The effect of vitamin B_{12} on physical performance capacity

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1. Physical performance capacity was assessed before and after injection of cyanocobalamin and a placebo for thirty-one Burmese male subjects whose age ranged from 18·7 to 20·8 years.

2. The subjects chosen were free from anaemia and were paired on a 'weight–age' basis and divided into two groups.

3. One group received an injection of 1 mg cyanocobalamin and the other was given a placebo injection three times weekly for 6 weeks. This was done on a 'double-blind' basis.

4. There was no significant difference between the two groups in any of the criteria measured, before and after administration of either 1 mg cyanocobalamin or placebo injection. So also there was no significant increase in any of the measurements in the subjects after receiving cyanocobalamin injections compared with those receiving the placebo.

Human physical performance is the result of complex interdependent physiological, psychological and physical processes. Vitamins have long been used as ergogenic aids to improve physical performance capacity. Vitamin B_{12} is known to have a role in the growth and maturation of every cell in the body as well as having a role in the physiology of the nervous system.

Vitamin B_{12} is used extensively in general practice in the treatment of patients complaining of tiredness for no known reason, to improve well-being.

It has been claimed by certain authors that vitamin B_{12} improves the well-being of patients not suffering from a deficiency of this vitamin (Morwood, 1952; Wilkinson, 1968). Ellis, Nasser & Wrighton (1970) stated that in a survey of the use of vitamin B_{12} in general practice, 68% of the practitioners questioned believed it to be effective especially in the treatment of tiredness, neurasthenia, debility, anorexia and convalescence. Ellis & Nasser (1973) in a pilot study of vitamin B_{12} in the treatment of tiredness also showed that the subjects showed a favourable response to vitamin B_{12} as regards well-being, appetite, mood and energy, with a statistically significant response in respect of general well-being. However, Montoye, Spata, Pinckney & Barron (1955) in a study on the effect of vitamin B_{12} supplementation of young males aged 12–17 years, noted that strength and endurance were unaffected by vitamin B_{12} administration.

This study was undertaken to determine whether administration of vitamin B_{12} has any effect on the physical performance capacity of healthy subjects.

MATERIAL AND METHODS

Thirty-six healthy male students, aged 18–21 years, of the Institute of Medicine (I), Rangoon, were used as subjects for the study. The packed cell volume and haemoglobin levels of the subjects were determined to exclude those with anaemia. The subjects were paired on a 'weight–age' basis. One of each pair was assigned randomly to two groups of which one group received cyanocobalamin injections (1 mg three times/week for 6 weeks), and the other group was given a placebo injection on a similar schedule. This was done on a

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'double-blind' basis. Of the thirty-six subjects, thirty-one subjects completed the experiment, the remaining five subjects decided not to complete the experiment and the results for these subjects were not included in the study.

Base-line measurements for the following criteria were made for both groups: (1) aerobic work capacity: the measurement of maximum oxygen uptakes reflects the ability of the cardio-respiratory system and the work muscle to transport and utilize O_2; (2) performance tests: the measurement of the dynamic strength of different muscle groups; (3) co-ordination tests.

After the base-line measurements were taken, subjects were given injections of cyanocobalamin and placebo as described previously. At the end of the 6 week period, aerobic work capacity, performance and co-ordination tests were again measured.

Statistical analysis of results was done using the *t* test for comparison with regards to changes between the pre- and post-injection period for each group. Paired comparison tests between the two groups before and after the injections were also done.

1. *Aerobic work capacity.* Bicycle ergometry was used for the assessment of aerobic work capacity. Resting heart rate and blood pressure were taken before exercizing on a Monark ergometer (Monark-Crescent AB, Verberg, Sweden).

Resting heart rate was measured from direct electrocardiograph recording using a Mingograph (Elema-Schonandor Fack, S-17120 solna 1, Sweden).

Determination of maximal aerobic power was made in every subject, during the pre- and post-injection period. Maximum aerobic power was studied by starting with a submaximal load of 300 kg-m/min and which was increased at the rate of 150 kg-m/min until the subject became exhausted. The maximum load reached was assessed by the fact that some subjects vomited and some were in a state of near-collapse. The heart rates and O_2 consumption of some of the subjects reached a plateau while that of others did not.

Heart rate was measured during the last minute of each work-load.

Recovery heart rate was taken for the 1st and 30th minute.

Expired air was collected in Douglas bags during the last minute of each work-load. The volumes of expired gas were measured using Parkinson-Cowan dry gas meter and the volume of O_2 in expired air was analysed using the Lloyd-Haldane gas analyser.

2. *Performance tests.* The following performance tests, chosen from a series of tests proposed by the American Association for Health, Physical Education and Recreation (1962), were performed: (1) hand-grip, as a measure of static strength of arm and hand; (2) standing broad jump, as a measure of leg strength and explosive power; (3) leg-lift, as a measure of abdominal and hip muscle strength.

3. *Co-ordination tests.* (Fleishman, 1964) Plate-tapping: this test proposed to measure the speed with which the subject could horizontally adbuct and adduct his arm.

RESULTS

Thirty-one subjects participated in and completed the experiment, of which sixteen subjects received the cyanocobalamin injection and fifteen received the placebo.

Table 1 shows a comparison of results obtained for the two groups; the two groups were found to be comparable as regards all criteria measured.

Table 2 shows the results of tests of physical performance capacity before and after receiving the cyanocobalamin injections. The results were not significantly different.

Table 3 shows the results of tests of physical performance capacity before and after the placebo injections. There was no significant difference in any of the measurements in the pre- and post-injection periods.

Table 4 shows a comparison of results obtained for the two groups after they had received

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Table 1. *Comparison of measurements* obtained with thirty-one healthy adult Burmese males, aged 18–21 years, before receiving either 1 mg cyanocobalamin or a placebo three times/week for 6 weeks*

(Mean values with ranges in parentheses)

	Vitamin B_{12} group	Placebo group
No. of subjects	16	15
Height (m)	1·67 (1·58–1·75)	1·67 (1·60–1·72)
Body-wt (kg)	51·33 (44·4–57·8)	50·81 (44·4–55·4)
Age (years)	19·90 (18·7–20·8)	19·86 (18·7–20·5)
Haemoglobin (g/l)	151 (130–172)	159 (140–179)
Resting heart rate (beats/min)	82·9 (69·0–96·0)	78·5 (56·0–89·0)
Recovery heart rate (beats/min):		
At 1 min	183·00 (165–198)	183·00 (166–198)
At 30 min	107·00 (90–129)	103·00 (80–123)
$\dot{V}_{O_2\,max}$:		
l/min	1·81 (1·27–2·28)	1·78 (1·12–2·14)
ml/kg per min	35·37 (25·39–45·78)	34·98 (20·22–44·37)
Pull-up (no. of times/min)	9·06 (1–24)	7·87 (3–17)
Leg-lift (no. of times/min)	23·88 (9–40)	22·86 (9–33)
Hand-grip (kg):		
Left	36·37 (25–50)	33·53 (20–50)
Right	41·13 (30–53)	38·75 (28–58)
Standing broad jump (m)	2·08 (1·48–2·50)	2·13 (1·82–2·65)
Plate-tapping (no. of times/min)	38·31 (25–70)	40·00 (27–67)

$\dot{V}_{O_2\,max}$, maximum O_2 uptake.
* For details of procedures, see p. 270.

Table 2. *Physical performance capacity* of sixteen healthy adult Burmese males, aged 18–21 years, before and after receiving injections of 1 mg cyanocobalamin three times/week for 6 weeks*

(Mean values with ranges in parentheses)

	Before injection	After injection
Resting heart rate (beats/min)	82·9 (69–96)	78·7 (69–92)
Recovery heart rate (beats/min):		
At 1 min	183·00 (165–198)	184·00 (168–200)
At 30 min	107·00 (90–129)	102·00 (86–116)
$\dot{V}_{O_2\,max}$:		
l/min	1·81 (1·27–2·28)	1·91 (1·44–2·64)
ml/kg per min	35·37 (25·39–45·79)	36·77 (28·57–47·96)
Pull-up (no. of times/min)	9·06 (1–24)	8·94 (2–20)
Leg-lift (no. of times/min)	23·88 (9–40)	28·25 (13–43)
Hand-grip (kg):		
Left	36·37 (25–50)	36·06 (24–49)
Right	41·13 (30–52)	41·19 (29–52)
Standing broad jump (m)	2·08 (1·48–2·50)	2·12 (1·42–2·47)
Plate-tapping (no. of times/min)	38·31 (25–70)	41·06 (29–63)

$\dot{V}_{O_2\,max}$, maximum O_2 uptake.
* For details of procedures, see p. 270.

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Table 3. *Physical performance capacity* of fifteen healthy adult Burmese males, aged* 18–21 *years, before and after receiving injections of placebo three times/week for* 6 *weeks*

(Mean values with ranges in parentheses)

	Before injection	After injection
Resting heart rate (beats/min)	78·5 (56–89)	76·3 (63–88)
Recovery heart rate (beats/min):		
At 1 min	183·00 (166–198)	181·00 (168–198)
At 30 min	103·00 (80–123)	100·00 (81–124)
$\dot{V}_{O_2\,max}$:		
l/min	1·78 (1·12–2·14)	1·83 (1·35–2·54)
ml/kg per min	34·98 (20·22–44·37)	36·01 (27·69–55·34)
Pull-up (no. of times/min)	7·87 (3–17)	7·46 (4–10)
Leg-lift (no. of times/min)	22·86 (9–33)	26·20 (10–43)
Hand-grip (kg):		
Left	33·53 (20–50)	35·80 (28–49)
Right	38·73 (28–58)	40·07 (31–51)
Standing broad jump (m)	2·14 (1·82–2·65)	2·16 (1·84–2·41)
Plate-tapping (no. of times/min)	40·00 (27–67)	41·00 (25–61)

$\dot{V}_{O_2\,max}$, maximum O_2 uptake.
* For details of procedures, see p. 270.

Table 4. *Comparison of measurements* obtained with thirty-one healthy adult Burmese males, aged* 18–21 *years, after receiving* 1 *mg cyanocobalamin or a placebo three times/week for* 6 weeks

(Mean values with ranges in parentheses)

	Vitamin B_{12} group	Placebo group
No. of subjects	16	15
Height (m)	1·67 (1·57–1·76)	1·66 (1·60–1·72)
Body-wt (kg)	51·63 (44·2–59·8)	51·14 (45·2–57·2)
Age (years)	19·90 (18·7–20·8)	19·86 (18·7–20·5)
Resting heart rate (beats/min)	78·7 (69·0–92·0)	76·3 (63·0–88·0)
Recovery heart rate (beats/min):		
At 1 min	184·0 (168–200)	181·0 (168–198)
At 30 min	102·0 (86–116)	100·0 (81–124)
$\dot{V}_{O_2\,max}$:		
l/min	1·91 (1·44–2·64)	1·83 (1·35–2·54)
ml/kg per min	36·77 (28·57–47·96)	36·01 (27·69–55·34)
Pull-up (no. of times/min)	8·94 (2–20)	7·46 (4–10)
Leg-lift (no. of times/min)	28·25 (13–43)	26·20 (10–43)
Hand-grip (kg):		
Left	36·06 (24–49)	35·80 (28–49)
Right	41·19 (29–52)	40·07 (31–51)
Standing broad jump (m)	2·12 (1·42–2·47)	2·16 (1·84–2·41)
Plate-tapping (no. of times/min)	41·06 (29–63)	41·00 (25–61)

$\dot{V}_{O_2\,max}$, maximum O_2 uptake.
* For details of procedures, see p. 270.

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either the cyanocobalamin or placebo injection. There was no significant increase in any of the measurements in the subjects receiving cyanocobalamin injections compared with those receiving the placebo.

DISCUSSION

From the preceding results, it can be seen that vitamin B_{12} did not have any significant effect on the physical performance capacity.

Montoye *et al.* (1955) also obtained similar results in that supplementation of vitamin B_{12} did not affect strength and endurance of young boys. O'Brien (1954) compared the subjective feeling in four groups of patients receiving liver extract, vitamin B_{12} and saline injections, the patients acting as their own controls. He found that they could not distinguish between the injections. However, there was a great improvement in the sense of well-being and energy contrasting with slight improvement in sleep and appetite with all three injections. O'Brien (1954) was of the opinion that it was easier to persuade oneself of an improvement of feeling that was merely subjective than to persuade oneself of an improvement in a function that has some measure of objective assessment.

Ellis & Nasser (1973), however, stated a favourable response to vitamin B_{12} in the case of patients whose blood values were in the normal range and complaining of fatigue or tiredness for no apparent reasons. The well-being, mood, fatigue, sleep and effect of the injections were determined using questionnaires. They found that as regards the sense of general well-being, the results were statistically significant in favour of vitamin B_{12} compared with the placebo. They speculated on the mode of action. It may be due to the ability of vitamin B_{12} to affect the brain or neurones, or to an influence of vitamin B_{12} on natural metabolism or penetration of other substances such as folate.

Here the results suggested that there was no significant difference in the physical performance capacity after injections of either vitamin B_{12} or the placebo.

Thus, it can be concluded that vitamin B_{12} did not produce any significant effect on the physical performance capacity of normal, healthy individuals.

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