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Review Article

# Should Workers Avoid Consumption of Chilled Fluids in a Hot and Humid Climate?

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ABSTRACT

Despite provision of drinking water as the most common method of occupational heat stress prevention, there remains confusion in hydration messaging to workers. During work site interactions in a hot and humid climate, workers commonly report being informed to consume tepid fluids to accelerate rehydration. When questioned on the evidence supporting such advice, workers typically cite that fluid absorption is delayed by ingestion of chilled beverages. Presumably, delayed absorption would be a product of fluid delivery from the gut to the intestines, otherwise known as gastric emptying. Regulation of gastric emptying is multifactorial, with gastric volume and beverage energy density the primary factors. If gastric emptying is temperature dependent, the impact of cooling is modest in both magnitude and duration ($\leq$ 5 minutes) due to the warming of fluids upon ingestion, particularly where workers have elevated core temperature. Given that chilled beverages are most preferred by workers, and result in greater consumption than warm fluids during and following physical activity, the resultant increased consumption of chilled fluids would promote gastric emptying through superior gastric volume. Hence, advising workers to avoid cool/cold fluids during rehydration appears to be a misinterpretation of the research. More appropriate messaging to workers would include the thermal benefits of cool/cold fluid consumption in hot and humid conditions, thereby promoting autonomy to trial chilled beverages and determine personal preference. In doing so, temperature-based palatability would be maximized and increase the likelihood of workers maintaining or restoring hydration status during and after their work shift.



Heat stress education is a key element for mitigating heat-related harm in the workplace. In addition to identifying practical evidence-based strategies to combat heat stress, educational sessions provide workers an opportunity to address heat- and hydration-related queries. From workers based in hot and humid regions of Northern Australia during the period October 2016 to April 2017 (encompassing the hottest months), common questions of the author relating to hydration were: “Is it true that drinking cool fluids is bad for hydration?” “Don’t cool fluids need to be warmed to body temperature to optimize hydration?” Such queries followed the presentation of research and workplace case studies related to heat stress mitigation strategies of ingesting cold fluids [1,2] or crushed ice [2–4]. By contrast, workers predominantly reported advice from workplace health and safety staff to promote rehydration through consumption of tepid fluids while dehydrated during or after their work shift. When asked why chilled fluids are not recommended for rehydration, workers generally reported being informed that absorption is delayed by ingestion of cool/cold beverages. Prior to absorption in the small intestine (intestinal absorption), fluids are released from the stomach, a process otherwise known as gastric emptying (GE). A direct influence of cool/cold beverages on intestinal absorption is unlikely as fluids entering the small intestine approximate body temperature owing to equilibration within the stomach [5]. Delayed absorption of cool/cold fluids would therefore be mediated by a beverage temperature-induced decrement of GE.

The search for evidence supporting the aforementioned workplace advice revealed a host of hydration-themed internet health/wellness articles and blogs [6], with recommendations for and against cool/cold fluid ingestion supported by anecdotes. Within the peer-reviewed literature, some researchers report enhanced GE following ingestion of cold (5°C) or cool (12°C) fluid [7,8], or no GE

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differences between a variety of meal temperatures [9]. However, the advice reported by workers may be based on observations of lower GE immediately after consumption of a cold meal (4°C) as opposed to a thermoneutral (37°C) meal [10], or cold beverage (4°C) compared to hot (50°C) beverage [11]. Notably, the reported GE delay was both modest in magnitude and duration ($\leq$ 5 minutes). If temperature is a key regulator of GE, the warming of fluids upon ingestion [12], particularly where workers have elevated core temperature, would act to minimize any GE discrepancy between cool/cold and tepid fluids. The rewarming of the gastrointestinal tract following cool/cold fluid ingestion is routinely observed when monitoring workers' core temperature with thermosensitive pills prior to the thermometers passing the pyloric sphincter [13], but serial cold fluid ingestion [14] or crushed ice consumption [15] may result in sustained lowering of gastrointestinal temperature. On the balance of the research, this is thought to have minimal negative effect on GE and overall fluid absorption [16], as gastric volume and beverage energy density are the key determinants of GE [5].

The minimal influence of beverage temperature on GE is a significant point, as a survey of 190 workers from hot and humid regions of Northern Australia in late 2016 revealed an overwhelming majority prefer to ingest cool (54.2%) or cold beverages (32.1%) compared to thermoneutral (11.1%), warm (2.1%), or hot fluids (0.5%) during their work shift (unpublished observations). The preference for cool/cold fluids is reflected in the ubiquitous provision of ice on worksites across Northern Australia [17], permitting workers to chill fluids to desired temperature thereby improving palatability [18]. Such an approach is supported by evidence, as access to cool or cold fluids increases consumption during [19,20] or after physical activity [21,22]. The resultant additional fluid consumption would promote GE through higher gastric volume. Hence, advising workers to avoid cool/cold fluids during rehydration appears to be a misinterpretation of the research. More appropriate messaging to workers would include the thermal benefits of cool/cold fluid consumption in hot and humid conditions, thereby promoting autonomy to trial chilled beverages and determine personal preference. In doing so, temperature-based palatability would be maximized and increase the likelihood of workers maintaining or restoring hydration status during and after their work shift.

## Conflicts of interest

The author declares no conflict of interest.

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