Chromium

Fact Sheet for Health Professionals

This is a fact sheet intended for health professionals. For a general overview, see our consumer fact sheet.

Introducti

Chromium, as turally
present in ma mium also
exists as hexa steel and
other manufa ely on trivalent
chromium.

Chromium mi abolism by
potentiating i or this activity
has not been i nds to an
oligopeptide t um-binding
substance tha ote insulin
action [4,6-8]. Chromium might also have antioxidant effects [1].

In 2001, the Food and Nutrition Board (FNB) of the National Academies of Sciences, Engineering, and Medicine considered chromium to be an essential nutrient based on its effects on insulin action [2]. However, recent research has suggested that although chromium might have benefits at pharmacologic amounts (e.g., in the hundreds of mcg), it is not an essential mineral because an absence or deficiency of chromium does not produce abnormalities that can be reversed with the addition of chromium (see the Chromium Deficiency section below) [5,9-13]. The FNB has not evaluated chromium since 2001. However, in 2014, the European Food Safety Authority Panel on Dietetic Products, Nutrition and Allergies concluded that no convincing evidence shows that chromium is an essential nutrient and, therefore, setting chromium intake recommendations would be inappropriate [5].

In the blood, most chromium is bound to plasma proteins, particularly transferrin, and only about 5% is unbound [5,12]. Chromium accumulates mainly in the liver, spleen, soft tissue, and bone [2,5,12].

Chromium is excreted mainly in the urine [1,12,13]. Urinary chromium levels are therefore a good indicator of chromium absorption. However, because these levels are closely related to recent chromium intakes, they are not good indicators of chromium body stores [4,14]. Hair levels might reflect past chromium intakes [5], and some studies have measured chromium levels in hair, sweat, serum, and toenails [15,16]. However, no validated methods for determining c … deficiency state exist [6,8 …

Recomm…

Intake recomm … vided in the Dietary Refere … e of the FNB at the Nationa … [2]. DRI is the general term f … sessing nutrient intake … and sex, include the fol …

- Recomme … f intake sufficient … -98%) healthy individuals; often used to plan nutritionally adequate diets for individuals
- Adequate Intake (AI): Intake at this level is assumed to ensure nutritional adequacy; established when evidence is insufficient to develop an RDA
- Estimated Average Requirement (EAR): Average daily level of intake estimated to meet the requirements of 50% of healthy individuals; usually used to assess the nutrient intakes of groups of people and to plan nutritionally adequate diets for them; can also be used to assess the nutrient intakes of individuals
- Tolerable Upper Intake Level (UL): Maximum daily intake unlikely to cause adverse health effects

In its 2001 evaluation, the FNB found the existing data insufficient to derive an EAR for chromium. The FNB therefore established AIs for all ages based on usual chromium intakes in healthy populations [2]. Table 1 lists the current AIs for chromium.

Table 1: Adequate Intakes (AIs) for Chromium [2]

Age	Male	Female	Pregnancy	Lactation
Birth to 6 months*	0.2 mcg	0.2 mcg		
7–12 months*	5.5 mcg	5.5 mcg		
1–3 years	11 mcg	11 mcg		
4–8 years	15 mcg	15 mcg		
9–13 years	25 mcg	21 mcg		
14–18 years	35 mcg	24 mcg	29 mcg	44 mcg
19–50 years				
51+ years				

Download this ta

*For infants fr mean chromium inta r infants, complementa

Sources o

Food

Chromium is p ts, fruits, vegetables, nu hromium amounts in th ter conditions as well as agricultural and manufacturing processes used to produce them [4,7,12,17-20]. For example, the amount of chromium can vary 50-fold in samples of oatmeal because of growing and processing differences [21]. Some chromium can also be transferred to foods from stainless steel equipment during food processing and from pots and pans during cooking [3,4,10,17,20,22,23].

Most dairy products and foods high in sugar (e.g., sucrose and fructose) are low in chromium [2,17,24].

Human milk contains about 0.25 mcg/L chromium [2], but reported values vary widely. Small studies in Europe found chromium concentrations ranging from 0.14 to 10.8 mcg/L [5].

Dietary chromium absorption is low, ranging from about 0.4% to 2.5% [5,6]. Ascorbic acid and prostaglandin inhibitors, such as aspirin, increase chromium absorption, whereas oxalate and antacids inhibit it [1,22,25].

A variety of types of foods and their chromium levels per serving are listed in Table 2. Determining the chromium content of food is challenging because samples are easily contaminated by standard tools used for measurement and analysis [2]. Therefore, the values in Table 2 should only serve as a guide.

Table 2: Chromium Content of Selected Foods [17,19]

Food	Micrograms	
Grape juice, 1	[illegible]	[illegible]
Ham, 3 ounce	[illegible]	[illegible]
English muffin	[illegible]	[illegible]
Brewer's yeast	[illegible]	[illegible]
Orange juice, 1	[illegible]	[illegible]
Beef, 3 ounces	[illegible]	[illegible]
Lettuce, 1 wed	[illegible]	[illegible]
Turkey breast,	[illegible]	[illegible]
Barbecue sau	[illegible]	[illegible]
Tomato juice,	[illegible]	[illegible]
Apple, with peel, 1 medium	1.4	4
Green beans, ½ cup	1.1	3
Banana, 1 medium	1.0	3
Whole wheat bread, 1 slice	1.0	3
Ketchup, 1 tablespoon	1.0	3
Tomato, 1 medium	0.9	3
American cheese, 1½ ounces	0.8	2
Peanut butter, 1 tablespoon	0.6	2
Rice, white, ½ cup	0.6	2
Haddock, 3 ounces	0.6	2

Food	Micrograms (mcg) per serving	Percent DV*
Chicken breast, 3 ounces	0.5	1
Peas, ½ cup	0.4	1
Orange, 1 medium	0.4	1
Spaghetti, 1 cup	0.3	1
Carrots, raw, 1 medium	0.3	1
Egg, 1 medium	0.2	1
Celery, 1 stalk	0.1	0
Fat free milk, 1 cup	<0.1	0

Download this table as a CSV file

*DV = Daily Va ... veloped DVs
to help consu ... tary
supplements ... n is 35 mcg
for adults and ... ood labels to
list chromium ... d. Foods
providing 20% ... of a nutrient,
but foods prov ... a healthful
diet.

Dietary supp

Most multivita ... ly 35–120
mcg. Supplem ... d they
commonly pro ... contain up to
1,000 mcg [16,27].

Dietary supplements contain many forms of chromium, including chromium picolinate, chromium nicotinate, chromium polynicotinate, chromium chloride, and chromium histidinate [18,27]. The absorption of various forms of chromium is similar [6,9]. For example, research suggests that the proportion of chromium absorbed from chromium picolinate is about 1.2%, whereas that from chromium chloride is about 0.4% [1]. These values are similar to the proportion of chromium absorbed from food [5].

Chromium compounds contain various percentages of elemental chromium. For example, elemental chromium accounts for 12.4% of the weight of chromium picolinate [18,28]. The Supplement Facts label on a dietary supplement product declares the amount of elemental chromium, not the weight of the entire chromium compound, in the product.

Chromium Intakes and Status

The National Health and Nutrition Examination Survey (NHANES) provides dietary intake data for many nutrients, but not chromium [29]. Therefore, data on chromium intakes in the United States are limited.

A small study in eight men and 11 women in the United States found mean chromium inta... y for men
[30]. In anothe ... f 22 well-
balanced diets ... ged from
about 17 to 47 ... in the United
States have ch ... ake
assessment in ... ke was about
57 mcg/day fr

Data on chrom ... limited.
According to a ... dian
supplemental ... hose taking
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Chromiu

Chromium deficiency has not been reported in healthy populations, and no definitive deficiency symptoms have been established [3,4].

In three case studies published in the 1970s and 1980s, patients on long-term total parenteral nutrition (TPN) experienced adverse metabolic and neurological effects, including hyperglycemia, glycosuria, unexplained weight loss, peripheral neuropathy, glucose intolerance, and/or confusion [32-34]. These effects were alleviated with pharmacologic amounts of chromium. Although these adverse effects were presumed to be caused by chromium deficiency, the studies did not adequately evaluate the chromium concentrations in the TPN solutions [5].

Scientists have concluded, based on recent evaluations, that these studies do not provide evidence that the patients had chromium deficiency and thus do not demonstrate that heathy people can develop chromium deficiency [3,5,6,10,13].

Currently, chromium is routinely added to TPN solutions to provide 10–15 mcg chromium per day, a much higher daily amount than the approximately 0.15 mcg/day that healthy individuals absorb from a balanced diet [9]. Thus, the American Society for Parenteral and Enteral Nutrition and other experts recommend research on parenteral chromium requirements to determine whether chromium levels in TPN solutions should be lowered [9,13,35,36].

Chromium and Health

This section focuses on five conditions in which chromium might have beneficial effects: impai ome, polycystic ova an body mass.

Impaired gl

Because chro ave examined whether increa aired glucose tolerance.

Numerous ran of chromium supplements– s of mcg)–in people withou]. One of the most commo um supplementation for type 2 diabetes was a 1997 randomized controlled trial [37]. The trial assigned 180 adults age 35–65 years with type 2 diabetes to receive 100 mcg chromium (as chromium picolinate), 500 mcg chromium, or placebo twice daily for 4 months. At both 2 and 4 months, participants receiving 1,000 mcg/day chromium had significantly lower fasting serum glucose concentrations than those receiving placebo or 200 mcg/day chromium. At 4 months, for example, mean fasting serum glucose levels were 7.1 mmol/L (128 mg/dL) in the group receiving 1,000 mcg/day chromium and 8.8 mmol/L (159 mg/dL) in those receiving placebo. Mean serum glucose concentrations after a 75 g glucose challenge were also significantly lower at both 2 and 4 months in those receiving 1,000 mcg/day chromium (10.5 mmol/L [189 mg/dL] at 4 months vs. 12.3 mmol/L [222 mg/dL] for placebo). In comparison with placebo, both 200 mcg and 1,000 mcg/day chromium also significantly reduced fasting insulin concentrations at both 2 and 4 months, as well as insulin concentrations after a glucose challenge. Finally, hemoglobin A1c (HbA1c) levels were significantly lower after 4 months in participants receiving 200 mcg/day chromium (mean 7.5%) or 1,000 mcg/day chromium (mean 6.6%) than in those receiving placebo (mean 8.5%). HbA1c is a robust measure of blood glucose control because it reflects long-term changes in blood glucose levels [38].

Several subsequent studies that used various doses of chromium had inconsistent findings. A 2019 review of chromium and glycemic control included eight meta-analyses and systematic reviews of a total of 58 clinical trials [16]. The trials lasted from 3 weeks to 6 months and administered 1.28 to 1,000 mcg chromium dai [illegible] olinate, followed by ye [illegible] verall, when used as an adj [illegible] glucose and HbA1c levels [illegible] significance of these findin [illegible] ium supplementati [illegible] usions, noting the insufficien [illegible] people with type 2 diabete [illegible] rate glucose levels in healt [illegible]

Some researc [illegible] ation may vary, and supp [illegible] more severe insulin resista [illegible] ized trial in 137 participants age 30–70 years with type 2 diabetes, daily supplementation with 1,000 mcg chromium (as chromium picolinate) for 24 weeks did not significantly affect insulin sensitivity, fasting glucose levels, or HbA1c values in comparison with placebo [40]. However, some participants did respond to chromium supplementation, and these people had significantly lower insulin sensitivity (3.98 vs. 5.91 mg/kg fat-free mass/min) and higher fasting glucose (8.5 vs. 6.7 mmol/L [153 vs. 121 mg/dL]) and HbA1c levels (7.57 vs. 6.29%) than those who did not respond.

Manufacturers market chromium supplements widely in the United States for people with type 2 diabetes, and many adults use them in the hope that the supplements will reduce their risk of diabetes or improve their glycemic control [6,8,18,39]. However, FDA allows only the following qualified health claim for chromium picolinate dietary supplements:

> "One small study suggests that chromium picolinate may reduce the risk of insulin resistance, and therefore possibly may reduce the risk of type 2 diabetes. FDA concludes, however, that the existence of such a relationship between chromium picolinate and either insulin resistance or type 2 diabetes is highly uncertain" [41,42].

In its 2010 diabetes guidelines, the American Diabetes Association concluded that because studies have not definitively shown that chromium supplementation benefits people with diabetes or obesity, the association cannot recommend such supplementation [43]. This determination was based on conflicting … ies. Similarly, the associatio… ence is insufficient to … hromium and other micronu… 4]. Additional research is ne… , ethnic background, o… tion use) might be more … entation [18].

Metabolic s…

Metabolic syn… high triglyceride lev… rol level, hypertension, … isk of heart disease, diabe… component of this condition and is a potential therapeutic target for dietary interventions for metabolic syndrome [46]. A prospective study of 3,648 adults age 20–32 years found that baseline toenail chromium concentrations were inversely associated with the incidence of metabolic syndrome over 23 years of follow-up [47]. For these reasons, some scientists have hypothesized that chromium supplements might benefit people with metabolic syndrome.

Only a few clinical trials of chromium supplementation for metabolic syndrome have been conducted [46,48-50]. One of these trials included 63 adults age 18 to 75 years with metabolic syndrome who received either 500 mcg chromium picolinate or placebo twice daily for 16 weeks [46]. In comparison with placebo, chromium supplementation significantly increased acute insulin response to glucose but did not affect HbA1c levels, insulin sensitivity, or other measures of glucose metabolism. Chromium supplementation also had no effect on body weight or serum lipids.

Similarly, in a 2018 clinical trial of 70 adults (mean age 58 years) with metabolic syndrome and impaired glucose tolerance, daily supplementation with 300 mcg chromium (200 mcg with breakfast and 100 mcg with dinner, as chromium yeast) for 24 weeks did not affect fasting glucose levels, HbA1c, waist circumference, blood pressure, or lipid levels [49].

Overall, limited research suggests that chromium supplements do not significantly benefit people with metabolic syndrome.

Polycystic o

PCOS is a com ... uctive age. It is characterize ... sm, and elevated risks ...]. Because insulin resista ... ave investigated th ... S to help maintain glyce

Four recent sy ... clinical trials have examine ... symptoms of PCOS [52,54-5 ... 351 participants th ... at 200 mcg to 1,000 mcg ... ion had no effect on fasting blood glucose, total testosterone, dehydroepiandrosterone, follicle-stimulating hormone, or luteinizing hormone levels. However, chromium did significantly reduce body mass index (BMI) by 2.37 kg/m^2 and free testosterone levels by 0.52 pg/mL in comparison with placebo; it also significantly reduced fasting insulin levels by 0.33 milli-IU/mL.

Another systematic review and meta-analysis of five randomized trials lasting 8 weeks to 6 months that included a total of 268 women with PCOS compared supplemental chromium (200–1,000 mcg/d, mostly as chromium picolinate) with placebo or metformin [55]. Chromium supplementation had no significant effect on fasting insulin levels or insulin sensitivity, but data from two trials showed that it did significantly lower a measure of insulin resistance. In addition, one trial included in the review found that chromium supplementation significantly improved a measure of beta-cell function. The authors concluded that the magnitude of chromium's effect was small and of uncertain clinical relevance. Similarly, another meta-analysis and a systematic review had mixed findings [54,56].

Overall, the evidence on whether chromium supplementation reduces the risk of PCOS or is beneficial for women with this condition is mixed, making it difficult to draw firm conclusions [16]. Additional studies with sufficient samples sizes and duration in well-defined populations are needed [53].

Dyslipidemia

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elevated bloo [illegible] size that
chromium sup [illegible] es have
examined this [illegible] vith impaired
glucose tolera [illegible]

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controlled typ [illegible] with 600
mcg/day chro [illegible] cholesterol,
HDL, low-dens [illegible] evels in
comparison w [illegible] en with PCOS
age 18–40 yea [illegible] picolinate
significantly d [illegible] cebo (−19.2
vs. +8.3 mg/d [illegible]) [58]. Results of studies with higher doses of supplemental chromium have also been mixed [37,59].

Overall, meta-analyses examining the effects of chromium supplementation in people with diabetes [60-64] and PCOS [54] have shown no significant changes in total cholesterol and LDL cholesterol levels [16]. However, some have shown that chromium supplementation increases HDL cholesterol levels by 1.73–4.64 mg/dL and decreases triglyceride levels by 11.71–26.57 mg/dL [63,64].

Additional research is needed to determine whether chromium supplementation has any clinically significant effects on dyslipidemia.

Weight and lean body mass

Because chromium might amplify insulin action, some scientists have proposed that chromium supplementation could reduce the amount of glucose converted to fat and increase protein synthesis and, hence, muscle mass [12]. Some preliminary research also indicates that chromium supplements might reduce food intakes, hunger levels, and fat cravings [65]. Therefore, chromium supplementation has been proposed to both enhance weight loss and improve body composition by decreasing body fat and increasing lean body mass; its effects on these outcomes have been evaluated in several clinical trials [12,66-69].

A 2019 meta-analysis included 21 trials that measured the impact of chromium supplementation on anthropometric indexes in a total of 1,316 participants age
18 or older wit … rom 9 to 24
weeks, and ch … trials used
chromium pic … chromium
nicotinate. Pa … antly more
weight, 0.75 k … 0 kg/m^2
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Overall, research suggests that supplementation with chromium, mainly in the form chromium picolinate, reduces body weight and body fat percentage to a very small, but statistically significant, extent. However, these effects have little clinical significance.

Health Risks from Excessive Chromium

The FNB concluded that no adverse effects have been linked to high intakes of chromium from food or supplements, so it did not establish a UL for chromium [2]. However, the FNB noted that caution may be warranted because the data are limited and that high intakes of chromium could have adverse effects [2,3,6]. The FNB also pointed out that people with renal and liver disease might be susceptible to adverse effects from high chromium intakes [2].

According to isolated case reports, chromium supplements might cause weight loss, anemia, thrombocytopenia, liver dysfunction, renal failure, rhabdomyolysis, dermatitis, and hypoglycemia [73,74].

Interactions with Medications

Several types of medications have the potential to interact with chromium supplements. A few examples are provided below. People taking these and other medications on a regular basis should discuss their chromium intakes with their health care pr

Insulin

Chromium mi ... mium concomitantly ... [77].

Metformin a

The results fr ... ation might lower blood gl ... upplements might have an ... medications and thus migh

Levothyroxi

A small study found that taking chromium picolinate supplements at the same time as levothyroxine (used to treat hypothyroidism) decreases levothyroxine absorption over 6 hours [78].

Chromium and Healthful Diets

The federal government's 2020–2025 *Dietary Guidelines for Americans* notes that "Because foods provide an array of nutrients and other components that have benefits for health, nutritional needs should be met primarily through foods. … In some cases, fortified foods and dietary supplements are useful when it is not possible otherwise to meet needs for one or more nutrients (e.g., during specific life stages such as pregnancy)."

For more information about building a healthy dietary pattern, refer to the *Dietary Guidelines for Americans* (https://www.dietaryguidelines.gov) and the U.S. Department of Agriculture's *MyPlate.* (https://www.choosemyplate.gov/)

The *Dietary Guidelines for Americans* describes a healthy dietary pattern as one that

- Includes a variety of vegetables; fruits; grains (at least half whole grains); fat-free and low-fat milk, yogurt, and cheese; and oils.
    - Many whole grains, fruits, and vegetables are good sources of chromium.
- Includes ... ; eggs; seafood; ... ducts.
    - Lean ...
- Limits fo... fat, and sodium.
- Limits alc...
- Stays wit...

Referenc...

1. Anderson ... Blackman MR, et al., eds ... York, NY Informa H...
2. Institute o... nce Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc Washington, DC: National Academy Press; 2001.
3. Vincent JB, Lukaski HC. Chromium. Adv Nutr 2018;9:505-6. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/30032219/)]
4. Eckhert CD. Trace Elements. In: A. Catharine Ross BC, Robert J. Cousins, Katherine L. Tucker, Thomas R. Ziegler, ed. Modern Nutrition in Health and Disease. 11th ed. Baltimore, MD: Lippincott Williams & Wilkins; 2014:248-51.
5. European Food Safety Authority NDA Panel. Scientific Opinion on Dietary Reference Values for chromium. EFSA Journal 2014;12(10):3845.

6. Vincent JB. Chromium In: Marriott BP, Birt DF, Stallings VA, Yates AY, eds. Present Knowledge in Nutritoin 11th ed. Cambridge, MA: Elsevier; 2020:457-65.
7. Swaroop A, Bagchi M, Preuss HG, Zafra-Stone S, Ahmad T, Bagchi D. Benefits of chromium (III) complexes in animal and human health. In: Vincent JB, ed. The Nutritional Biochemistry of Chromium (III). Cambridge, MA: Elsevier; 2019:251-78.
8. Landman GW, Bilo HJ, Houweling ST, Kleefstra N. Chromium does not belong in the diabetes treatment arsenal: Current evidence and future perspectives. World J Diabetes 2014;5:160-4. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/24748929/)]
9. Vincent JB, Brown S. Introduction: A history of chromium studies (1955-2007). In: Vincent JB, ed. The Nutritional Biochemistry of Chromium (III). Cambridg
10. Vincent J … race element. J Nutr 20 … (https://pu
11. Vincent J … m(III) as a second m … Med abstract (https://pu
12. Nielsen F … Other Trace Elements … esent Knowledg … 7.
13. Nielsen F … , and clinical importan … search. In: Vincent J … . Cambridge, MA Elsev
14. Anderson RA, Polansky MM, Bryden NA. Stability and absorption of chromium and absorption of chromium histidinate complexes by humans. Bio Trace Elem Res 2004;101:211-8. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/15564651/)]
15. Davies S, McLaren Howard J, Hunnisett A, Howard M. Age-related decreases in chromium levels in 51,665 hair, sweat, and serum samples from 40,872 patients--implications for the prevention of cardiovascular disease and type II diabetes mellitus. Metabolism 1997;46:469-73. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/9160809/)]

16. Costello RB, Dwyer JT, Merkel JM. Chromium supplements in health and disease. In: Vincent JB, ed. The Nutritional Biochemistry of Chromium (III). Cambridge, MA: Elsevier; 2019:219-59.
17. Anderson RA, Bryden NA, Polansky MM. Dietary chromium intake. Freely chosen diets, institutional diet, and individual foods. Biol Trace Elem Res 1992;32:117-21. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/1375047/)]
18. Wang ZQ, Cefalu WT. Current concepts about chromium supplementation in type 2 diabetes and insulin resistance. Curr Diab Rep 2010;10:145-51. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/20425574/)]
19. Dattilo AM, Miguel SG. Chromium in Health and Disease. Nutr Today 2003;38:121-33.
20. Hamilton EM, Young SD, Bailey EH, Watts MJ. Chromium speciation in foodstuff ... bstract (https://pu
21. Vincent J ... llero B, Finglas P ... cademic Press; 20
22. Vincent J ... Kingdom: John Wiley & S
23. Kuligowsk ... ificant source of nickel, ... 92;23:211-5. [PubMed
24. Kozlovsky ... ts high in simple su ... 35:515-8. [PubMed
25. Seaborn C ... n tissue accumulation and urinary excretion of 51chromium. Nutr Res 1990;10:1401-7.

26. U. S. Food and Drug Administration. Food Labeling: Revision of the Nutrition and Supplement Facts Labels. (https://www.federalregister.gov/documents/2016/05/27/2016-11867/food-labeling-revision-of-the-nutrition-and-supplement-facts-labels) 2016.
27. National Institutes of Health. Dietary Supplement Label Database. (https://dsld.nlm.nih.gov/dsld/index.jsp) 2020.
28. Komorowski J, Juturu V. Chromium supplementation does not improve glucose tolerance, insulin sensitivity, or lipid profile: a randomized, placebo-

controlled, double-blind trial of supplementation in subjects with impaired glucose tolerance: response to Gunton et al. Diabetes Care 2005;28:1841-2; author reply 2-3. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/15983360/)]

29. U.S. Department of Agriculture and Agricultural Research Service. What We Eat In America. (https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/wweianhanes-overview/) 2018.
30. Anderson RA, Bryden NA, Polansky MM. Dietary intake of calcium, chromium, copper, iron, magnesium, manganese, and zinc: duplicate plate values corrected using derived nutrient intake. J Am Diet Assoc 1993;93:462-4. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/8454817/)]
31. Filippini T, Cilloni S, Malavolti M, Violi F, Malagoli C, Tesauro M, et al. Dietary intake of … and zinc in a Northern … -17. [PubMed abstract (…
32. Brown R… deficiency after long… 61-4. [PubMed …
33. Freund H, … total parentera… (https://pu…
34. Jeejeebh… ertson A. Chromiu… ersed by chromium… tal parenteral nutrition. … (https://pu…
35. Fessler TA. Trace elements in parenteral nutrition: a practical guide for dosage and monitoring for adult patients. Nutr Clin Pract 2013;28:722-9. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/24163318/)]
36. Vanek VW, Borum P, Buchman A, Fessler TA, Howard L, Jeejeebhoy K, et al. A.S.P.E.N. position paper: recommendations for changes in commercially available parenteral multivitamin and multi-trace element products. Nutr Clin Pract 2012;27:440-91. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/22730042/)]
37. Anderson RA, Cheng N, Bryden NA, Polansky MM, Cheng N, Chi J, et al. Elevated intakes of supplemental chromium improve glucose and insulin

variables in individuals with type 2 diabetes. Diabetes 1997;46:1786-91. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/9356027/)]

38. National Institute of Diabetes and Digestive and Kidney Diseases. The A1C Test & Diabetes. (https://www.niddk.nih.gov/health-information/diagnostic-tests/a1c-test) 2018.
39. Costello RB, Dwyer JT, Bailey RL. Chromium supplements for glycemic control in type 2 diabetes: limited evidence of effectiveness. Nutr Rev 2016;74:455-68. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/27261273/)]
40. Cefalu WT, Rood J, Pinsonat P, Qin J, Sereda O, Levitan L, et al. Characterization of the metabolic and physiologic response to chromium supplementation in subjects with type 2 diabetes mellitus. Metabolism 2010;59:755-62. [PubMed abstract (https://pu
41. U. S. Foo … etters of Denial. (h … ealth-claims-letters-den
42. Trumbo P … f type 2 diabetes: … and Drug Administr … (https://pu
43. American … diabetes--2010. Di … ct (https://pu
44. American … ation, nutrition, … re, and immuniza … abstract (https://pubmed.ncbi.nlm.nih.gov/25537702/)]
45. National Heart Lung and Blood Institute. Metabolic Syndrome. (https://www.nhlbi.nih.gov/health-topics/metabolic-syndrome) 2019.
46. Iqbal N, Cardillo S, Volger S, Bloedon LT, Anderson RA, Boston R, et al. Chromium picolinate does not improve key features of metabolic syndrome in obese nondiabetic adults. Metab Syndr Relat Disord 2009;7:143-50. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/19422140/)]
47. Bai J, Xun P, Morris S, Jacobs DR, Jr., Liu K, He K. Chromium exposure and incidence of metabolic syndrome among American young adults over a 23-

year follow-up: the CARDIA Trace Element Study. Sci Rep 2015;5:15606. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/26489690/)]

48. Ali A, Ma Y, Reynolds J, Wise JP, Sr., Inzucchi SE Katz DL (2011). Chromium effects on glucose tolerance and insulin sensitivity in persons at risk for diabetes mellitus. Endocr Pract 17:16-25. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/20634174/)]
49. Nussbaumerova B, Rosolova H, Krizek M, Sefrna F, Racek J, Muller L, et al. Chromium supplementation reduces resting heart rate in patients with metabolic syndrome and impaired glucose tolerance. Biol Trace Elem Res 2018;183:192-199. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/28856601/)]
50. Kim HN, Kim SH, Eun YM, Song SW. Effects of zinc, magnesium, and chromium supplementation on cardiometabolic risk in adults with metaboli … mised trial. J Trace Ele … (https://pu …
51. Goldrat O … Clin Biochem 2018;62:2 … ov/30195483/)]
52. Fazelian … mentation and polycysti … lysis. J Trace Elem Me … (https://pu …
53. Piotrowsk … , Wolak M, et al. The po … orting treatment … 2019;192:91-7. [PubMed …
54. Tang XL, … with polycystic ovary syndrome: Systematic review and meta-analysis. J Obstet Gynaecol Res 2018;44:134-43. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/28929602/)]
55. Heshmati J, Omani-Samani R, Vesali S, Maroufizadeh S, Rezaeinejad M, Razavi M, et al. The effects of supplementation with chromium on insulin resistance indices in women with polycystic ovarian syndrome: a systematic review and meta-analysis of randomized clinical trials. Horm Metab Res 2018;50:193-200. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/29523006/)]

56. Maleki V, Izadi A, Farsad-Naeimi A, Alizadeh M. Chromium supplementation does not improve weight loss or metabolic and hormonal variables in patients with polycystic ovary syndrome: A systematic review. Nutr Res 2018;56:1-10. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/30055769/)]
57. Paiva AN, Lima JG, Medeiros AC, Figueiredo HA, Andrade RL, Ururahy MA, et al. Beneficial effects of oral chromium picolinate supplementation on glycemic control in patients with type 2 diabetes: A randomized clinical study. J Trace Elem Med Biol 2015;32:66-72. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/26302914/)]
58. Jamilian M, Zadeh Modarres S, Amiri Siavashani M, Karimi M, Mafi A, Ostadmohammadi V, et al. (2018). The influences of chromium supplementation on glycemic control, markers of cardio-metabolic risk, and oxidative stress in infertile polycystic ovary syndrome women candidate for in vitro fe … olled trial. Biol Trace Ele …
(https://pu …
59. Gunton J … ster-Powell K, et al. Chr … lerance, insulin se … olled, double-blind trial … e tolerance. Diabetes …
(https://pu …
60. Balk EM, … f chromium suppleme … atic review of randomiz … [PubMed abstract (…
61. Patal PC, … ct of chromium picolinate on glucose and lipid profiles among patients with type 2 diabetes mellitus. Philipp J Intern Med 2010;48:32-7.
62. Abdollahi M, Farshchi A, Nikfar S, Seyedifar M. Effect of chromium on glucose and lipid profiles in patients with type 2 diabetes; a meta-analysis review of randomized trials. J Pharm Pharm Sci 2013;16:99-114. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/23683609/)]
63. Suksomboon N, Poolsup N, Yuwanakorn A. Systematic review and meta-analysis of the efficacy and safety of chromium supplementation in diabetes. J Clin Pharm Ther 2014;39:292-306. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/24635480/)]

64. Huang H, Chen G, Dong Y, Zhu Y, Chen H. Chromium supplementation for adjuvant treatment of type 2 diabetes mellitus: Results from a pooled analysis. Mol Nutr Food Res 2018;62. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/28677892/)]
65. Anton SD, Morrison CD, Cefalu WT, Martin CK, Coulon S, Geiselman P, et al. Effects of chromium picolinate on food intake and satiety. Diabetes Technol Ther 2008;10:405-12. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/18715218/)]
66. Manore MM. Dietary supplements for improving body composition and reducing body weight: where is the evidence? Int J Sport Nutr Exerc Metab 2012;22:139-54. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/22465867/)]
67. Tian H, Guo X, Wang X, He Z, Sun R, Ge S, et al. Chromium picolinate
suppleme ... tabase Syst
Rev 2013
(https://pu
68. Willoughb ... es in weight
loss: stra ... y mass, a
brief revie
(https://pu
69. Lukaski H ... ent. In:
Vincent J ... Cambridge,
MA: Elsev
70. Tsang C, ... A meta-
analysis ... pometric
indices o ... ;9:e12313.
[PubMed
71. Onakpoya I, Posadzki P, Ernst E. Chromium supplementation in overweight and obesity: a systematic review and meta-analysis of randomized clinical trials. Obes Rev 2013;14:496-507. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/23495911/)]
72. Pittler MH, Stevinson C, Ernst E. Chromium picolinate for reducing body weight: meta-analysis of randomized trials. Int J Obes Relat Metab Disord 2003;27:522-9. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/12664086/)]
73. Fowler JF, Jr. Systemic contact dermatitis caused by oral chromium picolinate. Cutis 2000;65:116. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/10696566/)]

74. Vincent JB. The potential value and toxicity of chromium picolinate as a nutritional supplement, weight loss agent and muscle development agent. Sports Med 2003;33:213-30. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/12656641/)]
75. Martin J, Wang ZQ, Zhang XH, Wachtel D, Volaufova J, Matthews DE, et al. Chromium picolinate supplementation attenuates body weight gain and increases insulin sensitivity in subjects with type 2 diabetes. Diabetes Care 2006;29:1826-32. [PubMed abstract (https://pubmed.ncbi.nlm.nih.gov/16873787/)]
76. Cefalu WT, Bell-Farrow AD, Stegner J, Wang ZQ, King T, Morgan T, et al. Effect of chromium picolinate on insulin sensitivity in vivo. J Trace Elem Exp Med 1999;12:71-83.
77. Natural Medicines TRC. Chromium. (https://na
78. John-Kala which decrease ubMed abstract (

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