitive strain F (1,79)=9.16, p<.01; and overall strain F (1,79)=9.34, p< .01.

A series of two way ANOVAs showed that there was no main effect for condition, no main effect for diet, and no interaction between condition and diet, for satisfaction with life (SWLS), General affect (GAC) or self esteem.

Table 3 Multi-modal stress questionnaire mean change in stress scores as a function of condition and diet

	Placebo		Experimental	
	x	S.D.	x	S.D.
Physical				
Poor diet	1.80	(8.2:5)	10.67	(10.20)
Good diet	3.44	(9.87)	3.79	(10.54)
*Behavioural				
Poor diet	-0.53	(4.91)	2.67	(4.14)
Good diet	2.26	(3.36)	1.35	(3.83)
*Cognitive				
Poor diet	-0.76	(4.13)	3.13	(4.75)
Good diet	1.78	(3.73)	1.26	(4.89)
*Overall stress				
Poor diet	0.73	(13.40)	19.45	(16.88)
Gooddiet	6.91	(14.11)	6.91	(16.72)

*=p<.02
Significant interactioll between experimental conditiolls and diet

DISCUSSION

This study demonstrated a trend towards a greater change score in a positive direction for participants in the experimental condition, those taking dietary supplements, in relation to a placebo condition, suggesting a positive effect on health related QOL. However with the exception of the Vigour-Activity subscale of the POMS, and the overall strain scale on the Multimodal stress questionnaire, this trend failed to reach significance. It must therefore be concluded that there was little support for the hypothesis that dietary supplements would have a significant positive effect on health related QOL when overall group differences were examined.

However, further exploration of the data indicated that there was, for several measures of QOL, an interaction between whether the dietary supplements had a positive effect and whether participants normally had a relatively good or a relatively poor diet. The general conclusion of this further analysis was that participants on a relatively poor diet benefited from taking dietary supplements in terms of mood and stress levels. Participants in the experimental condition were found, in comparison to participants in the placebo condition, to report greater improvement in the subscales of tension-anxiety, anger-hostility, vigour-activity, confusion-bewilderment and on overall mood on the POMS. There was also a significant improvement on the subscales of behavioural strain, cognitive strain, physical strain and on overall strain on the Multi-Modal stress questionnaire.

Whilst no such positive effects were detected for satisfaction with life, self esteem or general affect, even for these measures the trends were in the predicted direction. It is possible that had a larger sample size had been used, the predicted differences may have been observed. In addition, it might be that any positive effects of dietary supplements on self esteem and satisfaction with life might take longer than eight weeks, the pre-post intervention period used in this study, to emerge. However, as many researchers use the POMS as a sole index of QOL (see Spilker, 1990), the finding

that dietary supplements produce a significant improvement on the POMS, combined with the significant improvement on the MMSQ, suggests that this is an area of research deserved of further serious investigation. It confirms previous reports of a relationship between diet and psychological wellbeing, and confirms the view that it is not only malnourished populations who may benefit from dietary supplementation (Lipton *et al.* 1979; Passmore and Eastwood, 1986).

There were a number of problems with the present study. Recruitment and assurance of compliance was difficult owing to the inaccessibility of the middle management populations, and drop-out was high. Permission was needed at board level of companies, and a number of individuals originally interested were later reluctant to participate. Whilst middle managers were chosen partly for their homogeneity as a group, and particularly their similarity in terms of economic status - a core component of the PCASEE consensus on QOL – future research investigating the effects of dietary supplements on QOL should concentrate on more accessible populations, where daily compliance could be ascertained more accurately. In the present study, as the drop out was equivalent across conditions, the comparison of groups was not unduly affected by non-compliance.

There is a difficulty in interpreting the underlying cause of any positive effect of the dietary supplements. As the supplement used contained a combination of vitamins, minerals and ginseng, it is unclear whether it was the combination of these three factors, or whether it was one of the factors alone, which accounted for the positive results. Further research is clearly needed to examine the differential effects of vitamins, minerals and ginseng on health related QOL. Equally, as the evaluation of diet in the present study was also somewhat rudimentary, a more systematic analysis of diet, using a daily dietary analysis, is essential in future research. A dietary analysis which allows comparison with standardised population mean, rather than focusing on relative dietary levels within the population studied, is also essential. Whether it is diet per se which is the important intervening variable in this study, or some correlate of diet, can only be ascertained by experimental research manipulating diet. However, a correlation matrix which examined the relationship between diet and all of the other factors assessed in the study (QOL, height, weight, alcohol intake, gender, age, marial, status, number of children, normal use of vitamins) did not yield any significant relationships between diet and the other factors, suggesting that the measure of diet was independent. It would also be informative to know whether participants believed themselves to be in the placebo or experimental conditions in future research, in order to assess the true blindness of the study – information which was not systematically collected in the present study.

CONCLUSIONS

This study provides some support for previous research which suggests that dietary supplements may have beneficial effects on aspects of health related quality of life. However, in most cases such benefits were limited to those on a relatively poor diet. Whilst further research is needed to clarify these results, these findings suggest that

nutritional information and advice may play an important part in any intervention attempting to improve QOL, and that dietary supplements may play a role in improving mood and reducing stress, and thereby contributing to improvements in health related QOL. These finding are of importance to those investigating QOL in both clinical and non-clinical settings, and have implications for health psychologists working in a number of different areas. Future research should examine the effects of dietary supplements in populations other than middle managers, and use a more carefully controlled analysis of diet. A comparison of vitamins and minerals with standardised ginseng extract would also be useful, in order to examine in more detail the mechanisms of these significant effects.

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