Article

Effects of Vitamin B6 (Pyridoxine) and a B Complex Preparation on Dreaming and Sleep

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Abstract

Anecdotal evidence indicates that supplementation with vitamin B6 (pyridoxine) before bed can enhance dream vividness and recall. In a single pilot study, Ebben, Lequerica, and Spielman (2002) found that vitamin B6 had a dose-dependent effect of increasing scores on a composite measure of dream vividness, bizarreness, emotionality, and color. The present research replicated this study using a larger and more diverse sample of 100 participants from across Australia. We conducted a randomized, double-blind, placebo-controlled investigation of the effects on dreaming and sleep of ingesting 240 mg vitamin B6 (pyridoxine hydrochloride) before bed for five consecutive days. We also included an exploratory condition involving a B complex preparation containing a range of B vitamins. We found that vitamin B6 significantly increased the amount of dream content participants recalled but did not significantly affect dream vividness, bizarreness, or color, nor did it significantly affect other sleep-related variables. In contrast, participants in the B complex group showed significantly lower self-rated sleep quality and significantly higher tiredness on waking. We discuss the potential for using vitamin B6 in research on lucid dreaming.

Keywords

dreaming, vitamin B6, vitamin supplementation, methodology, sleep

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Introduction

Vitamin B6 refers to a group of closely related water-soluble compounds that are essential for human health and are involved in a wide range of human biochemical processes (Peuhkuri, Sihvola, & Korpela, 2012; "Vitamin B6: Physiology," 2013). Vitamin B6 occurs naturally in various foods, including whole grain cereals, legumes, fruits (such as banana and avocado), vegetables (such as spinach and potato), milk, cheese, eggs, red meat, liver, and fish (Natural Medicines, 2015). Anecdotal evidence indicates that moderate to high doses of vitamin B6 can enhance dreaming (Ebben et al., 2002; Fredericks, 1983; Pfeiffer, 1975). For example, the Natural Medicines (2015) database lists improving dream recall as one of the reasons people supplement diets with vitamin B6, and it has been suggested that poor dream recall may be a sign of vitamin B6 deficiency (Pfeiffer, 1975). Kellog (2005) recommends taking 100–250 mg of vitamin B6 before bed as one of the several ways to increase dream vividness and recall, and there is a claim that vitamin B6 can make dreams appear more colorful (Hastings, 1997, as cited in Ebben et al., 2002).

To date, only one study has investigated the specific effects of vitamin B6 (in the form of pyridoxine hydrochloride) on dreaming. In a small double-blind, within-subjects experiment, Ebben et al. (2002) had 12 participants ingest capsules containing an inactive placebo, or either 100 mg or 250 mg of pyridoxine hydrochloride five minutes before going to bed. The three conditions were fully counterbalanced, lasted for five days each, and had a 2-day washout period between them. Analyses using a composite measure of dream salience based on daily ratings of dream vividness, bizarreness, emotionality, and color showed that dream salience scores were 30% higher in the 100-mg B6 condition and 50% higher in the 250-mg B6 condition, compared with the placebo condition. Only the latter comparison was statistically significant, possibly because of the study having been underpowered. The authors concluded that vitamin B6 supplementation before bed had a dose-dependent effect of increasing dream salience.

As Ebben et al. (2002) theorized, the effects of vitamin B6 on dreaming may be because of its role as a cofactor in converting L-Tryptophan to 5-Hydroxytryptophan (5-HTP), and in converting 5-HTP to serotonin (5-Hydroxytryptamine [5-HT]; Luboshitzky et al., 2002; Peuhkuri et al., 2012). As per the reciprocal interaction hypothesis of REM sleep neurobiology (J. A. Hobson, McCarley, & Wyzinki, 1975; J. A. Hobson, Stickgold, & Pace-Schott, 1998; McCarley & Hobson, 1975), elevated serotonin in the brain during the first few hours of sleep suppresses REM sleep, the sleep stage associated with the greatest dream recall rate (Gaillard, Nicholson, & Pascoe, 1994; Nicholson, Belhyavin, & Pascoe, 1989; Trivedi et al., 1999; Vogel, Buffenstein, Minter, & Hennessy, 1990). This can cause a subsequent REM-rebound effect in the last few hours of sleep, characterized by greater REM sleep and intensified dreaming activity (Goodenough, 1991; Manfridi & Kales, 1987). In support of this theory,

acute administration of vitamin B6 has been shown to cause increased serotonin synthesis in the primate brain (Hartvig, Lindner, Bjurling, Långström, & Tedroff, 1995). Furthermore, Luboshitzky et al. (2002) found that participants given 100 mg vitamin B6 (pyridoxine hydrochloride) at 5 p.m. subsequently spent 33% more time in REM sleep compared with participants given a placebo, although this difference did not reach statistical significance (possibly because of the small sample size of $N = 12$).

An alternative to the serotonin synthesis theory is that vitamin B6 causes disrupted sleep and more awakenings that provide opportunities for short term memories of dream content to be recalled and transferred into long-term memory, as per the arousal retrieval model of dream recall (Goodenough, 1991; Koulack & Goodenough, 1976). However, although Ebben et al. (2002) measured a range of sleep-related variables, these were not included in analyses, and thus it remains unclear whether vitamin B6 enhanced dream salience through disrupted sleep and more frequent awakenings. Because only a single composite measure of dream salience was used in statistical analyses, it is also unclear what effects vitamin B6 had on dream vividness, bizarreness, and color, specifically. Furthermore, although general dream recall rates were measured, they were not reported or included in analyses. It is thus unclear whether vitamin B6 increases the amount of content recalled from dreams or only affects the perceptual quality of dream recall.

If vitamin B6 enhances dream recall, it may be particularly useful in research on lucid dreams, which are dreams in which the dreamer is aware that they are dreaming while the dream is still happening (LaBerge & Rheingold, 1991). Indeed, findings from the recently published National Australian Lucid Dream Induction Study (Aspy, Delfabbro, Proeve, & Mohr, 2017) indicate that the physiological conditions that give rise to superior general dream recall are conducive to inducing lucid dreams. Lucid dreaming has a wide range of potential benefits and applications in areas such as scientific dream research (A. Hobson, 2009), the treatment of nightmares (Holzinger, Klösch, & Saletu, 2015), improvement of skills through rehearsal in the lucid dream environment (Stumbrys, Erlacher, & Schredl, 2016), recreation (Schädlich & Erlacher, 2012), and creative problem solving (Stumbrys & Daniels, 2010). However, research in this area has been limited by a lack of effective and reliable lucid dream induction techniques. Vitamin B6 may provide a simple, inexpensive, and low-risk means to enhance the effectiveness of lucid dream induction techniques (see Aspy et al., 2017; Stumbrys et al., 2012), and could thus make further research on the potential applications of lucid dreaming more practical.

The primary aim of this research was to further investigate the effects of vitamin B6 supplementation on dreaming and sleep. A secondary aim was to explore the possibility that other B vitamins may work synergistically with vitamin B6 to enhance dreaming. Indeed, the B vitamins all perform closely interrelated roles in a vast array of biochemical processes, including the synthesis of

neurotransmitters (see Kennedy, 2016). A randomized, double-blind, placebo-controlled experiment was conducted in which participants were randomly allocated to groups that involved ingesting either a placebo, 240 mg of vitamin B6 (pyridoxine hydrochloride), or a B complex preparation that contained 240 mg of vitamin B6 and a range of other B vitamins for five days (see Materials section). We hypothesized that participants in the B6-only group would have significantly greater general dream recall than participants in the placebo group. We also hypothesized that participants in the B6-only group would have significantly greater self-rated dream color, vividness, and bizarreness than participants in the placebo group. All analyses involving sleep-related variables and the B complex group were exploratory.

Method

Participants

A total of 100 participants (68 women, 31 men, 1 transsexual) who met the inclusion criteria (mentioned later) completed the study. Their mean age was 27.5 (standard deviation [*SD*] = 6.8). Most participants were employed nonstudents ($n = 50$), 42 were students, and eight were unemployed. The study attracted substantial mainstream media coverage during the recruitment phase because of a press release on the University of Adelaide website. Participants in the final sample learnt of the study from the following recruitment sources: 41 from social media, 12 from other internet sources such as online news articles, 22 from word of mouth, 16 from posters or flyers distributed at the University of Adelaide city campus, five from radio interviews with the first author, three from newspaper articles, and one from nationally televised news interviews with the first author. Participants were excluded from the study if they were under the age of 18 or over the age of 40 (for consistency with the exclusion criteria used by Ebben et al., 2002), had any significant medical problems (including diabetes, epilepsy, low blood pressure, heart disease, liver disease, kidney disease, psychiatric disorders, neurological disorders, or a sleep disorder), were currently pregnant or breast-feeding, napped during the day or were unable to keep a regular sleep schedule, drank more than seven alcoholic drinks per week, or had been advised by a doctor or other health-care practitioner to take a supplement or medication that contained B vitamins. All participants who completed the study were given a $50 gift voucher. Ethics approval was granted by the University of Adelaide Human Research Ethics Committee (approval number: H-2015-077).

Materials

Participants were given logbooks containing questions related to general dream recall and sleep quality. Participants were asked if they could recall anything

specific about their dreams from the previous night and were asked to provide brief titles for each dream recalled. This allowed dream recall to be operationalized as both *Dream Recall Frequency* (the percentage of days on which there was dream recall) and *Dream Count* (the number of dreams recalled each day; see Aspy, 2016). Participants were also asked to rate the amount of content recalled from each dream using four categories provided. This operationalization is referred to as *Dream Quantity* and provides a more sensitive measure of dream recall than Dream Recall Frequency or Dream Count. The measure was developed by Aspy (2016) and is based on an earlier measure developed by Reed (1973). Category ratings are converted to numerical values (*Fragmentary* = 1, *Partial* = 2, *Majority* = 4, *Whole* = 8) and summed (higher scores indicate superior dream recall). Participants rated how vivid, bizarre, and colorful their dreams were using Likert-type scales ranging from 1 (*not at all*) to 10 (*extremely*) that were based on descriptions of measures provided by Ebben et al. (2002). The following three sleep-related questions from a study by Aspy et al. (2017) were also included. Participants were asked to estimate how much time in total they spent awake during the night in minutes. Self-rated sleep quality was assessed with the following question: "On a scale of 1 to 5, what was the overall quality of your sleep last night?" (1 = *terrible*, 2 = *poor*, 3 = *okay*, 4 = *good*, 5 = *excellent*). Participants also indicated how tired they felt upon waking: "On a scale of 1 to 5, how tired do you feel this morning?" (1 = *not at all tired*, 2 = *slightly tired*, 3 = *somewhat tired*, 4 = *quite tired*, 5 = *very tired*).

The capsules were prepared for this study by a compounding pharmacy. They were made of gelatine and were opaque. In the B6-only group, the dose of vitamin B6 (pyridoxine hydrochloride) was 240 mg. This dose was used because 240 mg pyridoxine hydrochloride is equivalent to 197 mg of pyridoxine, which is slightly below the No Observed Adverse Effects Level (NOAEL) of 200 mg pyridoxine established in the Nutrient Reference Values for Australia and New Zealand (National Health and Medical Research Council, 2006). In the B complex group, dosages for the following B vitamins were used: vitamin B1 (thiamine hydrochloride), 75 mg; vitamin B3 (nicotinamide), 200 mg; vitamin B5 (calcium pantothenate), 150 mg; vitamin B6 (pyridoxine hydrochloride), 240 mg; vitamin B7 (biotin), 40 µg; vitamin B9 (folic acid), 400 µg; vitamin B12 (cyanocobalamin), 500 µg; inositol, 25 mg; and choline bitartrate, 100 mg. All of these dosages are at the upper end of what can be found in over the counter B complex supplement preparations in Australia. Note that vitamin B2 (riboflavin) was not included. Vitamin B2 causes urine to become brightly colored, which could have been revealed to participants that they were in the B complex group. Dosages were split over two capsules in all three groups, that is, each capsule contained a half-dose, and participants were instructed to consume two capsules at a time. The placebo capsules contained microcrystalline cellulose.

Procedure

Participants accessed an information sheet via a web URL that was included in all promotional materials and media items. The information sheet appeared on the first page of a brief pretest questionnaire hosted by the survey management website *Survey Monkey*. It explained that the purpose of the study was to investigate the effects of B vitamins on dreaming. Participants indicated that they understood the information sheet and provided informed consent by answering a question that appeared at the bottom of the first page. If they answered in the affirmative, they were then asked to provide demographic and postal details. Packages that contained a logbook, packet of capsules, and an instructions sheet were sent to participants via post. Participants thus completed the study in their own homes without direct contact with the experimenters. Participants were randomly allocated to experimental groups, and were blind to the group they were in. They were asked to consume two capsules directly before bed each night from Sunday to Thursday and were asked to make logbook entries immediately upon waking each morning. Throughout the entire study period, participants were instructed to check the ingredients lists of food, beverage, and supplement products and to avoid consuming products that contained added B vitamins. However, they were told that they could continue to consume basic food products that are routinely fortified with vitamin B6 in Australia (such as bread and cereals). Participants were asked to return their completed logbooks and any unused capsules via post using prepaid envelopes provided. All participants in the final sample completed the full study and no unused capsules were returned.

Results

Based on dates recorded at the start of each logbook entry, participants took an average of 5.1 days to complete their logbooks ($SD = 0.7$). Mean values for all logbook variables over the 5-day experimental period were calculated and are presented in Table 1. Planned contrasts were conducted for all variables and between all combinations of the placebo, B6-only, and B complex groups to explore group differences. The hypothesis that participants in the B6-only group would have significantly greater general dream recall than participants in the placebo group was partially supported. Although the differences in Dream Recall Frequency and Dream Count were nonsignificant, scores on the more sensitive measure of Dream Quantity were significantly higher in the B6-only group compared with the placebo group: $t(97) = 2.19$, $p = .032$, $d = 0.55$. There were no other significant differences between the B6-only and the placebo groups, and the hypothesis that participants in the B6-only group would have significantly greater self-rated dream color, vividness, and bizarreness than participants in the placebo group was not supported. Self-rated sleep quality was significantly lower, $t(97) = 2.51$, $p = .014$, $d = 0.61$, and tiredness on waking was

Table 1. Descriptive Statistics for All Participants Combined and for Participants in the Placebo, B6-only, and B Complex groups.

	M (*SD*)			
Logbook variable	All participants ($N = 100$)	Placebo ($n = 35$)	B6 only ($n = 33$)	B complex ($n = 32$)
Dream Recall Frequency	69.4% (27.9%)	72.6% (26.6%)	72.1% (30.0%)	63.1% (26.9%)
Dream Count	1.2 (0.8)	1.1 (0.6)	1.5 (1.0)	1.2 (0.8)
Dream Quantity	3.5 (3.3)	2.7 (2.1)	4.5 (4.1)	3.5 (3.5)
Vividness	4.7 (2.1)	4.8 (1.8)	4.9 (2.2)	4.4 (2.2)
Bizarreness	4.1 (1.9)	4.4 (1.9)	4.1 (2.0)	3.8 (1.7)
Color	4.4 (2.0)	4.3 (1.9)	4.5 (2.2)	4.3 (2.1)
Time awake during the night (minutes)	13.8 (23.1)	10.1 (10.7)	10.0 (14.6)	21.8 (35.5)
Self-rated sleep quality	2.8 (0.7)	2.9 (0.7)	3.0 (0.7)	2.6 (0.6)
Tiredness on waking	2.6 (0.7)	2.6 (0.7)	2.4 (0.7)	2.7 (0.7)

significantly higher, $t(97) = 2.11$, $p = .037$, $d = 0.43$, in the B complex group compared with the B6-only group. With the exception of the difference in tiredness on waking between the B6-only and the B complex groups, findings remained statistically significant when analyses were repeated using mean values for only the first three days of the experimental period as per the procedure used by Ebben et al. (2002).

Discussion

This study investigated the effects of vitamin B6 and a B complex preparation ingested before bed on dreaming and sleep in a randomized, double-blind, placebo-controlled experiment. The hypothesis that participants in the B6-only group would have significantly greater general dream recall than participants in the placebo group was partially supported. Dream Recall Frequency was virtually identical in the B6-only group compared with the placebo group, and no significant difference was observed using the more sensitive Dream Count measure of dream recall. However, using the most sensitive measure of dream recall—the Dream Quantity measure that quantifies the amount of content recalled from each individual dream participants in the B6-only group recalled a statistically significant 64.1% more dream content than participants in the placebo group. These findings indicate that supplementation with 240 mg of vitamin B6 before bed enhanced dream recall, consistent with anecdotal reports (Fredericks, 1983; Pfeiffer, 1975) and previous experimental findings (Ebben

et al., 2002) that vitamin B6 can be used for this purpose. These findings also highlighted the importance of using dream recall measures that are sensitive enough to reveal statistically significant effects (see Aspy, 2016).

The hypothesis that participants in the B6-only group would have significantly greater self-rated dream color, vividness, and bizarreness than participants in the placebo group was not supported. This is at odds with Ebben et al. (2002), who found that participants given 250 mg of vitamin B6 before bed scored higher on a composite measure of dream color, vividness, bizarreness, and emotionality compared with placebo. The reason for this discrepancy is uncertain, although one possibility is that participants of this study already had sufficiently high dietary intake of vitamin B6 that supplementation affected only the quantity of dream recall, without further detectable effects on the overall perceptual quality of dreaming. Poor dream recall has been described as a symptom of vitamin B6 deficiency (Pfeiffer, 1975), and the dream enhancing effects of vitamin B6 supplementation may be weaker or qualitatively different for people who already have sufficient intake. Although participants of this study were asked to avoid a range of foods, beverages, and supplements that contained added vitamin B6, many other basic foods, such as bread and cereals, are regularly fortified with vitamin B6 in Australia and vitamin B6 deficiency is rare in this country. The effects of vitamin B6 on dreaming may be more pronounced in populations where deficiency is more common.

Results indicated that the B complex preparation had no significant effects on dreaming, even though the same dosage of vitamin B6 was used in the B complex preparation as in the B6-only group. It is possible that one or more of the other B vitamins may have counteracted the effects of vitamin B6 on dreaming, or otherwise inhibited dream activity or dream recall. Because of the wide range of B vitamins included in the B complex preparation and the lack of research on the effects of B vitamins on dreaming and sleep, it is impossible to know whether or which B vitamins may have been responsible for these counteractive effects. Notwithstanding this possible counteractive effect, some B vitamins may work synergistically with vitamin B6 to enhance dream recall. For example, vitamins B1, B3, B5, and B9 play important roles in the synthesis of serotonin, and limited clinical evidence indicates that vitamin B1 may increase REM sleep, possibly by reducing the amount of tryptophan needed for conversion into niacin and thereby leaving more tryptophan available for serotonin synthesis (see Kennedy, 2016; Peuhkuri et al., 2012).

There were no significant differences in the B6-only group compared with the placebo group in time awake during the night, sleep quality, or tiredness on waking. These findings indicate that vitamin B6 supplementation had no detrimental effects on sleep quality, consistent with findings from Luboshitzky et al. (2002), who found that supplementation with 100 mg of vitamin B6 at 5 p.m. did not significantly affect total time asleep or sleep efficiency. However, participants in the B complex group showed significantly lower self-rated sleep

quality and significantly higher tiredness on waking compared with the B6-only group. Thus, the B complex preparation had a detrimental effect on sleep quality, consistent with a study by Lichstein et al. (2007) in which participants taking multivitamin supplements (containing a range of B vitamins) or other vitamin supplement combinations showed poorer sleep quality and more frequent awakenings compared with participants who did not take any vitamin supplements.

Strengths and Limitations

Strengths of this study include our use of a wide range of dreaming and sleep-related variables in the analyses, our use of a large and highly diverse participant sample from across Australia, and the use of a randomized, double-blind, placebo-controlled experimental design. A limitation of the study is that our B complex preparation contained a range of B vitamins, making it impossible to isolate any effects of individual B vitamins other than B6 on dreaming and sleep. Another limitation is that participation was restricted to healthy people between the age of 18 and 40. The findings may not generalize to people outside of this age range or clinical populations. Vitamin B6 supplementation before bed might influence or even exacerbate sleep disorders related to REM sleep such as REM sleep behavior disorder (RBD). It may be advisable for people with RBD to avoid taking vitamin B6 supplements before bed, and further research into this issue is warranted. In this study, participants only consumed vitamin B6 supplements for a 5-day period. It is possible that the effects of vitamin B6 supplementation on dreaming diminish over longer time periods.

Directions for Future Research

Findings from this study discount the theory that vitamin B6 enhances dream recall by disrupting sleep and causing more frequent awakenings as per the arousal retrieval theory of dream recall (sleep quality was not significantly different in the B6-only group compared with the placebo group). More research is needed to investigate the theory that vitamin B6 increases serotonin levels in the brain and causes a REM-rebound effect later in the night. This future research could be conducted in a sleep laboratory with polysomnography to compare the sleep architecture of participants given vitamin B6 with placebo. Such a study could also measure blood serum levels of vitamin B6 to help identify the ideal time to ingest vitamin B6 for enhancing dreaming. If the serotonin synthesis theory is correct, dream enhancement effects should be greatest if vitamin B6 ingestion is timed so that the increase in serotonin peaks during the first 4–6 hours of sleep and then declines during the final few hours of sleep, allowing a strong REM-rebound effect to occur. Further research is needed to investigate

whether the effects of vitamin B6 vary according to how much vitamin B6 is being obtained from the diet. If vitamin B6 is only effective for people with low dietary intake, its effects on dreaming may diminish with prolonged supplementation. Future studies should investigate the effects of vitamin B6 over longer periods of time. Future research should also investigate the potential use of vitamin B6 for lucid dream induction. Indeed, vitamin B6 has been described as an "extremely useful" aid for inducing lucid dreams (FitzGerald, 2014), and there are many anecdotal reports on the various online lucid dreaming forums (e.g., "Dream Views," "LD4all," "World of Lucid Dreaming") of vitamin B6 being used for this purpose. Further research on the effects of vitamin B6 and other B vitamins on dreaming is thus warranted.

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