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A SYNBIOTIC INTERVENTION TO IMPROVE WELL-BEING AT WORK

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ABSTRACT

Background: There has been extensive research on the effects of probiotics and prebiotics. Research is now examining them in combination (synbiotics), which was done in the present study. There has been no previous research on the effects of synbiotics on well-being at work, which was investigated here. **Methods**: Fourteen participants from a third-sector charity completed the Well-being Process Questionnaire before and after a 6-week intervention involving the consumption of kefir and a prebiotic mixture. **Results**: The results showed that several aspects of well-being significantly improved after consumption of the synbiotic drink. The participants reported feeling less sleepy during the day and more immersed in their work. They also reported higher life satisfaction and greater flourishing (thriving). **Conclusion**: This is the first study to demonstrate the benefits of a synbiotic drink for the well-being of workers. Further research with appropriate comparison conditions is required to identify what produces such effects. Including gut microbiome assays will also help determine the underlying biological mechanisms.

KEYWORDS: Probiotics, Prebiotics, Synbiotics, Kefir, Well-being at work; Daytime sleepiness; Flow; Flourishing; Life satisfaction.

INTRODUCTION

In 2001, the Food and Agriculture Organization (FAO) of the United Nations, in collaboration with the World Health Organization (WHO), convened a panel of experts tasked with establishing a clear definition for probiotics. Their efforts culminated in the

seminal publication delineating probiotics as "Live microorganisms which, when administered in adequate amounts, confer a health benefit on the host".[1] This definition was later subtly updated by the International Scientific Association for Probiotics and Prebiotics (ISAPP), which replaced "which" with "that" to offer a consensus statement[2] that is still accepted as the official definition to date.

Prebiotics are selectively fermented ingredients that allow specific changes in the composition and/or activity of the gastrointestinal microbiota that benefit host well-being and health.[3] These typically comprise non-digestible fibres that foster advantageous gut bacteria proliferation or metabolic activity, notably *Bifidobacteria* and *Lactobacilli*.[4,5] Furthermore, the fermentation of prebiotic fibres by these beneficial bacteria in the colon produces short-chain fatty acids (SCFAs) such as butyrate, acetate, and propionate. These SCFAs are recognised for their potential systemic anti-inflammatory properties.[6] They supply energy and trophic factors to colonocytes,[7] modulate T regulatory (Treg) cell colonies,[8,9] and exert crucial physiological effects on several organs, including the brain, via the bidirectional communication system known as the gut-brain axis.[10-14] There is also a growing body of evidence indicating that health-promoting gut bacteria can exert a range of antagonistic effects against pathogens, suggesting that augmenting their numbers could help thwart the colonisation of pathogens, thereby enhancing the gut's defensive mechanisms. Enhancing the population of native *Bifidobacteria*/*Lactobacilli* through prebiotic intake, therefore, could bolster this protective barrier.[15,16]

Synbiotics were formally defined by the ISAPP in 2020 as "a mixture comprising live microorganisms and substrate(s) selectively utilised by host microorganisms that confer a health benefit on the host", wherein the prebiotic component selectively favours the probiotic organism, thereby enhancing its survival and adherence in the gastrointestinal tract.[17] The concept is based on the premise that using substances from both categories can have a more beneficial effect on the host's health than either one alone.[18]

Probiotics are not solely confined to food supplement capsules and powders. They are also naturally present in fermented dietary sources such as kefir, a rich consortium of live microorganisms with a wide array of potential health benefits.[19,20] Originating from the Caucasus and Tibet, Kefir is a fermented milk drink featuring renowned lactic acid bacteria that coexist in synbiotic association with other microorganisms in kefir grains, including other bacteria and yeast.[21] Kefir has raised interest in the scientific community due to its

unique microbiological profile. The most predominantly found bacterial species in kefir grains are *Lactobacillus kefiranofaciens*, *Lacticaseibacillus paracasei* (basonym *Lactobacillus paracasei), Lactiplantibacillus planatarum (basonym Lactobacillus plantarum*), *Lactobacillus acidophilus*, and *Lactobacillus delbrueckii* subsp. *bulgaricus*. On the other hand, *Saccharomyces cerevisiae*, *S. unisporus*, *Candida kefyr*, and *Kluyveromyces marxianus* ssp. are the most commonly found species of yeast in kefir.[22,23] Our study used a synbiotic drink that combined goats milk kefir with a wholefood powder containing 18 different types of prebiotics, including fructooligosaccharides (FOS) from beetroot,[24] beta-glucans, chitin and mannan from maitake mushroom,[25-27] isomaltooligosaccharide (IMO) from miso,[28] glycyrrhizans and glycyrrhizin from liquorice root,[29,30] arabinan from quinoa,[31] xylan and galactan from spirulina,[32,33] arabinoxylan and cellulose/hemicellulose from psyllium husk,[34] resistant starch from arrowroot,[35] inulin from chicory,[36] xyloglucan from tamarind,[37] pectin from orange peel,[38] xylooligosaccharides (XOS) from rice bran,[39] guar bean,[40] and galacto-oligosaccharides (GOS) from chickpeas.[41]

Despite the burgeoning body of research on probiotics and prebiotics, with bibliometric data of November 2023 revealing 45,643 and 14,820 indexed papers compared to 760 and 672 prior to 2001, respectively, the intersection of these interventions with occupational health remains curiously underexplored. Specifically, literature examining the influence of probiotics and prebiotics on employee well-being within the workplace is sparse. This gap in the evidence base is even more pronounced when considering synbiotics, a nascent term in scientific discourse, for which there are a mere 2,696 entries - compared to 19 prior to 2001 - and not a single one addressing their impact on workplace well-being. This represents a significant knowledge gap, given the potential implications for enhancing the health and productivity of the workforce through nutritional interventions. Well-being at work is a multifaceted construct that includes factors such as stress levels, job satisfaction, and overall mental health.

Since synbiotics could potentially influence systemic and neurological functions through gut microbiota modulation, exploring their impact on employees' well-being could reveal significant occupational health insights. However, there is a notable absence of studies investigating this connection within the work environment context. This notable oversight is an incentive for the present study, designed to elucidate the potential impact of synbiotic supplementation on employee well-being. By navigating this uncharted territory, our research

aims to illuminate whether integrating synbiotics into the diet could represent a feasible strategy to foster the health and productivity of workers, thereby contributing to a more resilient and thriving workforce.

One important feature of recent research has been the conceptualisation of well-being in terms of a well-being process with positive and negative predictors and outcomes.[42, 43] The Well-being Process Questionnaire (WPQ) was developed to measure the different components of this well-being process model. This questionnaire has been used with the general working population and workers in specific occupational sectors.[44-72] The results from these studies have shown that positive outcomes (e.g., positive affect, happiness, life and job satisfaction) are predicted mainly by positive individual (e.g. psychological capital – optimism, high self-esteem, and high self-efficacy) characteristics and positive job characteristics (e.g., social support and control over work), and to a lesser extent, by the absence of negative characteristics (e.g., negative coping and high job demands). Negative outcomes (e.g., negative affect, fatigue, stress, anxiety and depression) are predicted by the opposite profile of individual and work characteristics.

An essential feature of the WPQ is that other questions can be included to examine associations between the well-being process and other factors. Recent studies have used the WPQ to examine associations between well-being and health-related behaviours (HRBs) of adolescents, university students, and working adults.[73-78] The current study was conducted within an organisation in the third sector, recognising that charity workers are often exposed to higher stress levels and burnout. Third-sector work frequently involves emotionally charged environments, high demands, and resource constraints, increasing stress levels. This organisational stress impairs well-being and can lead to burnout, a state of physical, emotional, and mental exhaustion caused by prolonged and excessive stress. Investigating synbiotics within this cohort is particularly relevant because of the potential for these interventions to mitigate some of the occupational stressors inherent in the third sector, thereby supporting the health and well-being of this workforce.

METHOD

The ethics committee of the School of Psychology approved the research (EC.23.03.07.6755R), and it was carried out with the informed consent of the participants.

Participants

Sixteen workers were recruited and provided baseline survey data. Fourteen workers (3 male and 11 female) completed the intervention and the post-intervention survey.

Procedure

As part of the study, one of the researchers co-created a "gut-brain health" corner in the participants' office kitchen, where participants had access to two food blenders and all food ingredients required to make a "gut-brain smoothie," namely goat's milk kefir and the multi-fibre prebiotic. Detailed instructions on how to make the synbiotic drink were also displayed in this area. The "gut-brain health" corner was available for the duration of the study, i.e., six weeks. Some participants were hybrid workers, so they collected the necessary ingredients and instructions from the gut-brain corner whenever they were in the office.

Synbiotic Drinks

All drinks were made using 170ml of goat's milk kefir[79] and 10g of "Complete Prebiotic"[80] provided by Chuckling Goat Ltd. The kefir and the complete prebiotic powder were blended with a banana to provide a more palatable participant experience and a better, creamier texture.

Well-being Process Questionnaire

The version of the WPQ used in the study is shown in the Appendix.

RESULTS

Baseline data

Initial analyses examine whether the usual associations between established predictors and outcomes were obtained. The presence of these associations demonstrates that the power of the study was appropriate and gives one more confidence in any novel findings. Positive well-being was correlated with a healthy lifestyle, control over work and high social support. It was negatively correlated with job demands and negative coping (wishful thinking, avoidance and self-blame). Negative well-being was positively associated with high job demands and negative coping and negatively correlated with social support, positive coping (solving the problem, getting support from others) and psychological capital (being optimistic, having high self-esteem and self-efficacy). In summary, the present sample showed the profile of associations predicted by the well-being process model.

Adverse effects of the intervention

The only adverse effect some volunteers reported was increased gas in the first few days of the intervention. Such effects are frequently found in studies involving probiotic and prebiotic interventions.

Changes from baseline to post-intervention

T-tests were used to compare the scores for the outcome variables at baseline and post-intervention. These analyses showed that after the intervention, the participants were significantly more satisfied with life, felt more flourishing, were more immersed in their jobs, and were less sleepy. These results are shown in Table 1.

Table 1: Significant differences between baseline and post-intervention scores.

Outcome variable	Mean	s.e.	t-value	p
Sleepy during the day - baseline	6.92	0.56	2.94	<0.05
Sleepy during the day - post	5.31	0.41		
Immersed in job-baseline	6.43	0.51	-2.25	<0.05
Immersed in job - post	7.21	0.31		
Flourishing - baseline	6.71	0.42	-2.21	<0.05
Flourishing – post-intervention	7.07	0.45		
Satisfied with life - baseline	6.50	0.34	-3.02	<0.01
Satisfied with life - post	7.29	0.52		

Other analyses compared job and individual characteristics ratings from baseline and post-intervention. These scores were not significantly different, suggesting that the significant effects in Table 1 reflect the intervention rather than changes in the nature of the job or other changes in individual characteristics.

DISCUSSION

The present results are the first to demonstrate the effect of a synbiotic drink containing both probiotic and prebiotic active ingredients. The outcomes examined well-being at work; this is the first study to investigate this topic. Commercially available probiotic and prebiotics were used, and the drink was consumed during the working day. Significant effects of the intervention were observed in several important domains. The workers felt more alert during the day and engaged more with their work. The benefits also extended beyond work; they felt a greater sense of thriving and were more satisfied with life.

The present study used a small sample, and their results at baseline confirmed the profile of associations observed in previous surveys using the WPQ. The present results provide

essential information on the sample size needed in future research. Further research on the effects of synbiotics on well-being is required because the present study had some limitations. First, there was no placebo control group. Secondly, the effects of the drink's components (the probiotic and prebiotic) were not examined. While the precise biological mechanisms underlying our observations remain undetermined, the gut-brain axis presents a plausible conduit through which these effects may be mediated.[81,82] However, the intricacies of this relationship cannot be fully discerned from the current study alone. The gut microbiome was not measured, and underlying biological mechanisms were not identified. It should also be noted that the consumption of fruit has been associated with increased well-being[83], and a condition without fruit should be included in future research.

In conclusion, the present study is the first to demonstrate increased well-being at work and in life generally following the consumption of a synbiotic drink containing kefir, a prebiotic mixture and a banana. Further research with appropriate comparison groups is now required to identify which factor(s) produce the improvement in well-being. In addition, using a gut microbiome assay will enable one to assess underlying mechanisms.

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Appendix

The short form Well-Being Process Questionnaire for Workers

Please answer the following questions about how you have felt and behaved in the last month.

(All questions answered on 10 point scale or Yes/No)

A healthy lifestyle involves taking exercise, eating a balanced diet, not smoking, not drinking excessive amounts of alcohol, and not being overweight. To what extent do you have a healthy lifestyle?

1 Not all to 10 very much so

I feel that my work is too demanding (for example, I have to work very fast, I have to work very hard, I have conflicting demands).

1 Disagree strongly to 10 Agree strongly

I feel that I get adequate control over my work (for example, I have a choice in what I do or how I do things).

1 Disagree strongly to 10 Agree strongly

Is the noise in your work environment too loud?

1 Not all to 10 very much so

To what extent do you feel stressed at work?

1 Not all to 10 very much so

How satisfied are you with your job?

1 Not all to 10 very much so

I do my work efficiently.

1 Not efficiently to 10 Extremely efficiently

Have you had an illness caused or made worse by work?

- Yes
- No

Do you ever come to work when you are feeling ill and know you can't do your job as well as you like?

1 Never to 10 Very often

I have been experiencing positive feelings (e.g. feeling happy, satisfied with life, in good spirits, feeling good about relaxation, being able to relax, and feeling energetic and interested).

1 Disagree strongly to 10 Agree strongly

I have been experiencing negative feelings (e.g. feeling stressed, feeling physically or mentally tired, and feeling emotionally drained).

1 Disagree strongly to 10 Agree strongly

I feel that I have the social support I need (e.g. people to talk to, support for financial needs, friendship, and someone to discuss problems with).

1 Disagree strongly to 10 Agree strongly

When I'm in a stressful situation, I try to solve the problem or look for support from others.

1 Disagree strongly to 10 Agree strongly

When I am in a stressful situation, I blame myself or wish for things to improve or avoid the problem.

1 Disagree strongly to 10 Agree strongly

To what extent do you feel you have a high level of resilience (can cope and recover from adverse events)?

1 Not all to 10 very much so

I am optimistic and confident in my ability to solve problems, and I am generally satisfied with myself.

1 Disagree strongly to 10 Agree strongly

Does life outside of work interfere with your work, and work interferes with other aspects of your life?

1 Not all to 10 very much so

Do you have a high workload that makes you feel stressed and could affect how efficiently you do your work?

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1 Not all to 10 Definitely Yes

How often do you feel sleepy during the day?

1 Never to 10 All the time

In general, how would you rate your physical health?

1 Extremely poor to 10 Extremely good

To what extent do you feel immersed in your work and have full involvement and engagement with it?

1 Not all to 10 Very much so

To what extent do you feel you are thriving or flourishing (e.g. being successful, feeling that life is going well, and having a sense of belonging)?

1 Not all to 10 Very much so

If you think about work in your free time, does it have a negative effect (e.g. makes you tense and troubled), or does it help to solve problems?

1 Negative effect to 10 positive effect

How stressful is your life?

1 Not at all to 10 Extremely

How satisfied are you with life?

1 Not at all to 10 Extremely

To what extent have you been feeling anxious?

1 Not at all to 10 Extremely so

To what extent have you been feeling depressed?

1 Not at all to 10 Extremely so