The effects of probiotic supplementation on emotional memory and pain response

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INTRODUCTION

The human intestinal microbiota is the ecological community of micro-organisms that share our gastrointestinal tract (1). Increasing evidence suggests a mediating relationship exists between gut microbiota activity and brain function (2). Recent research has shown that probiotic administration is capable of altering brain activity in regions controlling central processing of emotion and sensation when compared to a placebo (3).

AIMS

To aims of the present study were to;

1) Evaluate any potential modulating effect of probiotics on emotional memory and fear, and
2) Assess any potential modulating effects of probiotics on acute peripheral pain tolerance

HYPOTHESIS

It was hypothesised that a 6 week intervention of probiotic administration would moderate;

- Emotional memory processing and anxiety
- Acute peripheral pain sensitivity/tolerance and immune function measures and reactivity to a painful event.

METHODOLOGY

A total of 60 participants (aged 18-40 years, mean 24.08 ± 3.90 years) completed a randomised, double-blind, placebo controlled intervention trial. The study followed a between groups design with 30 participants allocated to receive probiotic treatment and 30 to receive placebo.

TREATMENT

Probiotic; 1 capsule per day (LAB4®, 5 x 10^{10} CFU daily), containing;

- *Lactobacillus acidophilus* CUL60 (NCIMB 30157)
- *Lactobacillus acidophilus* CUL21 (NCIMB 30156)
- *Bifidobacterium lactis* CUL34 (NCIMB 30172)
- *Bifidobacterium bifidum* CUL20 (NCIMB 30153).

Placebo; 1 capsule per day (maltodextrin).

MEASURES

Emotional memory: Remember, Know, Guess (RKG) task, which involves the presentation and recall of neutral and negative emotionally arousing images (4).

Anxiety: State-Trait Anxiety Inventory (STAI) questionnaires; 40-item questionnaire that assesses in the moment (state) and general (trait) anxiety (5).

Pain response: cold pressor test (CPT), which involves the submergence of one's hand into a cold water bath set to 1°C (6). Pain threshold, removal of hand, and pain tolerance (7) were measured. Subjective pain score was measured using a visual analogue scale.

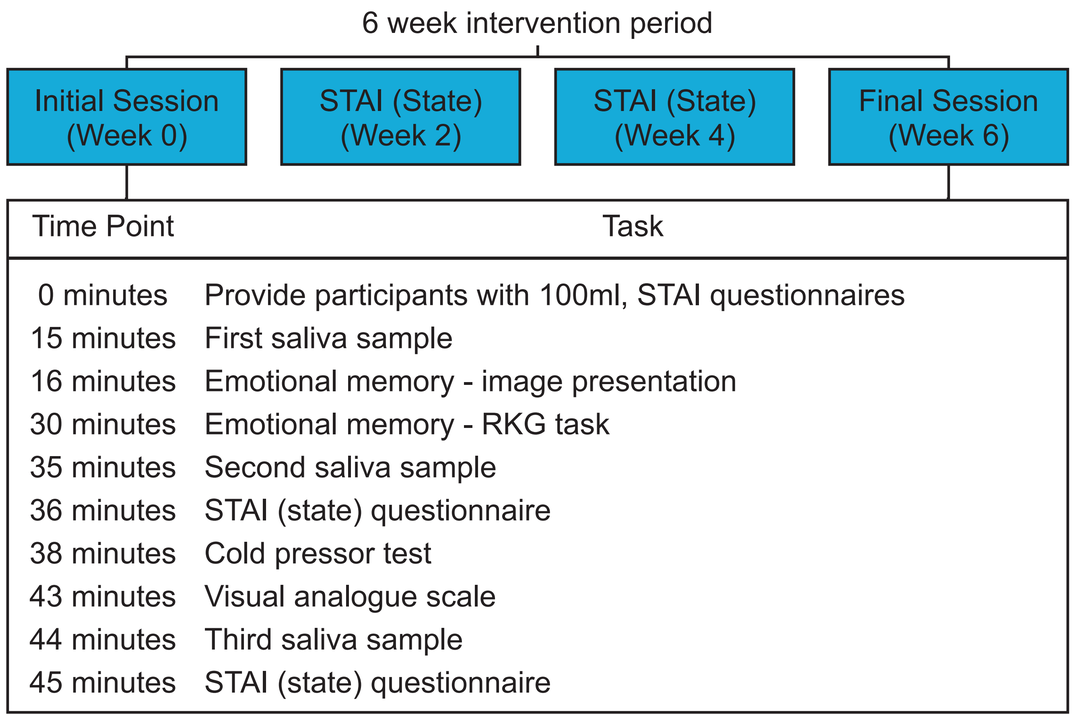
Immune function: secretory immunoglobulin A (sIgA) (8), collected using a Salivette®.

PROCEDURE

Participants attended the lab on 2 occasions. They were required to provide a baseline saliva sample and STAI questionnaires. Participants then completed a RKG task, and provided a second saliva sample and STAI (state) questionnaire. Finally, a CPT was conducted, and a final saliva sample and STAI (state) questionnaire completed. Testing sessions lasted approximately 45 minutes.

At weeks 2 and 4 during the 6-week intervention period, participants were contacted via email to complete a STAI (state) questionnaire. At the end of the treatment period, participants were asked to attend the second lab session, which followed the same procedure as the initial session. See Figure 1.

FIGURE 1. INTERVENTION PROCEDURE.



RESULTS

EMOTIONAL MEMORY

The probiotic group recalled significantly more negative images compared to placebo (P=0.022, Graph 1.a.). This effect was more pronounced in female participants (P=0.009, Graph 1.b.).

ANXIETY

Significant increase in STAI (state) anxiety post-RKG task (P<0.001) and post-CPT (P=0.008). There was a significant reduction in trait anxiety in both groups post-treatment (P=0.007). There was no overall treatment effect.

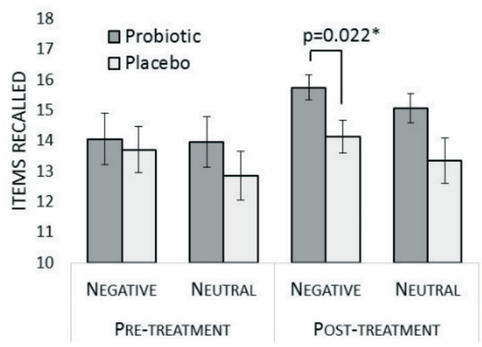
PAIN RESPONSE

For male participants only, pain threshold was significantly reduced post-treatment under the placebo condition (-3.687 second, P=0.027, Graph 1.c.). This could highlight a potential protective effect of probiotic treatment on pain threshold.

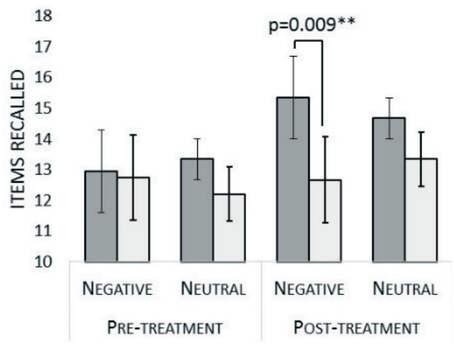
IMMUNE FUNCTION

There was a significant reduction in sIgA secretion rate post-CPT, when compared to baseline (-21.097µg/mL, P<0.001) and post-RKG task (-25.908µg/mL, P<0.001). There was no treatment effect.

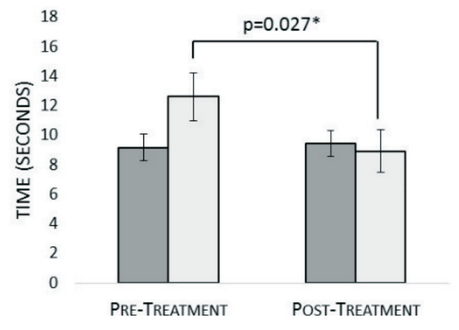
GRAPH 1.a. REMEMBER RESPONSES PRE AND POST TREATMENT.



GRAPH 1.b. REMEMBER RESPONSES PRE AND POST TREATMENT IN FEMALES.



GRAPH 1.c PAIN THRESHOLD PRE AND POST TREAMENT IN MALES.



CONCLUSION

A recent study examined the effects of probiotic administration utilising functional magnetic resonance imaging before and after probiotic intervention to measure brain response to an emotional attention task and resting brain activity (3). In this study, probiotic intake was associated with reduced task-related response of a distributed functional network containing affective, viscerosensory, and somatosensory cortices. In the present study, augmented recall of highly negative valiant stimuli in the probiotic treatment group was observed. Our findings also indicated altered activity of brain regions that control central processing of emotional stimuli.

It has been shown that individuals with microbial imbalance (overgrowth of 'bad' bacteria), e.g. in irritable bowel syndrome, is often accompanied by hyperalgesia (a heightened sensitivity to pain, particularly in the extremities), with probiotic administration helping to reduce severity (9,10). The observations of Tillisch *et al*. that probiotics may reduce activity in somatosensory brain regions also lead to the hypothesis that probiotics may have some modulating effect in the somatosensory processing of pain in healthy samples. The findings of the present study indicate that probiotic administration may have the capacity to stabilise pain threshold in healthy male participants exposed to experimentally induced pain. No concomitant effect on IgA was observed, however, this initial data warrants further investigation to substantiate these findings.

The University Of Sheffield.

Test supplements were provided by Cultech LTD

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