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情况说明书—铁的营养和铅的毒性

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铁的代谢：概要

铁是一种必需的微营养物[1] [2] [3]。涉及的总量是小的，一个成年女性的体内含有 2-4 克铁（大约 38 毫克/公斤体重），一个成年男性可以达到 6 克（大约 50 毫克/公斤体重）[4]。男性趋于更多是因为体格大，没有遭受因为月经和一些开始与青春期的固有的差别的足够的失血[5][6]。成年男性通常有三倍于绝经前的女性的铁储存量（1000 毫克对比 300 毫克像是广泛地采用的数字，但是我还没有见过原始资料），对于素食主义者和杂食动物来是讲事实是正确的（480 毫克对比 160 毫克；可适用于同源问题）[7]。

大多数体内的铁是与血红蛋白结合[或 hemoglobin(美国拼写)]（发现于红血细胞[erythrocyte]）在那里它被用来运输和处理体内的氧气。多达 10% 的铁在肌红蛋白里被用来储存氧气在肌肉里[8][9][10]。多达 10% 的铁在肌红蛋白里被用来储存氧气在肌肉里[11][12][13][14]。 超过 4%用于肺的代谢[15] 在呼吸中扮演重要的角色[16]剩余的多数存在于复合铁蛋白，超过三分之二的复合铁蛋白储存于肝脏，剩余的多数分开储存在骨髓和网状内皮细胞内[17][18][19]。铁在体内的运输是由血清分子转铁蛋白处理的。是在细胞水平上通过 DMT1[二价金属转运载体 1]完成的[20][21][22]。整个复杂的系统被设置来保证有最少的自由铁离子，因为自由的铁离子具有高度反应性会通过氧化反应损害身体的器官[23][24]。

更小的痕量在身体之内履行着关键角色有如此功能，例如免疫防御[25][26],神经系统的功能[27][28][29],脱氧核糖核酸合成[30][31],细胞能量的产生[32]、肝功能[33]、细胞凋亡[34]、弹性蛋白产生[35] 和胶原产生[36]。铁水平与骨头强硬度和密度有关[37]; 铁缺乏症与女性运动员的应力性骨折有连系。[38]

铁不能从体内被系统的排出， 在体内再循环[39][40]主要通过巨噬细胞的网状内皮系统。脾脏和肝脏的巨噬细胞通常回收红血细胞在他们的自然寿命结束之前（ 120 天）每天清除 1 %[41]。 每天从食物吸收的总铁大约是成人体内总铁的 0.06%[42]，虽然这个数字对于婴儿可以乘以多达 6 倍[43]。铁从身体丢失的主要原因是失血（包括重大的消化道内失血[44]，尤其是运动员[45][46]）。这是铁状态的主要决定因素[47][48]虽然有些铁是通过汗水（高峰在严重出汗的半小时内）和皮肤丢失[49][50]。从尿中损失是最小的（约 0.1 毫克）[51]。大多数妇女的月经将有二至三倍的铁损失，青少年损失略高，但可以甚至更高[52]。饮食不能补充严重失血[53][54]。妇女有严重月经出血应该去看他们的医生的因为一些药物（包括避孕药）可以减少月经出血。

铁和铅：相互作用和铁的补充

低铁水平是与较高的血铅水平有关[55][56][57]，虽然没有因果关系的直接证据。铁和铅在体内占据相似的位点，因此竞争可能结合位点尤其是在吸收的时候[58]。在老鼠试验里，铁缺乏会增加铅的转移率到大脑，因为它们享有共同的转运载体（DMT1 ）[59] 。大鼠的研究表明铁可能可以减少铅诱导细胞凋亡（程序性细胞死亡）在大脑中[60]，和减少铅有关的大脑发育过程的中断[61]。

矫正严重的缺铁可能会大大影响血铅水平[62][63][64]。对于孕妇它可直接影响新生儿的血铅水平[65]。产妇低血铁水平或高血铅水平会增加胎儿在以后的生活中患精神分裂症的危险[66][67]。在儿童，纠正铁（或锌）缺乏可能导致停止异食癖（强制性消费非食品物品，如油漆或粘土） ，它可以是铅污染的来源[68]。

另一方面，对于铁摄入量是充足的铁补充的证据是不足的[69][70]，特别是低铅含量的患者[71]。对于那些环境暴露于铅是通过摄入的，补充铁剂有可能仍然是有益的[72]。

铁烹饪容器：下列项目，当烹调在不用防护表面的铁容器的时候，他们的铁含量将增加一倍以上。*后排*：红甘蓝，西红柿，米，玉米粉； *前排*：西红柿，辣椒（在美国甜椒或香蕉胡椒），蔬菜泥，野生稻，苹果酱，炒鸡蛋，玉米粉；*前景*：炒鸡蛋； *无图像*：牛奶。

铁的消费和铁的水平：一个长期的项目

铁的水平可以通过饮食修改[73][74][75]，虽然各个营养素的作用不应该被夸大[76]。身体能调节铁的吸收，这样当铁水平升高时铁的吸收就下降， 因为受到肝脏抗菌多肽激素的影响。[77].越多的肝脏抗菌多肽被肝细胞的产生，越少的铁会被吸收[78]。迅速改变铁的状态是不应该期望的[79][80]。

铁吸收的促进剂

就增加铁而言（增加身体的铁水平）一种最简单的方法是增加食物中的肉类。肉中大量的铁是铁血红素（haem）。[或 haeme, 或 heme（美国拼音）]。 有 15-40%的血红素铁在食物中被吸收， 与此相比有 1-15%的非血红素铁被吸收[81]。血红素铁被发现在动物类食品和一些补充物中。而非血红素铁被发现在动物，

植物和补充物中。煮过的牛肉含有更多的血红素铁（65%的铁含量），比煮过的猪肉（39%）和家禽或鱼类（26%）多[82]。

对于素食主义者和严格素食者一个好补充技术是通过烹调酸性菜(例如蕃茄或圆白菜)在非上釉的生铁罐[83]。非血红素铁的吸收能被减少，如果削弱胃酸度[84]（例如由变老，传染或者使用抗酸剂[85]）。维生素 C（抗坏血酸)明显地能提高非血红素铁的吸收[8687],虽然不应该夸张它的作用[88]。在食物吸收的时候，维生素 C 可能也会提高铁能力来置换铅[89] 。鱼油（和/或碳水化合物）能增加铁的吸收，在有某些重大的抑制剂存在的情况下[90]。

维生素 C：120 克的食物（上图）应提供足够的维生素 C，以优化铁的吸收（如煮熟的可高达 480 克，对于相应的果汁可查标签）。最上面一行：香菜，番石榴（果汁如图），黑加仑子（果汁如图），羽衣甘蓝；中排：萝卜，辣椒（美国甜椒），猕猴桃，花椰菜；下排：费约果，婴儿辣椒，甘蓝，番石榴，辣根；无图：芥菜，红辣椒，百里香

维生素 C：240 克的食物（上图）应提供足够的维生素 C，以优化铁的吸收（如果煮熟可高达 960g，相对应果汁可查标签）。最上面一行：水芹菜，大头菜[科尔拉比德国萝卜]（叶），银甜菜（菠菜在澳大利亚），爆玉米花。中间行：大头菜（灯泡），葡萄柚，橘子，柠檬，花椰菜；下行：木瓜[Paw paw 在澳大利亚]，草莓，青金桔，莳萝，泰国柠檬[K-lime，makrud lime]。无图：荔枝。

酒精扭转控制肝脏抗菌多肽激素的基因的作用（减低肝脏抗菌多肽的水平），从而导致更高的铁的吸收[9192]。重要的是要注意，尽管在高铁的水平，个人如果消费了大量的酒精，会比普通人增加了 5 倍的可能有血铅升高[93]，和在怀孕的妇女的案例，更有可能转移铅给胎儿[94]。

铁吸收的抑制剂：

钙可以减少铁的吸收 50-60%[95]，但是实验的资料含有不一致性。并且它对总的饮食的影响是很难估计的[96]。她是唯一的能够影响血红素和非血红素铁的抑制剂[97]。

下面关于抑制剂的评论只适用于非血红素铁：

大豆蛋白抑制铁的吸收[98]，除非该产品是发酵（如传统的酱油，丹贝或大酱）[99]。植酸[植酸在盐形式]（存在大量使用于全谷类，麦麸，坚果和种子[100]）可减少高达 90%，铁的吸收。即使是少量对铁的吸收有明显的抑制作用[101]。然而，这抑制效果由于抗坏血酸的存在而显着降低，维生素 C 的影响，是与植酸含量成正比例[102]。

钙和大豆：如图中牛奶或奶酪的量，会减少铁的吸收。一半的量将影响很小。如牛奶产品（像酸奶）检查标签（影响从 300 毫升或更多开始迅速加剧。）未发酵的大豆产品，(豆， 牛奶，和肉类替代品)能抑制铁的吸收，但含有高铁。

*肌醇六磷酸（植酸）：*最强大的铁抑制剂（上图）。当与酵母烤一起时抑制性最小（*右后*：全麦面包），并应该总是与维生素 C 一起食用（*左后*：苹果和黑加仑果汁）。*中排*：烤豆，豆（黑龟，黑眼睛，利马，白色，巴罗蹄），麸皮，花生；*前排*：葵花籽和芝麻，豌豆，豆类，坚果（杏仁，巴西，腰果），牛奶什锦

单宁（鞣质）（茶中找到的多酚）可以减少铁的吸收达 90%[103]（通常接近三分之二）[104]，但快速消散，而在咖啡中发现的其他多酚类物质有大约一半的作用，但作用时间较长[105]。类胡萝卜素（色素在浅绿色蔬菜之外）和维生素 C 可以拮抗多酚的影响[106][107]。

多酚：上述项目中含有多酚，可能抑制铁的吸收。请注意大量的肌醇六磷酸（植酸）重叠。*从左到右*：坚果（杏仁，巴西，腰果），豆类（黑龟，黑眼睛，利马，白色，巴罗蹄），咖啡，茶，酒，菜豆，荷兰豆，巧克力，坚果（花生），小扁豆，花生酱，烤豆；*无图像*：高粱

类胡萝卜素-在上述图中的一些物品找到的一些类胡萝卜素可能能够抗衡的咖啡和茶的多酚抑制性影响。*上排*：银色甜菜（在澳大利亚菠菜），黄色印度玉米，菊苣，莴苣，鲜红色的葡萄柚汁，罗勒。*中排*：壁球，红色卷心菜，西兰花，西瓜，粉红色葡萄柚，圆白菜，南瓜。*下排*：香蕉，芦笋，胡萝卜，西红柿，红洋葱，红辣椒，费约果，番石榴，苹果，红辣椒，豆，豌豆，香蕉辣椒（在美国的香蕉胡椒），鳄梨。*无图像*：多香果，胡椒草，香菜，猕猴桃。

类胡萝卜素和维生素 C：在这些项目中（左照片），这两种营养素的含量是很高的，在多酚存在时，应当能够最优化铁的吸收：*左到右*：羽衣甘蓝（盆栽），百里香，香蕉辣椒（在美国香蕉胡椒），辣椒（在美国的甜椒），红辣椒，番石榴，西兰花，费约果，猕猴桃。
一般注意：并非所有多酚抑制铁的吸收，也没有足够的证据确切知道个别的含有类来胡萝卜素的食物项目如何有效抵消那些作用。

蛋白（卵清蛋白）能够抑制铁的吸收达 27%每个蛋[108]。

鸡蛋：产品含有蛋清（如帕夫洛娃中心后）严重抑制铁的吸收，并应该被这些产品如木瓜，蛋黄布丁取代（因为维生素 C 会增加从鸡蛋的铁的吸收）。简单的陶瓷鸡蛋分离器是马上可用的。传统的意大利冰淇淋（不是所有的冰淇淋）可能使用蛋黄（右碗）或较不常用的蛋白（左碗）。

金属营养素：相对的竞争。

锌补充品能抑制铁的吸收，但只有在大剂量的水平[109]（剂量为 15 毫克/天似乎对铁吸收没有影响）。补铁应该对锌的水平影响很小[110]，虽然影响是可能的[111]。食用铁补充品不是以每日为基础应该会使问题减到最小[112]。铜缺乏症（通常由过度补锌引起[113]）在大鼠能抑制铁的吸收[114]能够拮抗补铁[115116]。锰严重影响了铁的吸收[117]，其吸收又被高铁储量阻碍[118]。

补铁：持谨慎态度

补铁直接通过药丸或多种维生素，应使用的非常谨慎，特别是儿童[119120]。凡采取补充低剂量可能几乎同采取高剂量一样有效[121122123]，甚至可能产生优越，低风险的长期效果。[124125126127]。最近的一项老鼠大脑的研究发现，在铅诱导的损伤中，较低水平的补铁比高水平的补铁得到了更正面的作用效果[128]。

虽然身体失去铁（例如通过月经）它没有系统地排泄铁，因此，从补充的累积效应可能是危险的，一个连续负载超过 1-2 毫克/天最终导致铁超负荷而导致器官衰竭[129]。对怀孕妇女的研究表明，每周补铁可能最好每天补充[130]。每周或每两周补充可以从根本上减少因补铁副作用的风险[131]。

高铁水平：影响

这是值得记住的是铁，也是一种神经毒素，在美国铁是 6 岁以下儿童的致命意外中毒事件的最大原因[132]。高铁水平提高疟疾和结核病的作用[133]。高铁水平有两倍患糖尿病的危险[134]。有高铁和高极低密度脂蛋白（VLDL）胆固醇水平显示两倍患癌症[135]和三倍患阿尔茨海默氏病的风险[136]。高铁水平会对肝脏影响，并可能导致肝衰竭[137]。

高水平的铁在怀孕期间与妊娠期糖尿病联系在一起[138]。婴儿出生体重会受到产妇高铁的水平的不利影响[139]。必须强调，然而，对大多数个人怀孕期间高铁的风险是大大低于那些低铁的[140141]；考虑补充的论据是强有力的[142143]。

‘缺铁不是一个诊断’

请记住，铁缺乏症可以是疾病的结果[144]包括癌症[145]。’缺铁不是一个诊断[146]。一种不充分地均衡饮食也许是诊断。

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