Effects of niacin-bound chromium supplementation on body composition in overweight African-American women

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Aim: This pilot study was designed to determine whether 600 μg niacin-bound chromium ingested daily over 2 months by African-American women undergoing a modest dietary and exercise regimen influences weight loss and body composition.

Methods: Twenty overweight African-American women, engaged in a modest diet–exercise regimen, participated in a randomized, double-blinded, placebo-controlled, crossover study. They received placebo three times a day (t.i.d.) during the control period and niacin-bound chromium, 200 μg t.i.d., during the verum period. Control and verum periods were each 2 months in duration. One-half received placebo first (group 1), the other half received chromium first (group 2). Body weights (b.w.) and blood chemistries were measured by routine clinical methodology. Fat and nonfat body masses were estimated using bioelectrical impedance (electrolipography).

Results: In the first group of 10 women receiving niacin-bound chromium after the placebo period (group 1), b.w. loss was essentially the same, but fat loss was significantly greater and non-fat body mass loss significantly less with chromium intake. In contrast to the previous findings, there was a significantly greater loss of fat in the placebo compared to the verum period in the second group of eight women who received chromium first (group 2). Blood chemistries were not affected by intake of chromium for 2 months.

Conclusions: Niacin-bound chromium given to modestly dieting-exercising African-American women caused a significant loss of fat and sparing of muscle compared to placebo. Once chromium was given at these dose levels, there was a 'carry-over' effect. Blood chemistries revealed no significant adverse effects from the ingestion of 600 μg of niacin-bound chromium daily over 2 months.

Keywords: chromium (niacin-bound), chromium (fat losses), obesity, chromium (muscle sparing), African-American women, weight loss
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Introduction

In earlier studies, chromium supplementation was reported to produce loss of body fat mass and/or to increase lean body mass [1–4], however, these findings were not reproduced in an equal number of studies [5–8]. This has led to general confusion concerning the value of chromium supplementation in treating obesity. Two additional investigations add further to the difficulty in interpreting the therapeutic value of chromium. Hasten *et al.* [9] found a significant increase in muscle mass after taking chromium picolinate in women only. Grant reported a significantly increased body weight (b.w.) in healthy, obese women taking chromium picolinate which

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Table 1 Group 1 of patients who started with placebo and then received ChromeMate™ (600 μg/day)

Patient	b.w. (lb)	Delta b.w. (lb)	Fat (%)	Fat (lb)	Delta fat (lb)	LBM (%)	LBM (lb)	Delta LBM (lb)
1	284.0–279.0	−5.0	47.1–47.4	133.8–132.2	−1.6	52.9–52.6	150.2–146.8	−3.4
	289.0-287.0	−2.0	47.5–47.3	137.2–135.7	−1.5	52.5–52.7	151.8–151.3	−0.5
3	212.0-206.0	−6.0	35.7–37.7	75.7–77.6	+1.9	64.3–62.3	136.3–128.4	−7.9
	206.0–203.0	−3.0	37.7–37.0	77.6–75.2	−2.4	62.3–63.0	128.4–127.8	−0.6
4	251.0–243.0	−8.0	41.7–41.7	104.7–101.3	−3.4	58.3–58.3	146.3–141.7	−4.6
	243.0–238.0	−5.0	41.7–41.0	101.3–97.6	−3.7	58.3–59.0	141.7–140.4	−1.3
5	137.0–138.0	+1.0	22.7–23.7	31.1–32.7	+1.6	77.3–76.3	105.9–105.3	−0.6
	138.0–135.5	−2.5	23.7–21.2	32.7–28.7	−4.0	76.3–78.8	105.3–106.8	+1.5
8	177.0–172.0	−5.0	33.6–34.6	59.5–59.5	0.0	66.4–65.4	117.5–112.5	−5.0
	172.0–170.5	−1.5	34.6–34.2	59.5–58.3	−1.2	65.4–65.8	112.5–112.2	−0.3
11	172.5-172.0	−0.5	37.5–37.4	64.7–64.2	−0.5	62.5–62.6	107.8–107.8	0.0
	172.0–170.5	−1.5	37.4–37.1	64.2–63.2	−1.0	62.6–62.9	107.8–107.3	−0.5
12	176.0–176.5	+0.5	35.7–39.0	62.8–63.0	+0.2	64.3–64.3	113.2–113.5	+0.3
	174.0–172.5	−1.5	38.4–38.0	66.7–65.6	−1.1	61.6–62.0	107.3–106.9	−0.4
13	184.0–183.0	−1.0	41.0–42.0	75.6–76.9	+1.3	58.9–58.0	108.4–106.1	−2.3
	182.0–181.0	−1.0	42.4–42.2	77.1–76.3	−0.8	57.6–57.8	104.9–104.7	−0.2
17	167.0–165.0	−2.0	35.2-34.8	58.8–57.4	−1.4	64.8–65.2	108.2–107.6	−0.6
	163.5–160.0	−3.5	35.7–34.8	58.4–55.8	−2.6	64.3–65.2	105.1–104.2	−0.9
18	244.0–243.8	−0.2	39.3–39.4	95.9–96.1	+0.2	60.7–60.6	148.0–147.6	−0.4
	243.8–240.5	−3.3	41.2–40.7	100.4-97.9	−2.5	58.8-59.3	143.4–142.6	−0.8

First number in grouping represents the placebo, second is verum (niacin-bound chromium) period.

contrasted with a significantly decreased b.w. with niacin-bound chromium consumption [10]. The precise reason why chromium should augment fat loss is not entirely clear but is believed to relate to its known influence on insulin metabolism [3,11–15].

The major purpose of the present pilot study was to determine whether supplementation with niacin-bound chromium could direct weight loss induced through diet and exercise more toward preferential fat loss with sparing of non-fat body mass in African-American women. African-American women are generally recognized to have severe weight problems with accompanying insulin perturbations [16–19]. We believe this is the first paper to focus specifically on the ability of chromium to influence body composition in this group. As a secondary gain, we wished to concentrate on effects of niacin-bound chromium on weight loss and body composition, since much less investigation has been reported on this ligand of chromium compared to picolinate.

Methods and Procedures

Twenty African-American women, who desired to lose weight, were recruited for a crossover study approved by the Institutional Review Board (IRB) at Georgetown University Medical Center. The majority of women were markedly overweight as indicated in tables 1 and 2. These patients were members of a local health club and received dietary consultation to lower caloric intake and exercised a minimum of three times a week for 60 min under the supervision of one of the authors (VC). They were especially encouraged to maintain the same dietary and exercise practices during the first and second periods of the crossover study. Two women (patients 7 and 19) were subsequently dropped from the study. Patient 7 moved from the area before the second period was completed, and patient 19 had a death in the family which affected her ability to comply with the protocol.

The women were arbitrarily divided into two groups of 10. The first group received placebo three times a day (t.i.d.) for 2 months, underwent a 1-month 'washout period' free of pills and, in the final 2 months, received niacin-bound chromium (ChromeMate™; InterHealth Neutraceutical Inc., Concord, CA, USA) 200 μg t.i.d. for 2 months (group 1). The second group received chromium first followed by placebo after the washout period under the same conditions as the first group (group 2). The study was randomized, double-blinded; only the supplier of pills knew the code prior to completion of the study.

The women were weighed on the same scale wearing the same amount of clothing at the beginning and ending of the two periods in the crossover study. Fat and non-fat body masses were estimated using a bioelectrical impedance technology termed electrolipography to predict b.w. composition (BioAnalogics ElectroLipoGraph, Beaverton, OR, USA) [20]. All measurements were made with the same apparatus. Complete blood

Table 2 Group 2 of patients who started with ChromeMate™ (600 μg/day) and then received placebo

Patient	b.w. (lb)	Delta b.w. (lb)	Fat (%)	Fat (lb)	Delta fat (lb)	LBM (%)	LBM (lb)	Delta LBM (lb)
2	150.8–147.5	–3.3	23.2–23.2	35.1–34.2	–0.9	76.7–76.8	115.7–113.3	–2.4
	1520–147.0	–5.0	24.1–22.3	36.7–32.8	–3.9	75.9–77.7	115.3–114.2	–1.1
6	180.0–182.0	+2.0	34.1–32.0	61.3–58.2	–3.1	65.9–68.0	118.7–123.8	+5.1
	180.0-178.0	–2.0	34.1–33.5	61.3–59.7	–2.6	65.9–66.5	118.7–118.3	–0.4
9	180.0–173.0	–7.0	34.7–32.5	62.5–56.3	–6.2	65.3-67.5	117.5–116.7	–0.8
	172.0–167.0	–5.0	31.9–30.6	54.9–51.2	–3.7	68.1–69.4	117.1–115.8	+1.3
10	168.0–166.0	–2.0	33.6–33.2	56.4-55.1	–1.3	66.4–66.8	111.6–110.9	–0.7
	165.0–162.0	–3.0	33.1–32.7	54.6–53.0	–1.6	66.9-67.3	110.4–109.0	–1.4
14	156.0–152.0	–4.0	28.7–27.5	44.7–41.8	–2.9	71.3–72.5	111.2–110.2	–1.0
	154.5–150.0	–4.5	28.4–27.0	43.8–40.4	–3.4	71.6–73.0	110.7–109.6	–1.1
15	184.0–184.5	+0.5	33.5–33.3	61.6–61.5	–0.2	66.5–66.7	122.4-123.1	+0.7
	186.0–185.0	–1.0	32.6-30.6	60.6-56.6	–4.0	67.4–69.4	125.4–128.4	+3.0
16	176.0-171.0	–5.0	36.5–37.1	64.2–63.4	–0.8	63.5–62.9	111.8–107.6	–4.2
	166.2–159.0	–7.2	36.5–34.7	60.6–55.2	–5.4	63.5–65.3	105.6–103.8	–2.8
20	156.0–153.0	–3.0	34.1–35.4	53.2–54.2	+1.0	65.9–64.6	102.8–98.8.	–4.0
	153.0–148.5	–4.5	34.8–33.6	53.2–49.9	–3.3	65.2-66.4	99.8–98.6	–1.2

First numbering in grouping represents verum (niacin-bound chromium) period, the second is the placebo period.

counts (CBC) and blood chemistries were measured by routine clinical procedures. The blood collections were made at the beginning and end of the first study periods of groups 1 and 2.

Statistics concerning changes in mass parameters and blood chemistries were performed by Student's *t*-test, paired analyses. Significance was $p < 0.05$. A one-way anova determined significance when comparing values for mass changes depicted in figure 1. Where a significant effect was detected by anova ($p < 0.05$), the Dunnett *t*-test was used to establish which differences between means reached statistical significance [21].

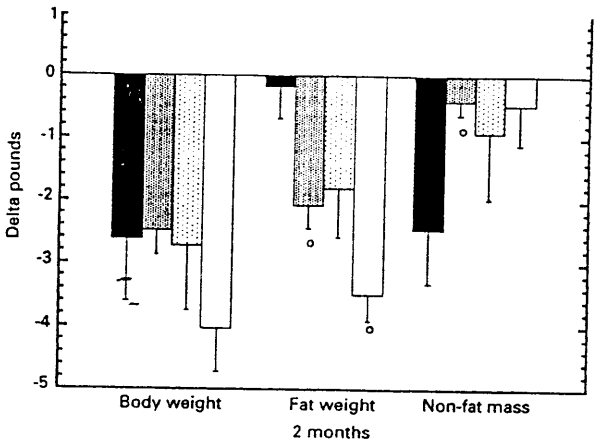

Fig. 1 Changes in body, fat and non-fat weight in placebo and chromium periods of the two groups of the crossover study. Averages ± s.e.m. are shown. The first bar (black) in each of the three groups represents the initial placebo period in group 1, and the second bar (dark grey) represents the final chromium period in group 1. The third bar in each group (light grey) represents the initial chromium period of group 2, while the last bar (white) depicts the final placebo period of group 2. The open circles indicate a significant difference between the first, second, third and fourth columns.

Results

Body Weight, Fat, and Non-Fat Body Mass Changes

Results from Group 1 and 2 were different. Accordingly the data will be handled separately.

Table 1 depicts individual data from 10 subjects who received placebo first in the crossover study (group 1). The general trend was to lose essentially the same b.w. whether the patient was taking placebo or chromium; but during the verum period, decreased weight was due primarily to fat loss with preservation of non-fat body mass. Nine of 10 lost more fat mass during the chromium period than their placebo period. In contrast, there was significantly less loss of non-fat mass in the chromium group.

Table 2 depicts individual data from eight subjects completing the study who received chromium first in the crossover (group 2). In contrast to results obtained in group 1, b.w. loss was relatively greater in the placebo period in seven of the eight patients, because fat loss was greater in six of the eight patients; and non-fat body mass loss was greater in three of the eight. Comparing the initial verum period of group 2 with the results from group 1 showed

Table 3 Blood chemistries

Parameter	Baseline 1	Placebo 1	Baseline 2	Chromium 2	Reference range
RBC	4.3 ± 0.1	4.4 ± 0.1	4.3 ± 0.1	4.3 ± 0.1	3.8–5.1 million/ml
Haematocrit	37.2 ± 1.0	37.5 ± 1.0	38.5 ± 0.6	37.9 ± 0.5	34–44%
Haemoglobin	12.4 ± 0.4	12.5 ± 0.3	13.1 ± 0.1	12.9 ± 0.2	11.5–15.0 g/dl
WBC	6.0 ± 0.4	5.5 ± 0.4	6.4 ± 1.0	44.4 ± 0.5*	3.7–10.5 thousand/ml
Platelets	250 ± 23	241 ± 26	252 ± 14.4	192 ± 9.2*	155–385 thousand/ml
Glucose	92 ± 4.6	91 ± 6.1	102 ± 8.5	86 ± 4.9	65–115 mg/dl
BUN	13 ± 1.3	14 ± 0.9	13 ± 0.9	12 ± 1.8	5–25 mg/dl
Creatinine	0.9 ± 0.06	1.0 ± 0.03	0.9 ± 0.07	0.7 ± 0.06	0.6–1.5 mg/dl
Uric acid	3.7 ± 0.4	3.4 ± 0.4	3.9 ± 0.7	3.7 ± 0.7	2.2-7.7 mg/dl
Sodium	140 ± 0.7	141 ± 1.0	141 ± 0.5	138 ± 0.9	135–147 mEq/l
Potassium	4.5 ± 0.13	4.5 ± 0.14	4.4 ± 0.13	4.2 ± 0.11	3.5–5.3 mEq/l
Chloride	103 ± 1.0	102 ± 1.1	103 ± 0.8	104 ± 0.2	96–109 mEq/l
Calcium	9.7 ± 0.14	9.5 ± 0.13	9.5 ± 0.13	9.4 ± 0.26	8.5–10.8 mg/dl
Phosphorus	4.1 ± 0.13	4.1 ± 0.19	3.7 ± 0.16	3.4 ± 0.18	2.5–4.5 mg/dl
Cholesterol	203 ± 11.1	190 ± 9.1	204 ± 27.1	198 ± 24.5	<200 mg/dl desirable
HDL	69.3 ± 6.4	63.9 ± 9.4	70 ± 12.9	62 ± 10.8	40–90 mg/dl
LDL	119.6 ± 9.4	110.8 ± 7.2	117 ± 23.1	95 + 16.6	<130 desirable
Triglycerides	69 ± 11	76 + 16	198 + 98	142 + 57	30–150 mg/dl
Total protein	7.4 ± 0.12	7.6 + 0.11	7.7 + 0.20	7.6 + 0.23	6.0–8.5 g/dl
Bilirubin	0.52 ± 0.06	0.54 + 0.04	0.58 + 0.09	0.50 + 0.12	0.1–1.2 mg/dl
Alk P'ase	88 ± 18.4	104 + 27.5	73 + 5.9	69 + 5.8	25–140 U/l
SGOT	18.8 ± 2.8	18.1 + 2.1	20.5 + 1.6	21.5 + 1.7	0–45 U/l
SGPT	17.3 ± 4.0	14.3 + 2.2	18 + 4.0	14 + 1.9	0–45 U/l
Lac deh	160 ± 9.3	174 + 13.4	195 + 16.6	232 + 42.0	0–240 U/l
GGT	28.0 ± 5.0	23.0 + 4.1*	26.6 + 6.8	18.0 + 6.6	0–70 U/l

Average ± s.e.m. of 8–10 patients depicted during the first half of this study. *Statistically significantly different than the baseline period.

essentially similar trends as the verum period of group 1 and a significantly greater loss of fat mass in the chromium period of group 2 compared to the placebo period of group 1. Suffice it to say, the placebo period of group 2 was in no way like the placebo period of group 1.

Figure 1 depicts the average changes in the mass parameters for the four groups. The first bar in each group represents the placebo period and the second bar the verum period in the first crossover group receiving placebo first. The average mass losses (placebo vs. verum) and s.e.m.s were: b.w. loss -2.62 ± 0.99 vs. -2.48 ± 0.39 lb ($p = 0.876$), the fat losses were -0.17 ± 0.52 vs. -2.08 ± 0.31 lb ($p = 0.009$), and the non-fat body mass losses were -2.45 ± 0.86 vs. -0.40 ± 0.23 lb ($p = 0.036$). The third bar in each group represents the verum period and the last bar the placebo period in the second crossover group receiving the chromium first. The average mass losses (verum vs. placebo) were: b.w. loss -2.72 ± 1.02 vs. -4.03 ± 0.69 lb ($p < 0.066$), the fat losses were -1.80 ± 0.79 vs. -3.49 ± 0.39 lb ($p = 0.007$), and the non-fat body mass losses were -0.91 ± 1.05 vs. -0.46 ± 0.64 lb ($p = 0.212$).

Blood Chemistries

Table 3 shows average ± s.e.m. of various blood chemistry measurements made during the first periods of groups 1 and 2. Baseline 1 and Placebo 1 refer to the beginning and ending readings of group 1 where placebo was given initially, and Baseline 2 and Chromium 2 (verum) refer to the beginning and ending of group 2 where chromium was ingested in the first period of the crossover. In general, blood chemistries did not differ between the two trial periods. However, there was a significant decrease in WBC and platelets in the chromium period of group 2 and GGT levels were lower in the placebo period of group 1. These results, although significantly different, were still within the normally accepted range. With future use of chromium, these parameters should be carefully checked. No statistically significant differences existed among the lipid parameters.

Discussion

Individual elements of Syndrome X (obesity, hypertension, lipid disturbances, and glucose intolerance) are frequently encountered, especially during ageing [22]; and these conditions, particularly obesity, are generally recognized to be more prevalent among African-American women [16–19]. The basic cause of the syndrome has been attributed by some investigators to insulin

resistance and/or hyperinsulinaemia which are prevalent during ageing [23–25]. Chromium supplementation has been shown to enhance insulin sensitivity in laboratory and clinical studies [11–15]; and chromium ameliorates individual elements of Syndrome X [11–15]. Accordingly, chromium has been found by some to beneficially influence weight loss, especially fat loss [1–4]. Unfortunately, others have not been able to duplicate these results [5–8]. These inconsistencies have led to some doubt concerning the use of chromium in influencing body composition.

In the present study, results from the two groups of the crossover study were markedly different. Results from subjects who received placebo followed by chromium in the crossover (group 1) seem straightforward and remarkably consistent with findings of others [1–4]. Although total b.w. losses were virtually the same in the placebo and verum periods of the first group, oral chromium intake brought about a significantly greater fat mass loss while preventing significant loss of non-fat body mass. The different direction of change in these two mass parameters when comparing the verum and placebo periods explains the lack of change in total b.w. between the placebo and verum periods of group 1, i.e. relative to placebo, the increased fat mass loss during chromium intake is counteracted by less loss in non-fat mass eventuating in an essentially similar total b.w. loss.

Results from the second group are more difficult to explain. The second placebo period actually showed greater fat loss than the initial verum period and a trend toward a greater weight loss. One could interpret these results as showing that in examining the overall data chromium has no apparent influence despite the findings in group 1. We do not believe that this is the case, and that another explanation must exist for the discrepancies between the placebo periods of groups 1 and 2. As a first approximation, we attributed these obvious differences to a carry over effect after chromium supplementation for 2 months at the 600 μg/day level.

We were unaware of previous crossover studies using chromium to help us to design the current study. Accordingly, we could not have predicted the outcome. Therefore, we attribute differences between the placebo periods of groups 1 and 2 to the accumulative effects of chromium in the body, i.e. the 1-month washout period was not long enough to completely wash away the 'chromium effect'. In fact, it would appear that the 'chromium effect' was even greater under these conditions–over a 2-month period. Thus, the placebo period of group 2 is still showing an effect from the previously ingested chromium. In retrospect, our experience from animal [26] and clinical studies [27] examining blood pressure and insulin response, respectively, suggests that chromium effects can last for a period of time after chromium supplementation is halted. Obviously, more studies are necessary to determine the proper dosing schedule for chromium use to aid loss of body fat, i.e. should supplementation be halted, or at least abated, after an appropriate loading period?

The use of bioelectrical impedance to estimate body composition, as was the case in the present study, has received support by some [28,29] and criticism by others [30,31]. Girandola and Contarsy developed a biolelectrical impedance technology termed electrolipography [20]. Using this technology, which incorporates an algorithmic method to predict body composition, they found a strong, positive correlation with a hydrostatic densitometry technique. Both densitometry (water) and bioimpedance were measured on 533 women and 420 men. Comparison of percent fat measurements by the two methods produced a multiple correlation for the combined sample of $R = 0.91$ with an SEE of $\pm 2.8\%$. In the present study, each individual served as her own control (placebo vs. verum) when comparing the results of electrolipography.

Marked changes were not noted in clinical chemistries. A previous study suggested that adversities could arise in red blood cell and iron metabolism in individuals taking chromium [8]. These perturbations were not apparent when examining chemistries after a 2-month challenge with niacin-bound chromium. There was a decrease in WBC count and platelets after the placebo period of group 2, however, no similar changes were seen in the first group. In addition, the concentrations of each were still in the normal range. More data must be gathered to determine if any clinical significance can be attributed to these findings. These patients were selected on the basis of their b.w. status, not on the basis of dyslipidemias. Suffice it to say, effects of chromium supplementation on various lipid parameters were not noted.

At least 10 studies have previously examined the role of chromium supplementation in the weight loss process [1–10]. These are outlined in table 4. Overall, it is not apparent that gender, age, exercising or non-exercising, means to assess body composition, dose and/or duration of examination will explain why some results were positive and others negative. All studies used chromium picolinate [1–10], with two exceptions. One also included yeast chromium and chromium chloride [8], and another chromium nicotinate [10]. The present study used niacin-bound chromium in an attempt to derive favourable results as far as losing fat and sparing protein. We conclude that: niacin-bound

Table 4 Reported human studies examining effects of chromium on body composition

	Reference	Subjects	Protocol	Groups	Duration	Body composition	Results/remarks
1.	Evans (+) 1989 [1]	2 Studies (1) 10 M (2) 31 M	Double-blind Parallel Strength train	Placebo 200 µg/d CP	40 days 6 Weeks	Skinfold thickness	(1) CP gained 1.6 kg LBM (2) CP had more fat loss and gained more BW
2.	Kaat *et al.* (+) 1991 [3]	154 M&F volunteers	Randomized Double-blind Parallel	Placebo 200 µg/d CP 400 µg/d CP	72 Days	Immersion Densitometry	CP lost 4.2 lb fat Gained 1.4 lb LBM
3.	Hasten *et al.* (±) 1992 [9]	59 collegiate M&F	Double-blind Parallel Strength train	Placebo 200 µg/d CP	12 Weeks	Skinfolds Strength Circumferences	CP Females gained LBM No sig changes in males
4.	Hallmark *et al.* (–) 1993 [5]	16 M	Double-blind Parallel	Placebo 200 µg/d CP Strength train	12 Weeks	Hydrodensitometry Skinfold	No significant changes in fat or LBM
5.	Clancy *et al* (–) 1994 [6]	36 M Football players	FB training Wgt training	Placebo 200 µg/d CP	9 Weeks	Hydrostatic Wgt Skinfold Strength	Effects of CP statistically insignificant
6.	Trent *et al.* (–) 1995 [7]	95 overweight M&F naval personnel	Double-blind Physical Exercise	Placebo 400 µg/d CP	16 Weeks	Circumferences	No sig changes in body composition
7.	Bahadori *et al.* (+) 1995 [2]	4 groups (6–10) Overweight Non-diabetics: M&F	Double-blind Low calorie d	Control Hi fibre Fibre suppl 200 µg/d CP	6 Months	Skinfold Measurements	Loss BW same in all Loss of LBM in 3 groups Increase LBM with CP
8.	Bulbulian *et al.* (+) 1996 [4]	40 collegiate swimmers M&F	Double-blind Swimming	Placebo 400 µg/d CP	24 Weeks	Immersion Densitometry	Lost fat/gained LBM 20–40% > than control Greater in F
9.	Lukaski *et al.* (–) 1996 [8]	36 M	Double-blind Wgt training	Placebp CCl 3.4 µm/d CP 3.4 µm/d 200 µg/d yeast	8 Weeks	DXA Anthropometry Body Strength	No beneficial effects on body comp or strength
10.	Grant *et al.* (±) 1997 [10]	43 healthy, obese F	Exercising & non-exercising	CP 200 µg bid E+Placebo E+CP 200 µg bid E+CN 200 µg bid	9 weeks	Hydrostatic Weighting	Gained wgt on CP alone Lost body wgt on E+CN No changes with E+CP and E+Placebo

+, Positive study. – Negative study. [] Reference in text. M = male, F = female, CP = chromium picolinate, CCl = chromium chloride, D = diet, CN = chromium nicotinate, E = exercise, Wgt = weight.

chromium can have favourable results in African Americans who are contemplating loss of fat mass. and no evidence of toxicity is seen after oral ingestion for 2 months of 600 µg chromium in the form of niacin-bound chromium.

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