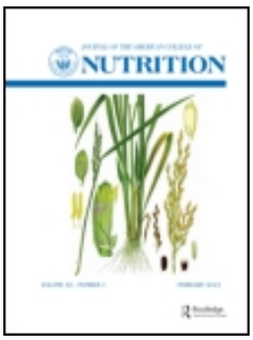

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Original Research

Baker's Yeast Beta-Glucan Supplement Reduces Upper Respiratory Symptoms and Improves Mood State in Stressed Women

Shawn M. Talbott, PhD,FACN, and Julie A. Talbott, MBA

SupplementWatch, Draper, Utah

Key words: dietary supplements, stress, beta-glucan, immune support

Objective: Several studies have shown a baker's yeast beta-1,3/1,6-D-glucan, extracted from *Saccharomyces cerevisiae*, is effective in reducing the incidence of cold and flu symptoms. This study evaluated the effect of a specific beta-glucan supplement (Wellmune) on upper respiratory tract symptoms and psychological well-being in women with moderate levels of psychological stress.

Methods: Healthy women (38 ± 12 years old) prescreened for moderate levels of psychological stress, self-administered a placebo (n = 38) or 250 mg of Wellmune (n = 39) daily for 12 weeks. We used the Profile of Mood States (POMS) psychological survey to assess changes in mental/physical energy levels (vigor) and overall well-being (global mood state). A quantitative health perception log was used to track upper respiratory symptoms.

Results: Subjects in the Wellmune group reported fewer upper respiratory symptoms compared to placebo (10% vs 29%), better overall well-being (global mood state: 99 ± 19 vs 108 ± 23, $p < 0.05$), and superior mental/physical energy levels (vigor: 19.9 ± 4.7 vs 15.8 ± 6.3, $p < 0.05$).

Conclusions: These data show that daily dietary supplementation with Wellmune reduces upper respiratory symptoms and improves mood state in stressed subjects, and thus it may be a useful approach for maintaining immune protection against daily stressors.

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INTRODUCTION

The relationship between stress and decreased immune function is well established [1–3], with psychological stress having been shown to increase susceptibility to the common cold and increased upper respiratory tract infection (URTI) episodes [3–5]. Psychological stress reduces immune cell populations, lowers antibody production, and alters cytokine responses [6,7]. Subjects reporting higher levels of psychological stress have a higher incidence and greater severity of illness [2–4].

A variety of dietary supplements have been studied for the prevention and treatment of both experimentally induced and naturally occurring colds, including echinacea [8], vitamin C [9,10], ginseng [11], vitamin E [12,13], and zinc [14], with equivocal results. In 3 previously published clinical trials, beta-1,3/1,6-glucan derived from bakers yeast (beta-glucan) has been shown to reduce the severity and duration of URTI symptoms in healthy subjects [15], physically stressed subjects [16], and healthy-stressed subjects [17]. The mechanism of action by which beta-glucan enhances the activity of innate immune cells has been extensively described [18–20] with increased survival in animals challenged with a variety of pathogens *in vivo* [21–23].

In this study, we report the effect of using beta-glucan on the physical and psychological well-being of healthy women under moderate levels of perceived psychological stress. The current study employed a series of subject self-assessment questionnaires that addressed overall health status and upper respiratory symptoms. In addition to evaluation of subjects for physical health, a psychological assessment known as the Profile of Mood States (POMS) was conducted to assess mood state. A key objective of the study was to explore how 12 weeks of beta-glucan supplementation (vs placebo) affected various moods, upper respiratory symptoms, and overall health status under conditions of moderate psychological stress.

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MATERIALS AND METHODS

Study Design

This study was done in accordance with the Helsinki Declaration, as revised in 1983, for clinical research involving humans and was approved by an external human subjects review board (Aspire IRB, La Mesa, CA). Subjects signed informed consent documents after the study details were explained. The study used a randomized placebo-controlled, double-blind design. Each subject was evaluated for inclusion and exclusion criteria and included in the study if meeting appropriate criteria, mentioned below. Subjects were randomly assigned through a random number generator to either 250 mg/d beta-1,3/1,6-glucan–containing supplement (250 mg of Wellmune WGP®) or a placebo (250 mg of rice flour); bottles were labeled with only a preassigned random code. Subjects self-administered the allotted capsule once daily in the morning at least 30 minutes before breakfast for 12 weeks. Subjects were contacted weekly to remind them to take their capsules daily and to complete survey forms at weeks 4, 8, and 12. Empty bottles were not returned after the study, but subjects were asked to report any unused capsules (an indicator of missed doses). Compliance with these instructions was high (data not shown). Participants completed a baseline POMS and health log questionnaire on the first day of the study. Subjects completed another health log and filled out a POMS assessment and a physical health questionnaire at weeks 4, 8, and 12 of the 12-week treatment period.

Subjects

Ninety female subjects were screened for "moderate" levels of perceived stress using a screening survey (77 female subjects completed the trial). The stress survey (15 questions) strongly correlates with other measures, such as the POMS [16,17,24,25], and served as a reliable screening tool for identifying subjects undergoing "moderate" levels of perceived stress. Subjects scoring 6–10 (indicating moderate stress) on this screening survey were eligible for enrollment. Inclusion criteria included healthy, asymptomatic adult women screened for moderate stress level who provided a completed informed consent form. Exclusion criteria included current upper respiratory symptoms, an inability to complete all questionnaires, low stress levels, and current use of antibiotic or other "immune" support product. The final subject pool was composed of healthy stressed women (n = 39 beta-glucan and n = 38 placebo) ranging in age from 18 to 65 (mean age: 41 ± 11 years).

Mood Assessment

We employed the POMS questionnaire [24,25] to measure 6 primary psychological factors (tension, depression, anger, fatigue, vigor, or confusion) plus the combined global mood state as an indication of subjective well-being. The POMS methodology has been used in more that 2900 studies [24], and its validity is well established. The POMS profile uses 65 adjective-based intensity scales scored on a 0–4 hedonic scale (0 = not at all, 4 = extremely). The 65 adjective responses are categorized into the 6 mood factors (tension, depression, anger, fatigue, vigor, or confusion), tabulated, scored, and analyzed. The output of the POMS questionnaire is an assessment of the positive and negative moods of each subject at baseline and at 4, 8, and12 weeks.

Health Log

The daily health log contained questions related to overall health status and 11 specific upper respiratory symptoms, including nasal congestion, runny nose, sore throat, sneezing, cough, chest congestion, fatigue, headache, fever, body aches, and general malaise. Upper respiratory symptoms were evaluated using a check box format, with frequency assessment (ranging from no symptoms to multiple symptoms per day) providing total upper respiratory symptoms for each subject. The upper respiratory symptoms reported by subjects are typical of cold and flu symptoms and analogous to self-reported symptoms measured in other studies [26–30], but they differed from some studies in which subjects were quarantined and upper respiratory symptoms clinically validated (as true viral infections) by a health care professional [31]. The study was conducted during the months of October 2008 through February 2009 (cold and flu season).

Data Management and Analysis

All questionnaires were mailed to a central location and transcribed to a central database. Subjects who did not complete the questionnaires or who submitted incomplete questionnaires were dropped from the study and not included in the study analysis. Data were identified by subject number and examined for accuracy and completeness. Tabulated data were analyzed with JMP 8.0 (SAS Institute, Cary, NC) using standard parametric paired t tests, and significance was assessed with a 2-tailed alpha level set at 0.05.

RESULTS

Compliance

Seventy-seven of 90 subjects completed the study requirements and were included in the study analysis. Reasons for dropping from the study included failure to return a completed questionnaire, providing incomplete answers to questionnaires, and failure to comply with supplementation instructions. Unused capsules were returned to the study site for subjects in the local area or verbal confirmation of compliance with dose

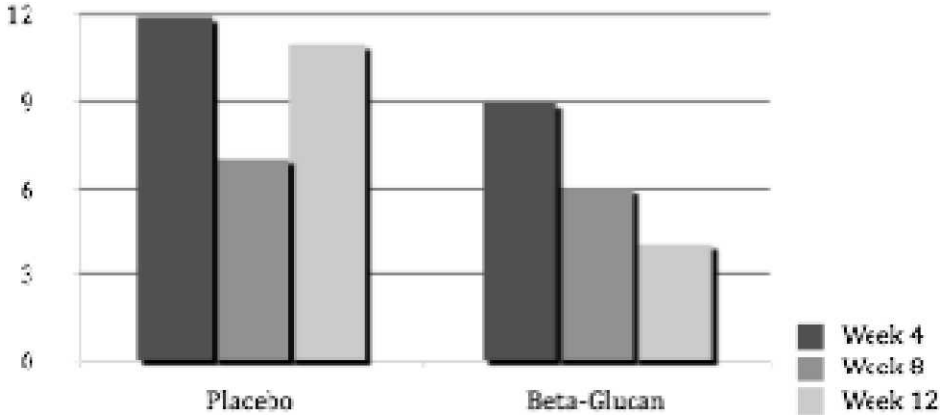

Fig. 1. Upper respiratory symptoms. Total number of subjects reporting any of 11 preselected upper respiratory symptoms at the conclusion of the study. Subjects were orally administered placebo or 250 mg beta-glucan–containing supplement daily for 12 weeks. The beta-glucan group reported fewer upper respiratory symptoms at each week (range 4–9 symptoms per week) and across all weeks (19 total) vs the placebo group (range 7–12 symptoms per week and 30 total).

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regimen was obtained; dose compliance was estimated to be close to 100%. Two subjects reported stomachaches when taking the assigned dose, but both were found to be in the placebo group; no other adverse events (other than upper respiratory symptoms, the primary outcome of the study design) were reported in this study.

Upper Respiratory Symptoms

Subjects in the beta-glucan–containing supplement treatment group had statistically significant ($p < 0.05$) improvements in measurements of physical health as indicated by fewer reported upper respiratory symptoms (days of symptoms) compared to the placebo group (Fig. 1). There were significantly ($p < 0.05$) fewer reported upper respiratory symptoms in the beta-glucan treatment group, defined as fewer people with one or more reported upper respiratory symptoms during the reporting period (4-week questionnaire period). After 12 weeks, 29% of subjects in the placebo group reported upper respiratory symptoms, but only 11% in the beta-glucan group reported symptoms (Fig. 1). The most common upper respiratory symptoms reported by subjects were sore throat, stuffy or runny nose, and cough. Other symptoms were reported infrequently or not reported at all.

POMS Assessment

The POMS assessment for psychological health strongly supported and mirrored the physical health assessment, as indicated by upper respiratory symptoms. The data analysis included an assessment of mood state at baseline (presupplementation) 4, 8, and 12 weeks after supplementation with 250 mg of a beta-glucan–containing supplement or placebo. Significant ($p < 0.05$) differences in mood state responses between the placebo and the beta-glucan treatment group were observed after 12 weeks for vigor (Fig. 2) and global mood

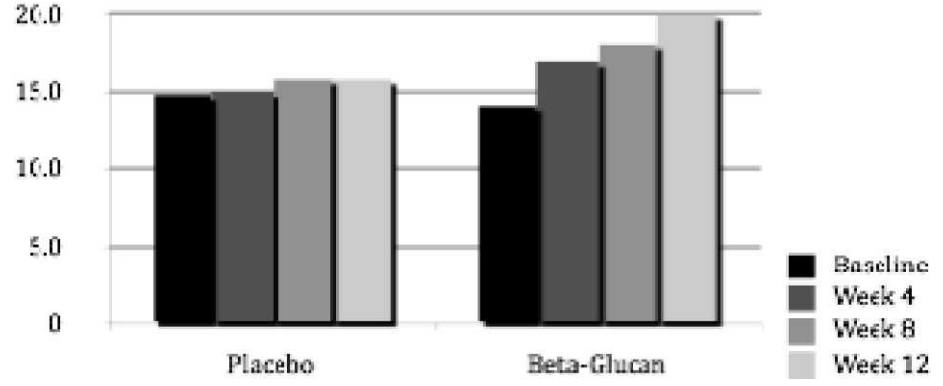

Fig. 2. Vigor score (POMS). Vigor improved 41% from baseline to week 12 in the beta-glucan group (14.1 ± 4.8 to 19.9 ± 4.7) compared to 7% in the placebo group (14.8 ± 5.5 to 15.8 ± 6.3). Vigor was significantly higher in the beta-glucan group (compared to placebo) at week 12 ($p < 0.01$) and showed a trend toward being higher at week 4 ($p = 0.08$) and week 8 ($p = 0.07$). Vigor is one of the 6 subscales of the POMS [25], encompassing physical energy, mental acuity, and emotional well-being.

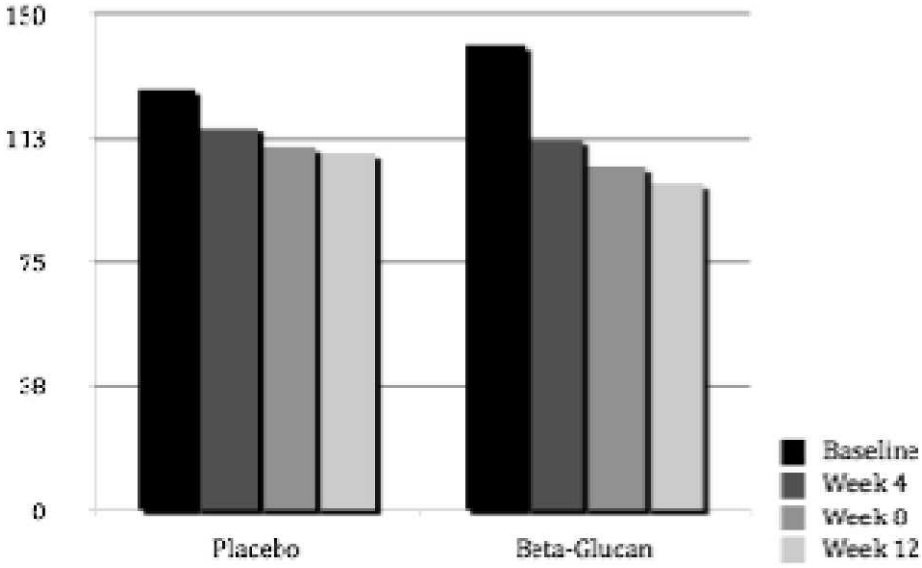

Fig 3. Global mood state score (POMS). Global mood state improved 29% in the beta-glucan group (140 ± 43 to 99 ± 19) compared to 16% in the placebo group (128 ± 37 to 108 ± 23). The global mood state was calculated based on scoring (0–4, with 0 = not at all, 2 = moderately, and 4 = extremely) answers to 58 of the 65 adjectives of the POMS (a lower number is a "better" global mood state).

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state (Fig. 3). There were no significant differences observed for other mood state subscales (tension, depression, anger, confusion; data not shown).

DISCUSSION

During the course of the 12-week treatment period, subjects supplementing their diets with a beta-glucan–containing supplement (250 mg/d) reported fewer upper respiratory symptoms (indicating better physical health) and higher overall mood state (global mood state and vigor, both indicating superior psychological health) compared to moderately stressed subjects taking a daily placebo.

Previous reports have suggested a link between chronic stress and increased susceptibility to the common cold and URTIs [3–5]. In the current study, moderately stressed participants in the beta-glucan treatment group self-reported fewer upper respiratory symptoms (Fig. 1) as well as a more positive psychological assessment (Figs. 2 and 3) than did subjects receiving placebo during a 12-week treatment period. The reduction in upper respiratory symptoms reported here is similar to those reported in other trials evaluating the effect of bakers yeast–derived beta-1,3/1,6-glucan on upper respiratory symptoms of healthy and physically stressed individuals [15–17]. This strongly suggests that bakers yeast beta-glucan is able to counteract the negative effects of stress on the immune system, which can increase susceptibility to upper respiratory symptoms. A possible weakness of the current study is that our assessment of the incidence of upper respiratory symptoms was based on self-reported symptoms. Although symptom self-reports are routinely employed in field studies of URTI incidence [15–17,27–30], others have verified symptomatology using viral identification or clinical examination [31].

Bakers yeast beta-glucan has been shown to bind to specific receptors on innate immune cells (CR3), priming them to be more effective in killing opsonized foreign challenges [20]. This binding site preferentially recognizes bakers yeast–derived beta-1,3/1,6-glucan over other forms of beta-glucans, resulting in a significantly higher level of immune system activation as compared to other immune modulators in an *in vivo* murine mouse model system [32]. The specificity of the activation mechanism [33] and preferential binding of bakers yeast beta-glucan on the CR3 receptor site on innate immune cells [34] also explains the lack of effect on URTI symptoms reported with cereal-derived beta-glucan supplementation [35].

The results of the POMS survey (Figs. 2 and 3) suggest that the reduction in upper respiratory symptoms (Fig. 1) for the beta-glucan group resulted in an improvement of various psychological factors that could be directly related to an individual's state of physical well-being (vigor and global mood state, with a trend for improvements in fatigue). It is interesting to note that although trends ($p < 0.10$) were found for the beta-glucan group on measures of fatigue at week 8 ($p = 0.08$) and week 12 ($p = 0.07$) and vigor at week 4 ($p = 0.08$) and week 8 ($p = 0.07$), statistically significant differences in mood state parameters did not emerge in the current study until 12 weeks of supplementation (Figs. 2 and 3). In previous trials of physical stress [15] and high psychological/lifestyle stress [16] we found mood state improvements with beta-glucan as early as 4 weeks. This may be due to differences in overall stress load between the subjects in this trial vs those in the

previous studies. It is possible that elevated levels of physical or psychological stress lead to a more severe suppression of immune system function and thus sets the stage for a superior/faster benefit of beta-glucan to restore normal immune function (i.e., the higher the stress load, the greater immune system suppression and the more benefit beta-glucan provides).

It is logical to speculate that the subjects in the placebo groups who experienced increased prevalence of upper respiratory symptoms "felt worse" physically, and this was then reflected in their psychological assessment. Conversely, subjects taking beta-glucan reported lower levels of upper respiratory symptoms and "felt better," which was then reflected in the psychological assessment techniques. The lack of an impact on certain mood state subscales (tension, depression, anger, confusion) is not surprising since yeast beta-glucan should not have a psychoactive effect, and the increases in vigor and global mood state (analogous to "overall psychological well-being") can be explained as a logical result of improvement in physical well-being.

CONCLUSION

This study shows that improving immune system function with bakers yeast beta-glucan has a noticeable effect on maintaining health and a positive mental attitude in psychologically stressed women. Daily supplementation with a beta-glucan–containing supplement reduced the incidence of upper respiratory symptoms and improved psychological well-being. Additional research is needed to investigate the mechanism(s) by which baker's yeast-derived beta-glucan improves immune function and psychological well-being in response to various sources of physical and psychological stress.

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