世界卫生组织

通过健康环境预防疾病

手工和小规模采金工人及其社区的汞接触和健康影响

《水俣公约》

2013 年 1 月，各国政府商定《汞问题水俣公约》的有法律约束力的文本 [1]。公约第 7 条和附件 C 的内容是手工和小规模采金业 [1]。附件 C 规定各国制订手工和小规模采金业国家计划，其中包括公共卫生战略，含卫生数据采集、卫生保健工作者培训以及通过卫生保健机构开展提高认识的活动。

手工和小规模采金业中使用汞

采金业中使用汞是为了形成“汞齐”—由差不多数量的汞和金组成的混合物—然后从中提取金 [2,3]。加热金汞齐将汞蒸发，剩下金 [2]。手工和小规模采金业使用这种采金法，因为该方案比大部分替代方法都便宜，而且可以由一个人独立操作，快速而简便 [3]。从全球看，手工和小规模采金业占汞排放总量的约 37%，而且也是空气和水汞污染的最大来源 [4]。汞齐燃烧地点附近空气中汞蒸汽的含量会非常高，往往超过世卫组织 1.0 微克/立方米的公众暴露限值。这些接触不仅影响到手工和小规模采金工人，而且会影响到金加工点附近社区的人员 [3]。蒸发的汞会最终沉降到土壤以及湖泊、河流、海湾和大洋的沉积物中，并通过厌氧生物形成甲基汞。水体中的甲基汞被浮游植物吸收，在浮游植物被浮游动物和鱼吞食后进入食物链。甲基汞会在长寿的食肉鱼类体内累积，包括鲨鱼和剑鱼 [3,5-8]。

手工和小规模采金业集中地区

全世界约有 1500 万人 70 个国家从事手工和小规模采金业，其中包括约 3 百万妇女儿童 [1]。这些国家主要在东亚、东南亚、撒哈拉以南非洲和南美洲。南亚、独立国家联合体（前苏联共和国）和其它欧洲国家也存在一些手工和小规模采金活动 [3,7]。

手工和小规模采金业造成的汞接触

很多现有有关手工和小规模采金业社区和矿工以及受手工和小规模采金业影响的社区汞接触情况的文献研究的都是头发中的汞含量。头发中的汞含量与饮食摄入甲基汞有关联[8]。其它对汞含量进行测量的生物基质包括尿和血。血汞浓度反映近期或当前汞接触情况，既包括元素汞也包括甲基汞；尿汞浓度反映元素汞和无机汞接触情况[8,9]。

居住在手工和小规模采金业社区或其附近的个人一般会由于食用被甲基汞污染的鱼或在汞齐燃烧过程中产生的汞蒸汽而发生汞接触[3]。对混合物加热以消除其中的汞或者将金和汞混合起来的工人的尿汞浓度会特别高。许多研究[10-17]报告的尿汞浓度高达50 微克汞/克肌酐以上，即已达到会对肾小管产生影响[18]；甚至达到 100 微克汞/克肌酐，此时出现汞中毒的典型神经症状的可能性“高”[19]。据报告，即使那些只是居住在手工和小规模采金业社区的人也会出现尿汞浓度高于 100 微克汞/克肌酐的情况，包括儿童[15,20-22]。居住在手工和小规模采金作业活动下游的人的头发中的汞含量也是暂定每周耐受摄入量（2.5 微克汞/克）的十倍以上[23-29]。甲基汞的暂定每周耐受摄入量是由联合国粮农组织/世卫组织食品添加剂联合专家委员会确定的[28]。

汞和健康结果

- 元素汞和甲基汞对中枢和外周神经系统有毒性。吸入汞蒸汽会对神经系统、消化系统和免疫系统以及肺和肾产生有害影响，甚至是致命的[5]。
- 神经症状包括精神发育迟缓、惊厥、视力和听力损失、发育滞后、语言障碍和记忆力减退。据报告，慢性汞接触会导致儿童出现以四肢发红疼痛为特征的肢痛症[5,8]。

汞和手工和小规模采金业社区的健康情况

目前有关手工和小规模采金业社区汞接触造成的健康影响的流行病学文献主要是涉及南美、亚洲和非洲三大洲多个国家的横断面研究。这些研究所涉及的主要健康结果包括神经障碍、肾功能不全和免疫毒性/自身免疫功能紊乱。

神经障碍和症状

- 几项关于手工和小规模采金业社区儿童的研究发现，汞浓度上升与深部肌腱反射增加、腿部协调差、视觉空间组织测试成绩下降、以及运动功能、视觉对比敏感度和手的灵巧程度下降有关[17,30-32]。
- 一项对菲律宾居住在金加工厂附近的儿童的研究揭示了重大不良神经影响[33]。

- 最近在布基纳法索进行的一项研究发现，参与金汞混合、汞齐加热或黄金交易和销售的人群中，频繁头痛、睡眠障碍、异常疲倦、颤抖和视力障碍的流行率高于一般人群[11]。对厄瓜多尔金矿工人的研究发现，血汞浓度和尿汞浓度与颤抖、反应时间和姿势不稳定增加有关[10]。
- 在巴西亚马逊塔帕若斯河流域进行研究的调查人员发现有三人患轻度水俣病，还有三人疑似患水俣病[35]。

肾功能不全

- 接触高浓度元素汞会对肾脏产生影响[9]。有两项研究发现，汞浓度与手工和小规模采金业社区居民肾功能不全或肾脏微损伤有关[36,37]。

免疫毒性/自身免疫功能紊乱

- 四项研究报告，接触甲基汞与巴西亚马逊采金者的自身免疫功能紊乱有关[38-41]。

采金业中的汞替代工艺

手工和小规模采金业中可以消除或大大减少汞的使用。联合国环境规划署已提出如下建议：

- 全矿混汞、不带蒸汽采集蒸馏系统的露天燃烧汞齐和用氰化物对汞污染废渣进行处理的工艺应予停止，以减少汞接触和汞排放[3,42]。
- 应在手工和小规模采金业中使用替代工艺，如重力选矿、直接熔炼和安全的化学浸出法，以减少或消除汞接触和汞排放[3]。

结论

手工和小规模采金业社区的汞接触与不良健康影响有关，包括肾功能不全、自身免疫功能紊乱和神经症状。手工和小规模采金从业人员的尿汞浓度高于可引起神经和肾脏影响的水平。鱼是手工和小规模采金业所在地区许多人群的主要蛋白质来源，但有关头发中汞含量的证据表明，鱼类受到甲基汞的污染。报告的头发中汞含量数据显著高于暂定每周耐受摄入量。

如需更多世卫组织有关汞问题的更多信息，请访问：http://www.who.int/ipcs/assessment/public_health/mercury/en/index.html

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