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ABSTRACT

Drawing on data gathered in the National Survey of Midlife Development in the United States, this study examined internal and external locus of control, self-esteem, neuroticism, perceived health status, uniqueness, and somatic amplification as correlates of dietary supplement use. With sex, race, and age measures also included in the study, bivariate analyses showed greater supplement use among women and older respondents as well as those scoring higher on internal locus of control, self-esteem, perceived health status, and somatic amplification. Regression analyses identified sex and internal locus of control as the strongest predictors. Interactions between age and external locus of control also emerged.

KEYWORDS

Dietary supplements; locus of control; MIDUS; psychosocial measures; somatic amplification

Since passage of the Dietary Supplement Health and Education Act of 1994 (DSHEA), supplement production and supplement use have increased dramatically in the United States. DSHEA classified dietary supplements—vitamins, minerals, herbs, and botanicals, as well as amino acids—as a subcategory of food, exempting product manufacturers from providing premarket evidence of safety and efficacy. More than half of all U.S. adults use at least one supplement on a regular basis (Bailey et al. 2013; Qato et al. 2008), and the National Institutes of Health (2015) recently estimated annual industry revenue at $36.7 billion. Supplement users cite health maintenance, health improvement, and weight management as primary reasons for use (see Blanck et al. 2007; Conner et al. 2001; Dickinson, Blatman, and El-Dash 2014; Kruger, Blanck, and Gillespie 2006).

The current research draws on data gathered in the third and most recent wave of the National Survey of Midlife Development in the United States (MIDUS; Ryff et al. 2013–2014; N = 2,661) in examining psychosocial correlates of supplement use. Little research has analyzed whether, and to what extent, factors such as internal and external locus of control, self-esteem, neuroticism, uniqueness, perceived health status, and somatic

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amplification predict not only the use of dietary supplements, but also the number of supplements used. To the extent that supplement use assists individuals in maintaining or enhancing personal health,[1] an assessment of psychosocial correlates stands to confirm or disconfirm conventional assumptions about health behaviors. For example, in contrast to individuals with an external locus of control, those with strong internal control tend to be more active in maintaining or improving their health (Norman 1995; Ryon and Gleason 2014; Wallston and Wallston 1981); the current study examines behavioral patterns in the context of supplement use. In addition, individuals prone to somatic amplification (i.e., hypersensitivity to body sensations) may use multiple, potentially interacting supplements in attempting to resolve perceived health problems; however, overuse may create problems as well. The following section discusses psychosocial constructs included in the current study.

Theory and constructs

This study examines whether, and to what extent, measures of internal and external locus of control, self-esteem, neuroticism, perceived health status, uniqueness, and somatic amplification correlate with supplement use. As a construct in health behavior, locus of control is grounded in social learning theory (Rotter 1954), which suggests that expected outcomes, and the value attached to those outcomes, play a significant role in determining behavior (Norman 1995; Ryon and Gleason 2014). AbuSabha and Achterberg (1997) explained that social learning theory and the locus-of-control construct assume the presence of *internals* and *externals*; the former characterizes individuals who view health outcomes as being within their control, and the latter reflects those who believe outcomes are under the control of others or due to chance. For purposes of the current study, Levenson (1974) suggested that behavioral differences may be observed between internals and externals. Informed by earlier studies (Raab 1987; Read et al. 1991; Sasagawa et al. 2008; Sirois 2008), the current research anticipates that individuals with high levels of internal locus of control will be more likely to use dietary supplements and to use more of them on a regular basis. Individuals with strong internal control tend to believe in their capacity to enhance their personal health (Cobb-Clark, Kassenboehmer, and Schurer

[1]Scientific research has offered limited evidence of supplement efficacy (see, for recent discussion, Stickel and Shouval 2015), but some studies have identified potential health benefits in certain products (see Fugh-Berman and Cott 1999; Troppman, Gray-Donald, and Johns 2002; Wang et al. 2008; Zandi et al. 2004). Daily multivitamins and fish-oil extracts are among the most popular substances used by individuals seeking to supplement their diets and maintain or improve their health. Recent studies have questioned the capacity of supplements to affect the health of consumers (see Bjelakovic, Nikolova, and Gluud 2013; Fortmann et al. 2013; Grodstein et al. 2013; Lamas et al. 2013; Martinez et al. 2012; Miller et al. 2010, 2005). Studies have also found an absence of active ingredients in certain products (Sarma, Giancaspro, and Venema 2016; Newmaster et al. 2013; Wheatley and Spink 2013).

2014; Ryon and Gleason 2014), while individuals with an external locus of control consider their health to be determined by others.

AbuSabha and Achterberg (1997) suggested that locus of control should not be studied in isolation, and the authors identified self-esteem as a related construct. In fact, Judge et al. (2002) noted that locus of control, self-esteem, and neuroticism—three of the most widely studied personality constructs in psychology and three constructs included in the current study—may be part of an even broader underlying construct. Citing Brockner (1979) and the behavioral plasticity hypothesis, Judge et al. (2002, 694) suggested, "People with low self-esteem are generally more susceptible to self-relevant social cues than are individuals with high self-esteem. This type of behavior mimics individuals who have an external locus of control." The current study includes a self-esteem index as an explanatory measure, with those reporting higher esteem expected to consider themselves empowered to enhance their personal health and therefore more likely to supplement their diets.

Research indicates that individuals with high levels of self-esteem, who tend to score higher on measures of internal locus of control, are often less neurotic than others (see Judge et al. 2002). Neuroticism thus may correlate with external locus of control (Horner 1996), as individuals prone to anxiety and worry may rely heavily on others for advice. Yet, neurotic individuals also may look to compensate for what they perceive as a lack of essential nutrients in their diets, overusing supplements. Consequently, anticipating the directionality of an association between neuroticism and supplement use becomes somewhat difficult, and the current study approaches the association from the standpoint of a research question, as opposed to a hypothesis.

The current study also investigates uniqueness and perceptions of health as predictors of supplement use, anticipating that individuals who report (a) enjoying their uniqueness and (b) considering themselves healthier than others their age will report greater supplement use. One may consider uniqueness a positive or negative trait (Snyder and Fromkin 1977), and the current study anticipates that individuals who enjoy being unique will engage in behaviors they consider appropriate. Individuals who view themselves as relatively healthy may seek to maintain their perceived levels of health and do so by using one or more dietary supplements.

Last, this research analyzes somatic amplification as an explanatory measure of supplement use. As Barsky et al. (1988, 510) explained, individuals sometimes amplify relatively minor somatic body sensations to a point at which the sensations become "intense, noxious, and disturbing." The authors continued: "Amplification involves three elements: (a) hypervigilance, or heightened attentional focus on body sensation; (b) a tendency to select out and concentrate on certain relatively weak and infrequent sensations; and 3) the disposition to react to somatic sensation with affect and cognitions that intensify them and make them more

alarming, ominous, and disturbing." The current study anticipates that individuals prone to somatic amplification may be more likely to supplement their diets, seeking to address certain body sensations with products they believe will offer assistance.

Anticipated empirical relationships

Radimer et al. (2004) found greater use of dietary supplements among females, White respondents, and older Americans (see also Rock 2007; Sebastian et al. 2007), and the current study anticipates the same patterns. The study also expects greater use of dietary supplements among individuals with higher levels of internal health locus of control and lower levels of external health locus of control; that is, individuals who believe they have the capacity to affect their health for the better will be inclined to use supplements, while those who believe that outcomes rest with others will not. In addition, the study includes a measure of neuroticism, and it expects to observe increased supplement use among those with higher levels of self-esteem, those who view themselves as being healthier than others the same age, those who enjoy their uniqueness, and those with higher levels of somatic amplification.

Methods

Sample

This study draws on data gathered in the 2013–2014 National Survey of Midlife Development in the United States (MIDUS 3; Ryff et al. 2013–2014), a research initiative funded by the Institute on Aging, a division of the National Institutes of Health. The first MIDUS study took place in 1995–1996 and the second in 2004. MIDUS 3, data for which were made available by the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan, included 3,294 respondents. The sample included 1,484 (45.1%) males and 1,810 (54.9%) females; 2,923 (89.5%) Whites and 344 (10.5%) members of other races; and respondents ranging in age from 39 to 93 years (M = 63.64, SD = 11.350).

The current study included responses from 2,661 individuals, reflecting the number of individuals who responded to questions about dietary supplements. In this case, 2,661 respondents indicated taking between 0 and 10 supplements on a regular basis. This subsample reflected overall sample numbers, including 1,181 (44.4%) males and 1,480 (55.6%) females; 2,376 (90%) Whites and 263 (10%) members of other races; and ages ranging from 39 to 93 years (M = 64.55, SD = 11.123).

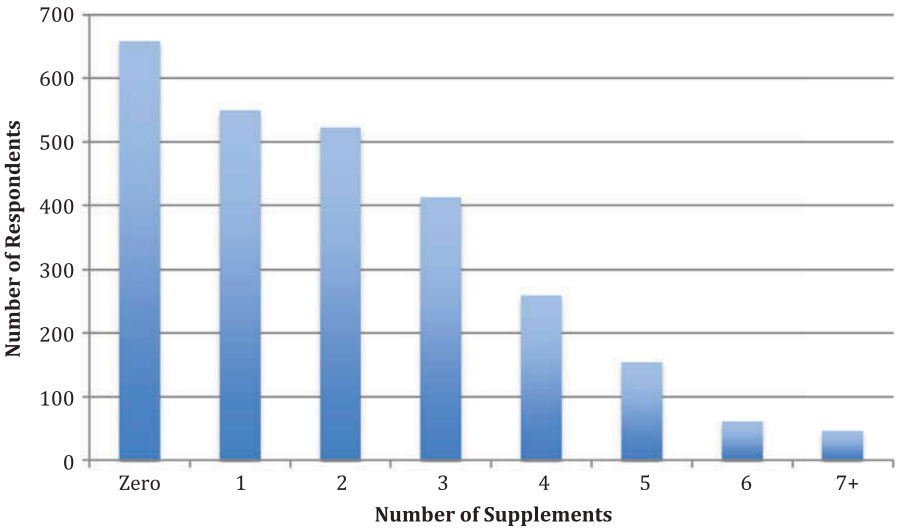

Figure 1. Distribution of supplements used on regular basis.

Response measures

The response measures drawn from MIDUS 3 asked respondents to indicate (a) whether they used a dietary supplement and (b) the number of supplements taken on a regular basis (i.e., at least a couple of times per week). For the first response measure, 2,003 (75.3%) of 2,661 respondents reported using a dietary supplement, and for the second dependent variable, figure 1 displays frequency counts for the number of supplements used. Consistent with the first dependent measure, 658 respondents did not use a dietary supplement, while 549 (20.6%) used one, 522 (19.6%) used two, 412 (15.5%) used three, and so forth. To conserve space, the 16 respondents who reported using more than seven supplements are collapsed into the "7" category. They are not collapsed for statistical analyses.

Explanatory measures

In addition to sex, race, and age demographic variables, the study included measures of internal and external health locus of control (Wallston and Wallston 1981).[2] For internal locus of control, a four-item scale included the following statements, as included in the MIDUS 3: "Keeping healthy depends on things I can do"; "There are certain things I can do for myself to reduce the risk of a heart attack"; "There are certain things I can do for myself to reduce the risk of getting cancer"; and "I work hard at trying to stay healthy." Seven-point response options for each item included "Agree

[2]The study uses citations provided by the MIDUS 3 authors (Ryff et al. 2013–2014).

strongly," "Agree somewhat," "Agree a little," "Neither agree nor disagree," "Disagree a little," "Disagree somewhat," and "Disagree strongly." The scale yielded a Cronbach's alpha value of .645 (M = 7.74, SD = 2.98). For external locus of control, a MIDUS 3 item stated, "When I am sick, getting better is in the doctor's hands" and included the same set of response options (M = 4.22, SD = 1.77).[3]

Next, a self-esteem scale (Rosenberg 1965) included six statements from MIDUS 3: "I take a positive attitude toward myself"; "At times I feel that I am no good at all"; "I am able to do things as well as most people"; "I wish I could have more respect for myself"; "On the whole, I am satisfied with myself"; and "I certainly feel useless at times." Seven-point response options followed each item, creating an index with a Cronbach's alpha value of .838 (M = 13.55, SD = 6.96). The second, fourth, and sixth statements were reverse coded. Following self-esteem, a four-item neuroticism index (see Rossi 2001) asked respondents "How well does each of the following describe you?" and included the respective terms "Worrying," "Moody," "Nervous," and "Calm." Response options included "A lot," "Some," "A little," and "Not at all." With "Calm" reverse coded, the neuroticism index showed a Cronbach's alpha value of .715 (M = 14.74, SD = 2.49).

Regarding health perception, a five-point MIDUS 3 item asked "In general, compared to most men/women your age, would you say your health is much better, somewhat better, about the same, somewhat worse, or much worse?" (M = 2.19, SD = 0.98). A uniqueness item (Singelis 1994) stated "I enjoy being unique and different from others in many respects" and included the seven response options mentioned previously: "Agree strongly," "Agree somewhat," "Agree a little," "Neither agree nor disagree," "Disagree a little," "Disagree somewhat," and "Disagree strongly" (M = 2.76, SD = 1.46). Last, a measure of somatic amplification (Barsky et al. 1988) stated "I am often aware of various things happening within my body," with response options including "Not at all true," "A little true," "Moderately true," and "Extremely true" (M = 2.94, SD = 0.79).

Analytic strategy

This research used a three-stage approach for examining correlates of dietary supplement use. First, a Spearman correlation matrix identified bivariate associations between explanatory and response variables. Second, a four-step binary logistic regression procedure tested explanatory effects of psychosocial measures on whether respondents used a dietary supplement. Third, the study used a four-step negative binomial regression procedure to test the explanatory effects of psychosocial measures on the

[3]An acceptable index for external locus of control was not available in MIDUS 3.

second dependent variable, a measure indicating the number of supplements used on a regular basis. Poisson and negative binomial regression are appropriate when a response measure consists of counts (Nussbaum 2015: 358), and in the current analysis, because the variance of the response variable exceeded the mean (not unusual), the negative binomial model was used.

Results

Bivariate analyses

The Spearman correlation matrix shown in table 1 (with values indicated here as ρ, the Greek symbol for rho) indicates that females (a) appeared more likely to use a dietary supplement (ρ = .053) and (b) used more supplements on a regular basis (ρ = .103). Older respondents appeared more likely to use a supplement (ρ = .176), and like female respondents, they used more supplements on a regular basis (ρ = .191). Notably, older respondents also showed higher levels of external locus of control (ρ = -.282); that is, they were more inclined to agree with the statement "When I am sick, getting better is in the doctor's hands." Race did not associate with supplement use.

Examining internal locus of control, one observes a positive association with self-esteem (ρ = .254) and a negative association with neuroticism (ρ = -.087), consistent with the observations of Judge et al. (2002). Recalling that lower values in response options reflected agreement, individuals with greater internal locus of control appeared more likely to use a dietary supplement (ρ = -.084), and they used more supplements on a regular basis (ρ = -.136). In bivariate analyses, external locus of control showed no relationship with supplement use. Respondents with higher levels of self-esteem appeared more likely to use dietary supplements (ρ = -.051) and to use them in higher numbers (ρ = -.049). Neuroticism did not correlate with supplement use, but those who saw themselves as relatively healthy reported using more supplements (ρ = -.045), as did those who scored higher on somatic amplification (ρ = .059).

From a bivariate perspective, the study observed most of the associations it anticipated. Females and older respondents used more supplements, but the study did not observe greater use of supplements by White respondents. Individuals with higher levels of internal locus of control were more likely to use supplements and in higher numbers, but external locus of control did not correlate with supplement use. Respondents with higher levels of self-esteem reported more use of dietary supplements, as did individuals who viewed themselves as comparably healthy and more attuned to their bodies. Neuroticism and uniqueness did not correlate with supplement use in bivariate analyses.

Table 1. Spearman Bivariate Correlations.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Sex	1.0	.022	−.016	−.079**	.011	.027	−.111**	.042*	.093**	.014	.053**	.103**
2. Race		1.0	−.006	.002	−.026	−.004	−.001	−.004	.022	−.080**	−.020	−.031
3. Age			1.0	.015	−.282**	−.084**	.131**	−.057**	−.098**	.113**	.176**	.191**
4. Internal locus of control				1.0	.044*	.254**	−.087**	.348**	−.265**	.166**	−.084**	−.136**
5. External locus of control					1.0	−.059**	.048*	−.054**	.053**	−.097**	−.029	.011
6. Self-esteem						1.0	−.484**	.322**	−.097**	.267**	−.051*	−.049*
7. Neuroticism							1.0	−.206**	−.011	−.095**	.027	.028
8. Health relative to others								1.0	−.094**	.134**	−.010	−.045*
9. Somatic amplification									1.0	−.166**	.035	.059**
10.Uniqueness										1.0	−.027	−.028
11.Supplements taken at all											1.0	.761**
12. Number of supplements taken												1.0

Note. *$p < .05$; **$p < .01$.

Table 2. Binary logistic regression models.

	Model 1		Model 2		Model 3		Model 4	
Parameter	B	SE	B	SE	B	SE	B	SE
Male	−.249**	.092	−.232*	.093	−.252**	.097	−.242*	.098
White	.166	.160	.155	.150	.048	.161	.041	.162
Age	.037***	.004	.012	.011	.012	.012	.011	.012
Internal locus of control			−.063***	.015	−.056***	.016	−.066***	.017
External locus of control			−.391*	.159	−.413*	.166	−.436**	.166
Age x External locus of control			.007**	.002	.007**	.003	.007**	.003
Self-esteem					−.008	.008	−.013	.008
Neuroticism					−.018	.023	−.017	.023
Uniqueness					−.079*	.034	−.079*	.035
Relative health							.141*	.056
Somatic amplification							.065	.064
Constant	−1.199***	.307	.681	.747	−1.397	.859	1.064	.989

Note. SE = standard error.
*$p < .05$; **$p < .01$; ***$p < .001$.

Logistic regression analyses

Table 2 contains the results of a stepwise logistic regression analysis, with a binary dependent variable indicating whether respondents used a dietary supplement. Examining Model 1, which contains demographic controls, males appeared less likely than females to use a supplement (B = -.249, SE = .092), and older respondents appeared more likely to use a supplement (B = .037, SE = .004).

Consistent with correlation analyses, Model 2 shows that internal locus of control predicted supplement use (B = -.063, SE = .015), as did external locus of control (B = -.391, SE = .159). The latter did not show significance in correlation analyses, but in the logistic regression model, those with a greater sense of external locus of control also appeared more likely to use a dietary supplement. A significant interaction between age and external locus of control (B = .007, SE = .002) informed this unexpected pattern. Older respondents scored higher on external locus-of-control measures, and they were more inclined to use a dietary supplement. Thus the explanatory effects of external locus of control appeared contingent on respondent age.

In table 2, Model 3 contains self-esteem, neuroticism, and perceptions of uniqueness in addition to locus-of-control and demographic measures. With locus-of-control measures in the regression model, self-esteem did not show significance as an explanatory measure, nor did neuroticism. However, while correlation analyses showed no association between uniqueness and supplement use, the regression analysis indicated that respondents who reported enjoying their relative uniqueness appeared more inclined to use a dietary supplement (B = -.079, SE = .034). That pattern held in Model 4, which added perceptions of relative health and somatic amplification to variables included in Model 3. In Model 4, relative health perception predicted supplement use

(*B* = .141, *SE* = .056), with those who viewed themselves as healthier than others their age more inclined to use a supplement. Somatic amplification did not show statistical significance, although it came close.

Negative binomial regression analyses

Table 3 contains the results of a stepwise negative binomial regression analysis. Model 1 shows results similar to those observed in the logistic regression analyses; that is, males appeared to use fewer supplements than females (*B* = -.205, *SE* = .051), and older respondents tended to use more supplements than younger study participants (*B* = .015, *SE* = .002). Model 2 included internal and external locus-of-control measures, and a significant interaction between age and external locus of control once again emerged. In this model, those with higher levels of internal locus of control reported using more dietary supplements (*B* = -.047, *SE* = .009), and the explanatory effects of external locus of control depended once again on the age of respondents (*B* = .003, *SE* = .014). While external locus of control did not show significance on its own, an interactive effect did appear.

Looking to the third model in table 3, self-esteem, neuroticism, and uniqueness did not prove significant as explanatory measures, nor did relative health and somatic amplification in the fourth model. To some extent, the lack of explanatory effects among these variables and indices could be attributed to the order in which independent measures were entered. Internal locus of control emerged as one of the most consistent predictors in the regression models; it also correlated with nearly every variable. The study now offers a discussion of its quantitative results.

Table 3. Negative binomial regression models.

	Model 1		Model 2		Model 3		Model 4	
Parameter	B	SE	B	SE	B	SE	B	SE
Intercept	−.217	.173	.625	.432	.683	.472	.504	.490
Male	−.205***	.051	−.182***	.051	−.183***	.051	−.177***	.051
White	.059	.085	.048	.085	.058	.085	.061	.085
Age	.015***	·002	.005	.006	.005	.006	.005	.006
Internal locus of control			−047***	.009	−.047***	.009	−.046***	.009
External locus of control			−.153	.090	−.157	.090	−.162	·094
Age x External locus of control			.003*	.014	.003*	.001	.003*	.001
Self-esteem					.002	.005	.002	.005
Neuroticism					−.003	.012	−.002	.012
Uniqueness					−.033	.018	−.031	.018
Relative health							.020	.029
Somatic amplification							.039	.033

Note. *$p < .05$; **$p < .01$; ***$p < .001$.

Discussion

This study examined internal and external locus of control, self-esteem, neuroticism, perceived health status, uniqueness, and somatic amplification as correlates of dietary supplement use. With sex, race, and age measures also included in correlation analyses, bivariate tests showed greater supplement use among women and older respondents as well as those scoring higher on measures of internal locus of control, self-esteem, perceived health status, and somatic amplification. When binary logistic regression and negative binomial regression tested relationships in multivariate models, sex and internal locus of control showed the strongest and most consistent explanatory effects.

The current study found that women tended to use more supplements than men. In their study of supplement use among women, Conner and his colleagues (2001) identified health value and susceptibility to illness as key determinants, and the current study observes that women use supplements such as calcium and magnesium in attempting to slow bone loss, especially the loss associated with postmenopausal osteoporosis (Prince et al. 1991; Sojka 1995). It appears worth noting as well that women have been encouraged for several decades to use folic acid and multivitamins during pregnancy (Milunsky et al. 1989), and they may be more inclined to continue supplement use later in life.

In this research, individuals with higher levels of internal locus of control appeared more likely to use a supplement; they also tended to use more supplements than other respondents. The study anticipated this finding because individuals with greater internal control tend to be more proactive when it comes to maintaining or enhancing their health. They believe they have the capacity to enhance their health, and unlike externals, who might view supplement use with great skepticism, internals appear willing to purchase and use dietary supplements in higher numbers. Future research might follow the lead of Ryon and Gleason (2014) by examining locus of control not as a stable trait but as a state variable, examining how supplement use (and other health behaviors) varies based on fluctuations in control.

External locus of control interacted with age in this research, with older respondents using more dietary supplements and showing higher levels of external control. Younger respondents used fewer supplements and appeared to possess greater internal locus of control, although the study did not observe a statistically significant interaction between age and internal control measures. In addition to using more supplements, older respondents appeared more inclined to attribute their health status to the actions of others. This finding may be important in that relatively few individuals discuss dietary supplements with their doctors (see Blendon et al. 2001; Greger 2001; Jump et al. 1998; Milden and

Stokols 2004; Morris and Avorn 2003; Neuhouser, Patterson, and Levy 1999), and significant numbers of supplement users appear unaware that products may not have been tested for safety and efficacy (see Bardia et al. 2007; Carvey, Farina, and Lieberman 2012; Mason, Scammon, and Fang 2007; Pillitteri et al. 2008). If older individuals take a passive approach to supplement use instead of an active one, they may be left uninformed when issues of quality control appear, as they have in recent years.

This study also addressed somatic amplification, exploring how hypersensitivity to body sensations relates to supplement use. While general body awareness is undoubtedly a "positive," obsessiveness is not; in the context of supplement use, it may lead to overuse and adverse interactive effects with actual drugs (Abebe 2002; Fugh-Berman 2000; Wold et al. 2005). As an example, in the current research, 16 individuals reported taking eight or more supplements, and 14 (87.5%) of those individuals responded "Extremely true" to the statement "I am often aware of various things happening within my body." Of 45 individuals who reported taking seven dietary supplements, 41 (91.1%) indicated either "moderately true" or "extremely true" in response to the preceding statement. Somatic amplification may manifest itself in an excessive use of dietary supplements; that also may be true for uniqueness. Some of the individuals who report enjoying their uniqueness may reject conventional medicine in favor of natural or herbal products.

In addition to identifying correlates of dietary supplement use, the current study also identified associations among explanatory measures. As anticipated, internal locus of control correlated with self-esteem and neuroticism, supporting research by Judge et al. (2002), who suggested the three constructs may be part of a broader psychosocial construct (see also Judge and Bono 2001). Self-esteem showed a strong inverse correlation with neuroticism and positive associations with perceptions of health relative to others and enjoyment of perceived uniqueness. Internal locus of control correlated strongly with those measures as well.

In terms of limitations, the current study was unable to incorporate indices for external locus of control and somatic amplification, as their Cronbach alpha values did not show sufficient reliability. More abstract representations of the constructs may have resulted in more informative associations with dietary supplement use. The study also may have benefitted from the inclusion of basic factual questions about dietary supplements, such that possible associations between the answers and psychosocial measures could be tested. Survey items regarding sources of information may have offered perspective on where individuals learn about supplements, and future studies might examine how supplement use varies depending on where individuals obtain information.

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