Effect of Medically Supervised Prolonged Fasting Therapy on Vitamin D, B12, Body Weight, Body Mass Index, Vitality and Quality of Life: A Randomized Control Trial

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ABSTRACT

BACKGROUND: Recent research indicates prolonged fasting for more than 7 days is beneficial in priming the vitamin D metabolism. However, methodological limitations in previous studies, such as insufficient sample size and a lack of control group, limits its generalizability. The present study evaluated the impact of prolonged fasting (10 days) on vitamin D, vitamin B12, body mass index (BMI), weight, hemoglobin, vitality and quality of life (QoL) compared to a normal diet.

METHODS: This randomized control trial was conducted in an in-patient private yoga and naturopathy setting between February and April 2022. A total of 52 participants (mean age 51.57 ± 13.67 years) with varying medical conditions were randomized into a fasting group (FG) or a normal diet group (NDG) with 26 participants in each group. The FG was on a fasting diet (500 KCal/day) which included holy basil herbal tea, lemon honey water, and water (3L). The NDG (1500 KCal/day) consumed a routine diet that included Indian bread, pulses, steamed rice, vegetable salads, and beverages.

RESULTS: The FG has shown significant increase in the Vitamin D levels (P = .003, d = 0.475), vitality (P = .006, d = 0.425), physical QoL (P < .001, d = 0.549), psychological QoL (P = .002, d = 0.488), and environmental QoL (P = .004, d = 0.457) compared to NDG. No significant changes were observed in vitamin B12, weight, BMI, haemoglobin, and social QoL. A weak to moderate (ρ = 0.330-0.483) positive correlation was observed between vitality scores and QoL domains, whereas BMI scores showed an inverse correlation (ρ = −.280) with vitamin D levels.

CONCLUSION: The results suggest that prolonged fasting for 10 days can improve vitamin D levels, improve vitality, and promote quality of life compared to a normal diet. Unlike previous studies, the FG does not differ from the NDG concerning weight and BMI. Nevertheless, fasting may be utilized as an effective tool to tackle vitamin D deficiency and associated health insufficiencies.

KEYWORDS: Vitamin D deficiency, fasting, diet, therapeutic fasting, vitality, quality of life

Introduction

Therapeutic fasting is increasingly becoming popular among scientists, physicians, and patients owing to its health benefits. The role of fasting in the prevention and management of various cardio-metabolic, musculoskeletal disorders is widely reckoned.¹ Except for a few studies, majority of the reports on fasting have reported the efficacy of intermittent fasting (lasting for 16–48 hours) or calorie restriction but not on prolonged fasting (more than 4 days).²³ Prolonged fasting is defined as a medically supervised fasting regimen that lasts for a minimum of 7 to 21 days with an average calorie intake of 200 to 500 kcal nutritional intake per day.⁴ Fasting has potential therapeutic benefits, it has shown to reduce body weight,⁵ body mass index (BMI), adiposity,⁶ inflammation,⁷ blood pressure, cholesterol, regulate blood sugar, insulin, glycaated hemoglobin,⁸ etc. Hence, fasting is viewed as a therapy with homeostatic potential.

Similarly, numerous observational studies have linked vitamin D deficiency as one of the primary precursors in cancers, immune disorders, metabolic disorders and neurodegenerative disorders, substantiating the transformation of vitamin D from a mere micronutrient to an essential element in preserving health.⁹ Previous data suggests that a hypocaloric diet that induces weight loss can improve the vitamin D status among patients.¹⁰ Arankale et al and Żychowska et al has reported that fasting can improve the circulating levels of vitamin D and has an impact on its metabolites as well.¹¹ However, both these studies were conducted on healthy volunteers without a control group.

It will be interesting to study the impact of prolonged fasting on the vitamin D levels of participants with different diseases, as fasting is widely practiced as a therapeutic, cultural, and religious practice. Further, the association of prolonged
fasting with vitality and quality of life is an unexplored domain. Fewer studies have reported fasting to act as a mood enhancer in pain,4 moderately relieve stress, anxiety, depression,12 and offers rewarding psychological experiences.13 However, all the previous reports necessitate the need for future randomized controlled trials. Further barring Ramadan fasting and calorie restriction, the impact of prolonged fasting on health indices like weight, BMI etc were not studied on individuals with various medical co-morbidities.

This study hypothesized that a 10 days prolonged fasting program will increase the vitamin D levels, Vitamin B12 levels, enhance the vitality, quality of life, reduce body weight, and BMI.

Methods

Study setting, study period, and ethical considerations

This study was conducted at a private yoga and naturopathy medical college hospital in India between February and April 2022. The study was approved by the institutional ethics committee via (P.No:12/SHMCNYS-IEC/P45/2021-2022) and registered in the Clinical Trials Registry of India CTRI/2022/02/40446. Written informed consent was obtained from all participants prior to participation in the study.

Study design

This was a pragmatic, parallel group, randomized controlled trial (n = 52). Eligible participants were randomized by the study coordinator at a ratio of 1:1 using computer random software into fasting arm or the normal diet arm. Figure 1 depicts the trial profile.

Inclusion and exclusion criteria. The study participants were those volunteers with diverse medical conditions enrolled in a 10-day lifestyle modification program that includes yoga and naturopathic interventions like hydrotherapy, mud therapy and yoga therapy at the inpatient department of a private yoga and naturopathy hospital. Both men and women aged 19 to 74 years participated in this program. All the patients who were underweight, with known nutritional deficiencies and psychiatric disorders were excluded from participating in this study. Any participants who have a previous history of fasting for more than 10 days in the last 6 months were also excluded from the study. Participants were also excluded if they are a part of any other clinical trial or following any dietary regimen both the study group and the control group received yoga and naturopathy therapies like hip bath, cold water enema, and mud packs to the abdomen and eyes which are intended to promote elimination.

Outcome measures

Baseline characteristics. Demographic characteristics like age in years, gender, height in centimeters, weight in kilogram, body mass index, socioeconomic status (as a categorical variable using the Kuppuswamy scale14), habits like smoking and alcohol, use of medications (as a categorical variable yes or no) and details on provisional diagnosis were collected at the baseline.

Biochemical measures. Blood samples were collected from both the study group at baseline and on the 10th day after intervention to evaluate the changes in the following biochemical parameters.

Vitamin D. Serum levels of vitamin D were measured using a fully automated Chemi Luminescent Immuno Assay. A vitamin D level of 30 to 100 ng/mL is considered to be within the normal range.

Vitamin B12. Serum levels of vitamin B12 were measured using a fully automated bi-directionally interfaced Chemi Luminescent Immuno Assay. A vitamin B12 level of 211 to 911 pg/mL is considered to be within the normal range.

Hemoglobin. The hemoglobin levels of the participants were measured using the Sodium lauryl sulfate hemoglobin method. The normal hemoglobin level ranges from 12 to 15 g/dL.

Anthropometric measures. Anthropometric measures collected were weight (Omron HN 286 Ultra Thin Automatic Personal Digital Weight Scale) and body mass index (BMI = kg/m² where kg is a person’s weight in kilograms and m² is their height in metres squared).

Psychological measures

Quality of life. Quality of life was measured using the World Health Organization Quality of Life (WHO-QoL BREF)
instrument, which measures the quality of life in 4 domains, viz., physical, psychological, social, and environmental planes.\textsuperscript{15}

\emph{Vitality.} Vitality, defined as the innate power to heal and to be resilient\textsuperscript{16} was measured using a visual analog scale (VAS) on a scale of 1 to 10, with “0” representing low vitality and “10” representing high vitality.

\textbf{Statistical analysis.} All the data were analyzed using Jeffreys’s Amazing Statistics Program (JASP) version 0.16. Shapiro’s Wilk’s test was used to test the normality of the data. Wilcoxon sign-rank test (within the group testing) and Mann-Whitney test (between the group testing) were used to analyze the non-normally distributed data, where as paired T test and Independent T test were used for analyzing the normally distributed samples.

The study results are published as a preprint before peer review and can be accessed from: https://www.medrxiv.org/content/10.1101/2022.04.08.22273614v1.full

\textbf{Results}

Of the 103 individuals screened for the trial, \(n = 52\) were randomized to the fasting (\(n = 26\)) or control groups (\(n = 26\)). All 52 participants completed the study without any adverse events. A Chi-square test revealed there was no significant difference in the baseline characteristics between the study groups except for socioeconomic status. The baseline characteristics are tabulated in Table 1.

\textbf{Changes in the body weight and BMI}

The changes in body weight (\(P = .51\)), BMI (\(P = .99\)) were not significant in the fasting group compared to the control group. A within-group analysis, however, revealed that weight and BMI changes were significant (\(P < .001\)) before and after the intervention in both the fasting and control groups.
Changes in Vitamin D, Vitamin B12, and Hemoglobin

Significant increase in the levels of vitamin D ($P = .003$) was observed in fasting group compared to the control group. A within group analysis between the mean values before and after the intervention has shown a significant increase in the vitamin D levels ($P < .001$) in the fasting group. However, the changes in vitamin D remained insignificant ($P = .23$) in the control group. The changes are depicted in Figure 2.

The changes in the vitamin B12 levels ($P = .40$) and hemoglobin ($P = .77$) were not significant in the fasting group compared to the control group. Similar observations were also observed when compared within the group. The mean changes in these parameters from the baseline to the end point are tabulated in Table 2.

Changes in vitality scores

Statistically significant increase was observed in vitality scores ($P = .003$) of the fasting group when compared to the controls. A within group analysis between the mean values before and after the intervention has also shown a significant improvement in the vitality levels ($P < .001$) both in the fasting and control group.

Changes in quality of life

All the participants in the fasting group have shown significant improvement in the quality of life domains of WHOQOL, namely the physical domain ($P < .001$), psychological domain ($P = .002$), and environmental domain ($P = .004$), except the social domain ($P = .06$) compared to their controls. Nevertheless, a within group analysis has shown significant improvement in all the QOL domains in the fasting group and control group, except for the psychological domain ($P = .09$) in the control group. The detailed results are tabulated in Table 2.

Spearman’s correlation has shown a weak negative correlation between BMI and vitamin D levels ($\rho = -.280$, $P = .04$). Physical QoL ($\rho = .442$, $P = .001$) and environmental QoL ($\rho = .483$, $P < .001$) were found to have a moderately positive correlation with vitality status. Additionally, vitality status showed a weak positive correlation with psychological QoL ($\rho = .348$, $P = .001$) and social QoL ($\rho = .330$, $P = .01$). The correlations between these variables are plotted in Figures 3 and 4.

Discussion

This study was conducted to validate the findings of our previous pilot study, which reported that 10 days of fasting significantly improved the levels of vitamin D and B12, led to weight loss, reduced BMI and primed other physiological functions.

### Table 1. Baseline demographic characteristics of the participants.

| PARAMETERS ASSESSED                  | FASTING GROUP (N=26) | CONTROL GROUP(N=26) | $P$ VALUE$^{a}$ |
|-------------------------------------|----------------------|---------------------|-----------------|
| Age (years)                         | 53.57 ± 10.21        | 49.96 ± 15.62       | $P = .408$     |
| Sex                                 | Males-11             | Males-11            | $P = 1.000$    |
|                                     | Females-15           | Females-15          |                 |
| Height (cm)                         | 159.65 ± 9.68        | 158.92 ± 9.55       | NA*            |
| Weight (kg)                         | 67.9 ± 10.53         | 70.88 ± 28.46       | NA*            |
| Body Mass Index (kg/m$^2$)          | 26.86 ± 4.71         | 27.8 ± 9.11         | $P = .240$     |
| Socio-economic status               | Upper Class-9        | Upper class-1       | $P = .010$     |
|                                     | Lower Middle class-17| Upper Middle class-2|                |
| Habits                              | Smoking-1            | Smoking-1           | $P = 1.000$    |
| Medications                         | Under Medications-9  | Under Medications-14| $P = .163$     |
|                                     | No Medication-17     | No Medication-12    |                |
| Conditions                          | Diabetes-2           | Asthma-2            | NA*            |
|                                     | Dyslipidemia-1       | Diabetes-6          |                 |
|                                     | Gastrointestinal disorders-2| Hypertension-5| Fatty Liver-1 |
|                                     | Hypertension-5       | Gastrointestinal disorder-3| Hypertension-5|
|                                     | Hyperthyroidism-1    | Hypertension-5      |                |
|                                     | Insomnia-1           | Lumbago-1           |                |
|                                     | Lumbago-3            | Migraine-1          |                |
|                                     | Osteoarthritis-2     | Osteoarthritis-3    |                |
|                                     | Obesity-5            | Obesity-4           |                |
|                                     | Skin disorders-3     |                      |                |

$^a$Chi-Square Test; *Not applicable.
among healthy volunteers. This randomized controlled trial found that fasting therapy improved patients’ vitamin D levels, quality of life, and vitality of the patients. The present study demonstrated an increase in vitamin D levels after fasting compared to a normal diet. This is strengthening the observations from earlier studies, which reported 8 to 10 days of fasting can increase the levels of serum vitamin D.

Earlier studies postulate that a reduction in body weight during fasting and/or exercise is the rate-limiting factor that stimulates the redistribution of vitamin D stored in the adipose tissue and skeletal muscles. In the present study, participants from both groups reported a significant reduction in their weight and BMI. Compared to the baseline, the fasting group had an average 3.7% reduction in weight and 0.25% reduction in the BMI scores, whereas the control group had a 3.1% and 0.23% reduction in weight and BMI, respectively. Statistically, fasting group did not differ from that of the control group with respect to weight and BMI scores. This is contrary to the results reported by a recent systematic review, that has shown intermittent fasting to reduce body weight. A previous observational study reported significant reductions in weight on a 20-day fasting program. However, the absence of a control group in this study limits its generalizability. To our knowledge, this is the first randomized control trial to compare the impact of prolonged fasting (10 days) with normal diet on body weight in a controlled residential setting.
The present data suggests that the changes in vitamin D level post-fasting may be independent of a reduction in weight or BMI. However, a correlation analysis suggests that a reduction in BMI was associated with an increase in vitamin D levels. This supports previous findings that vitamin D levels are inversely proportional to body weight and BMI. Adequate vitamin D levels are warranted in humans, as vitamin D is necessitated in all major functions of the body and mind. Reduced levels of vitamin D predispose to obesity, insulin resistance, and other metabolic disorders. Further, optimum levels of vitamin D are considered as a prerequisite for treating and preventing diseases ranging from diabetes to cancer. As of date vitamin D deficiency and insufficiency are a global concern. In this scenario, fasting therapy may be a promising solution for not only mitigating vitamin D deficiency but also preventing its ramifications.

We observed a 7% reduction in the vitamin B12 levels in the fasting group, whereas the control group had an increase of 1% in their vitamin B12 levels. However, these changes were not significant. The present study contradicts the results of the previous pilot study, which reported that fasting increased the vitamin B12 levels in a group of healthy volunteers. Vitamin B12 shares an inverse relationship with body weight; the study participants’ insignificant weight changes could explain the insignificant changes in vitamin B12 levels. Nevertheless, this needs to be revalidated by future studies.

Another significant change observed in the present study was the improvement in the vitality status and the quality of life in the fasting group. Vitality is reckoned as one of the important components in measuring one’s abilities, irrespective of his or her disabilities. There is a growing interest in measuring vitality as one of the indicators of well-being among various medical disciplines. Similarly, improving the quality of life remains a primary endpoint in health care delivery and research. The present data suggests a compelling positive relationship between vitality status and quality of life. Therefore, understanding and prodding the vitality status among the patients may be a key factor to be considered in future research and clinical practice, as the paradigm of health care and research.

**Table 2.** Comparison of variables between the fasting and control group.

| VARIABLES ASSESSED | FASTING GROUP | NORMAL DIET GROUP | BETWEEN GROUP ANALYSIS | EFFECT SIZE |
|--------------------|---------------|-------------------|------------------------|-------------|
|                    | PRE (MEAN ± SD) | POST (MEAN ± SD)  |                        |             |
| Weight (kg)        | 67.9 ± 10.53   | 65.38 ± 10.64     | <.001                  | .57^        | 0.155 |
| Body mass index (kg/m²) | 26.86 ± 4.71   | 25.99 ± 4.53     | <.001                  | .63^        | 0.131 |
| Vitamin D (ng/ml)  | 25.69 ± 10.66  | 31.5 ± 11.13      | <.001                  | .23         | .003^ |
| Vitamin B12 (pg/ml) | 384.42 ± 336.43 | 365.5 ± 207.92    | .75                    | .25         | .40^  |
| Hemoglobin (gm/dl) | 13.12 ± 1.14   | 13.04 ± 1.09      | .91                    | 1.2         | .77*  |
| Vitality           | 6.73 ± 1.18    | 7.61 ± 1.02       | <.001                  | .006^       | 0.425 |
| WHO-QUALITY OF LIFE (QOL) | | | | | |
| Physical QoL       | 70.38 ± 14.45  | 82.5 ± 11.85      | <.001                  | .5561 ± 17.23 | 68.8 ± 13.64 | <.001 | <.001^ | 0.549 |
| Psychological QoL  | 71.03 ± 15.01  | 83.26 ± 14.09     | <.001                  | 59.46 ± 15.17 | 70.73 ± 15.66 | .001 | .002^ | 0.488 |
| Social QoL         | 78.46 ± 13.6   | 82.88 ± 13.56     | .02                    | 72.15 ± 18.7 | 73.34 ± 19.53 | .42 | .06^ | 0.302 |
| Environment QoL    | 84.53 ± 11.34  | 88.26 ± 11.88     | .01                    | 71.53 ± 16.05 | 77.92 ± 13.69 | .006 | .004^ | 0.457 |

*Students T test; ^Mann-Whitney U test, QoL-Quality of Life.

**Figure 3.** Relationship between Vitamin D level and Body mass index.
is shifting toward a patient-centric approach. However, a better scale to measure vitality is required, as VAS scoring is very subjective and may not provide an accurate measurement.

**Limitations of the study**

The status of vitamins D, B12, weight, BMI, vitality, and quality of life were not measured post-fasting program. This remains one of the limitations of this study, as the changes in these parameters during the re-feeding phase in an uncontrolled atmosphere will add more information about the sustainability of the results. Further, due to operational constraints at the clinical setting, the authors could not control for the difference in disease status and medication use of the participants, which may be viewed as a potential confounder in this study. The authors have not assessed the specific disease related effects of fasting in these participants which may be included in future studies. Additionally, the interventions provided as a part of lifestyle program as well as the sunlight exposure may also have a role in the outcome measures especially with respect to vitamin D, which could be considered as another confounding factor. Nevertheless, the exposure to sun and the interventions were similar in both the groups Irrespective of the limitations, this is the first randomized controlled trial to report an association between therapeutic fasting and vitamin D.

**Conclusion**

Prolonged fasting up to 10 days has demonstrated to be safe and helps in improving the vitamin D levels, vitality and quality of life of patients. This may have considerable preventive and prophylactic benefits. Future studies should evaluate the long-term effects and cost effectiveness of fasting as a public health tool.17

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**Author Contributions**

Conceptualization: PMK, HS, GRT, KS, VVN, DY; Data curation: PMK, SK, KS, KG, AS; Formal analysis: PMK, KS, HS, GRT; Investigation: PMK, GS, MJ, SK, AS, JK, DY; Methodology: PMK, GRT, HS, KS, VVN, DY; Project administration: PMK, KS, KG, JK, NS; Resources: GRT, HS; Supervision: PMK, HS, GRT; Visualization: PMK, GRT, HS; Writing - original draft: PMK; Writing - review & editing: PMK, KS, HS, GRT, JK, SK, GS, NS.

**Availability of Data and Material**

The data will be made available on request to the corresponding author.
Ethics Approval
The study was approved by the institutional ethics committee of Sant Hirdaram Medical College for Naturopathy & Yogic Sciences, Bhopal, India.

Consent to Participate
All the participants signed a written consent to express their consent to participate in the study.

Consent to Publish
All the participants consented to publish their de-identified data on a medical journal.

Supplemental Material
Supplemental material for this article is available online.

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