UK Health Security Agency

Minimum water requirements

A rapid evidence summary

Contents

Main messages

1. This rapid evidence summary (search up to 29 June 2023) searched for, identified, and summarised systematic reviews exploring what is the minimum amount of fluid or water the average individual needs to survive or remain healthy over a 7-day period during a national power outage or disaster, including any different considerations for vulnerable groups.

2. Four reviews were identified that addressed the research question (1 to 4), 3 systematic reviews (1 to 3) and one systematic scoping review (4). Three systematic reviews focused on literature broadly concerning water needs following extreme events or natural disasters in mixed populations. One systematic review assessed oral hydration in older adults.

3. The reviews had retrieved a limited number of primary studies and grey literature on water needs following a disaster such as flooding or in humanitarian efforts, and the effect on several health outcomes. No review had identified studies specifically investigating the minimum amount of fluid intake (through drinking or food consumption) required to prevent effects on mortality or other relevant health-related outcomes.

4. One review investigated the necessary amount of water to minimise adverse outcomes in populations affected by natural disasters (1). This review found receiving larger quantities of water was associated with reduced diarrhoeal diseases and mortality in those <5 years of age, but no evidence was found concerning the minimum amount of fluid necessary to remain alive, and there was very low certainty in the evidence.

5. One review in older adults aged 60 years and above recommended consuming at least 1,600 millilitres (mL) of fluid per day to prevent dehydration in acute care, residential, or community settings (3).

6. Some reviews recommended between 15 and 20 litres of water per person per day for personal consumption and for other behaviours such as cooking and cleaning (1, 2). These conclusions were based on low quality evidence, a limited number of primary studies, and grey literature/guidelines.

Purpose

The purpose of this rapid evidence summary was to identify and assess the available evidence for the minimum amount of water (or fluid) that people require over a 7-day period and how this compares to vulnerable subgroups, in the context of a national power outage or disaster.

Methods

The review question was:

1. What is the minimum amount of water (or fluid) healthy people require over a 7-day period, and how might that differ for vulnerable subgroups (including older people, infants, pregnant people, those on home dialysis, those on certain medications, for example diuretics)?

A rapid evidence summary was completed in July 2023, which identified review level evidence to answer the research question specified above. We searched Ovid MEDLINE, Embase, Cochrane Database of Systematic Reviews and Epistemonikos to identify any existing reviews (systematic or rapid) or evidence summaries related to the review question, published prior to 29 June 2023. Title and abstract screening was completed by 4 reviewers, with at least 10% screened in duplicate (and any disagreements resolved by discussion). Full text screening was undertaken by 3 reviewers, with 10% completed in duplicate and disagreements resolved by discussion. Data extraction was undertaken by one reviewer. Due to time constraints critical appraisal of included studies was not undertaken. A protocol was produced before the literature search was conducted, including eligibility criteria, see Annexe A. There were no deviations from the protocol.

Evidence

There were 5,118 articles identified for title and abstract screening and 71 progressed to full text screening. Of these, one article could not be retrieved and 4 were included (1 to 4). Full data extraction tables can be found in Annexe B.

One review (De Buck and others, 2015) investigated how much daily water is needed for a person to remain healthy and to prevent mortality among survivors of natural disasters and in refugee camp settings (1). The review included 6 observational studies (one study during a disaster and 5 post-disaster studies such as in refugee camps in Ghana, Kenya, Malawi, Mozambique and post-emergency camps in Azerbaijan, Ethiopia, Myanmar, Nepal, Tanzania, Thailand and Uganda). There were 2 case-control and 4 cross-sectional studies included. Generally, the evidence was graded as very low quality due to incomplete data on outcomes or high variation among study outcomes. The review noted disagreement among experts on water

requirements at different phases of a disaster, but generally this was in the region of 15 to 20 litres per person per day (l/p/d). Higher amounts of water (for example, above 18.9 l/p/d) were related to lower disease rates in children younger than 6 years of age ($p<0.02$) in a single cross-sectional study. The review also found a potential relationship between a larger amount of water provided and reduced diarrhoeal disease and mortality rates in those under 5 years of age, however there was inadequate data to recommend a specific quantity of water, and very low certainty in the evidence.

One review (Carmichael and others, 2013) investigated the impact of water shortage on health following an extreme natural event by reviewing and synthesising peer-reviewed and grey literature (2). The review identified 24 records all of which were categorised as non-analytic studies, for example, case reports, case series, and expert opinions, and did not identify any high-quality primary studies for example, randomised-controlled trials. A key finding concerned the internationally recognised guidelines for the minimum standards in disaster response (Sphere project) which recommended between 15 and 20 litres/person/day (l/p/d) of water (hospitals = 40 to 60 litres/inpatient/day with more for other services such as laundry). The review could not establish the evidence base for this recommendation.

One included study (Behnke and others, 2020) performed a scoping review of the literature concerning environmental conditions in protracted displacement settings and described water quantity consumption (4). The review found 18 records (study designs not specified but included grey literature and peer-reviewed primary studies) indicating water consumption per capita per day ranged between 1 and 40 litres. This review did not identify evidence regarding the minimum amount of water required for the average person to prevent mortality.

The final included review (Hodgkinson and others, 2003) investigated risk factors for dehydration in older persons aged over 60 years of age (3). The review looked for randomised controlled trials (RCTs) and observational studies, but the authors did not specify the design of studies included in the review. The review found 17 records and the majority of studies were assessed as having low methodological quality. The review did not establish a minimum required amount of water intake to prevent mortality but found that the average older individual should consume no less than 1,600 mL/24h to prevent dehydration, based on grey literature (existing guidelines) rather than high level evidence.

Health inequalities

The limited evidence available was in groups who were at risk of inequalities such as older people and refugees in disaster settings. However, it was not possible to explore inequalities through variations across populations and subgroups, for example cultural variations or differences between ethnic, social or vulnerable groups.

Limitations

This rapid evidence summary used streamlined systematic methods to accelerate the review process. It was limited to review level evidence and therefore if primary studies exist that are not captured in these reviews, they will not have been included. Most article screening was completed without duplication, and thus it is possible relevant studies may have been missed. Due to time constraints critical appraisal was not undertaken which limits our ability to interpret the findings in the context of risk of bias. The included primary studies in each review did not answer the research question and majority of these studies were of low methodological quality and therefore any conclusion draw is based on low quality evidence.

Evidence gaps

As this rapid evidence summary was limited to reviews, it cannot inform whether there are evidence gaps in primary studies on this topic.

Conclusion

Overall, no evidence was identified to conclusively answer the research question. The relevant reviews that were identified included a mix of peer-reviewed studies and grey literature recommending the quantity of water or fluids needed to maintain health in mixed clinical and real-world settings for the average individual. An overarching message from the reviews was a requirement for between 15 and 20 litres of water per person per day spread across drinking, cleaning, and cooking, however this was not based on good quality evidence. Furthermore, the evidence did not specifically stratify water needs by demographic or social characteristics making it problematic to translate the average recommended water needs across varied populations in real-world settings. At best, the extant evidence found large variation in the amount of water needed to maintain normal health (although health was not well defined in the literature) but suggested it should be at least 15 l/p/d in displaced individuals during or after a natural disaster and that older community dwelling individuals should consume at least 1,600 mL/day to prevent dehydration. This evidence was based on studies with low methodological quality and on grey literature questioning internal validity and limiting the extent to which study outcomes can be translated onto real world cohorts comparable to study samples. There was no evidence in any other vulnerable groups.

Acknowledgments

We would like to thank colleagues within the All Hazards Public Health Response division who either reviewed or input into aspects of the review. Search terms for power outage and power cuts were adapted from literature searches developed by Caroline De Brun, Knowledge and Evidence Specialist for UKHSA South West.

Disclaimer

UKHSA's rapid reviews and evidence summaries aim to provide the best available evidence to decision makers in a timely and accessible way, based on published peer-reviewed scientific papers, unpublished reports and papers on preprint servers. Please note that the reviews:

- use accelerated methods and may not be representative of the whole body of evidence publicly available
- have undergone an internal, but not independent, peer review
- are only valid as of the date stated on the review

In the event that this rapid evidence summary is shared externally, please note additionally, to the greatest extent possible under any applicable law, that UKHSA accepts no liability for any claim, loss or damage arising out of, or connected with the use of, this review by the recipient and/or any third party including that arising or resulting from any reliance placed on, or any conclusions drawn from, the review.

References

1. De Buck E and others. 'A systematic review of the amount of water per person per day needed to prevent morbidity and mortality in (post-)disaster settings' PLOS One 2015: volume 10, issue 5, article e0126395
2. Carmichael C and others. 'Water shortages and extreme events: a call for research' Journal of Water and Health 2013: volume 11, issue 3, pages 377 to 381
3. Hodgkinson B and others. 'Maintaining oral hydration in older adults: a systematic review' International Journal of Nursing Practice 2003: volume 9, issue 3, pages S19 to S28
4. Behnke NL and others. 'Environmental health conditions in protracted displacement: A systematic scoping review' Science of the Total Environment 2020: volume 726, page 138234

Annexe A. Protocol

Eligibility criteria

	Included	Excluded
Population	Adults and children (Including vulnerable groups including older people, infants, pregnant people, those on home dialysis, those on certain medications, for example diuretics)	Animals
Settings	All (except hospital)	Inpatients
Context	National power outage or national disasters Evidence from non-disaster settings also relevant	
Intervention/exposure	Water or fluid intake	Fluid from food (unless combined in results)
Outcomes	• dehydration • death • hospitalisation • any outcomes indicating declining health or dehydration	
Language	Studies written in English language	
Date of publication	Any	
Study design	Systematic reviews	Primary studies
Publication type	Published and pre-print	

Search strategy

Database: Ovid MEDLINE(R) ALL <1946 to 29 June 2023>

1. Electric Power Supplies/ (8,872)
2. Electricity/ (19,716)
3. 1 or 2 (27,954)
4. (failure* or supply or supplies or cut or cuts or outage* or insecurity or instability or unstable or limited).tw,kf. (2,436,060)
5. 3 and 4 (2,666)
6. (blackout* or ((electric* or power) adj3 (cut* or outage* or failure* or suppl* or insecurity or loss))).tw,kf. (11,263)
7. 5 or 6 (13095)
8. exp Disasters/ (99,883)
9. ((disaster* or emergency or emergencies) adj5 (plan* or mitigat* or prepar* or stockpil*)).tw,kf. (14,724)
10. (drought* or hurricane* or flood* or forest fire*).tw,kf. (58,879)
11. Geological Phenomena/ or Avalanches/ or Earthquakes/ or Landslides/ or Tidal Waves/ or Tsunamis/ or Volcanic Eruptions/ or Wildfires/ (11,694)
12. (tidal wave* or volcanic eruption* or tsunami* or landslide* or avalanche* or earthquake* or Storm* or wildfire* or Snowstorm* or heat wave* or coldwave* or land fire* or Sandstorm* or cyclone* or typhoon* or extreme heat* or extreme cold* or extreme temperature*).tw,kf. (53,862)
13. (Camp or camps or refugee* or internal* displac*).tw,kf. (110,035)
14. Refugees/ (13,184)
15. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 (315,200)
16. Water/ (191,950)
17. Water Deprivation/ (3,053)
18. Thirst/ (3,409)
19. exp Drinking Water/ (11,897)
20. Drinking/ (14,773)
21. water.tw,kf. (961,796)
22. ((fluid* or beverage*) adj3 (require* or consum* or intake* or drink* or suppl* or resource* or scarce or scarcity or depriv* or shortage* or quality or quantit* or availab* or amount* or per person or allocat* or allowance*)).tw,kf. (29,004)
23. Dehydration/ (14,665)
24. dehydrat*.tw,kf. (50,385)
25. thirst*.tw,kf. (5,285)
26. exp Sanitary Engineering/ (135,675)
27. (sanitation or sanitary or hygien* or wash* or clean* or wastewater*).tw,kf. (428,786)
28. exp Water Supply/ (35,338)
29. Water Resources/ (1,472)
30. exp Water Pollution/ (31,916)
31. or/16-30 (1,493,460)

32. drinking habit*.tw,kf. (2,593)
33. (recommend* or guideline* or reference intake*).tw,kf. (1,186,626)
34. dietary allowance*.tw,kf. (2,357)
35. hydration criteria.tw,kf. (5)
36. exp Guideline/ (3,7748)
37. Drinking Behavior/ (6,884)
38. Nutrition Policy/ or Recommended Dietary Allowances/ (12,741)
39. exp Water/ad (2,223)
40. exp Drinking Water/st (699)
41. or/32-40 (1,216,390)
42. 15 and 31 (42,679)
43. 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 (1,083,342)
44. 41 and 43 (41,693)
45. 42 or 44 (82,918)
46. limit 45 to "reviews (maximizes specificity)" (1,285)
47. limit 45 to "systematic review" (806)
48. 46 or 47 (1,370)

Database: Embase <1974 to 29 June 2023>

1. power supply/ (10,383)
2. electricity/ (36,196)
3. 1 or 2 (45,672)
4. (failure* or supply or supplies or cut or cuts or outage* or insecurity or instability or unstable or limited).tw,kf. (3,431,720)
5. 3 and 4 (6,186)
6. (blackout* or ((electric* or power) adj3 (cut* or outage* or failure* or suppl* or insecurity or loss))).tw,kf. (13,113)
7. 5 or 6 (16,580)
8. exp disaster/ (34,581)
9. exp disaster planning/ (14,552)
10. ((disaster* or emergency or emergencies) adj5 (plan* or mitigat* or prepar* or stockpil*)).tw,kf. (18,127)
11. (drought* or hurricane* or flood* or forest fire*).tw,kf. (58,131)
12. "geographic and geological phenomena"/ or avalanche/ or earthquake/ or landslide/ or storm surge/ or tsunami/ or volcanic ash/ or volcano/ or exp wildfire/ (24,009)
13. (tidal wave* or volcanic eruption* or tsunami* or landslide* or avalanche* or earthquake* or Storm* or wildfire* or Snowstorm* or heat wave* or coldwave* or land fire* or Sandstorm* or cyclone* or typhoon* or extreme heat* or extreme cold* or extreme temperature*).tw,kf. (64,382)
14. (Camp or camps or refugee* or internal* displac*).tw,kf. (130,353)
15. refugee camp/ or exp forced migrant/ (18,321)
16. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 (319,365)
17. exp water/ (571,178)

18. water deprivation/ (4,624)
19. thirst/ (6,373)
20. exp beverage/ (270,420)
21. drinking/ (28,890)
22. water.tw,kf. (1,111,707)
23. ((fluid* or beverage*) adj3 (require* or consum* or intake* or drink* or suppl* or resource* or scarce or scarcity or depriv* or shortage* or quality or quantit* or availab* or amount* or per person or allocat* or allowance*)).tw,kf. (39,911)
24. dehydration/ (49,253)
25. dehydrat*.tw,kf. (62,395)
26. thirst*.tw,kf. (6,734)
27. exp sanitation/ (550,859)
28. (sanitation or sanitary or hygien* or wash* or clean* or wastewater*).tw,kf. (538,087)
29. exp water management/ (211,701)
30. exp water pollution/ (149,703)
31. or/17-30 (2,288,744)
32. drinking habit*.tw,kf. (3,415)
33. (recommend* or guideline* or reference intake*).tw,kf. (1,755,050)
34. dietary allowance*.tw,kf. (2,858)
35. hydration criteria.tw,kf. (6)
36. drinking behavior/ (55,574)
37. dietary reference intake/ or nutrition policy/ (6,426)
38. exp practice guideline/ (717,516)
39. or/32-38 (2,153,031)
40. 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 (1,550,995)
41. 16 and 31 (55,763)
42. 39 and 40 (82,150)
43. 41 or 42 (135,825)
44. limit 43 to "reviews (maximizes specificity)" (2,284)

Cochrane Database of Systematic Reviews

Date run: 30 June 2023

ID	Search	Hits
#1	MeSH descriptor: [Electric Power Supplies] explode all trees	82
#2	MeSH descriptor: [Electricity] explode all trees	944
#3	(failure* or supply or supplies or cut or cuts or outage* or insecurity or instability or unstable or limited)	234,136
#4	#1 OR #2	1,017
#5	#3 AND #4	206
#6	(blackout* or ((electric* or power) NEAR/3 (cut* or outage* or failure* or suppl* or insecurity or loss)))	1,141
#7	#5 OR #6	1,245

#8	MeSH descriptor: [Disasters] explode all trees	1,965
#9	((disaster* or emergency or emergencies) NEAR/5 (plan* or mitigat* or prepar* or stockpil*))	654
#10	(drought* or hurricane* or flood* or forest NEXT fire*)	786
#11	MeSH descriptor: [Geological Phenomena] this term only	3
#12	MeSH descriptor: [Avalanches] explode all trees	5
#13	MeSH descriptor: [Earthquakes] explode all trees	47
#14	MeSH descriptor: [Landslides] explode all trees	4
#15	MeSH descriptor: [Tidal Waves] explode all trees	3
#16	MeSH descriptor: [Tsunamis] explode all trees	4
#17	MeSH descriptor: [Volcanic Eruptions] explode all trees	0
#18	MeSH descriptor: [Wildfires] explode all trees	6
#19	(tidal NEXT wave* or volcanic NEXT eruption* or tsunami* or landslide* or avalanche* or earthquake* or Storm* or wildfire* or Snowstorm* or heat NEXT wave* or coldwave* or land NEXT fire* or Sandstorm* or cyclone* or typhoon* or extreme NEXT heat* or extreme NEXT cold* or extreme NEXT temperature*)	1,810
#20	(Camp or camps or refugee* or internal* NEXT displac*)	3,598
#21	MeSH descriptor: [Refugees] explode all trees	236
#22	{OR #7-#21}	9,620
#23	MeSH descriptor: [Water] explode all trees	3,014
#24	MeSH descriptor: [Water Deprivation] explode all trees	39
#25	MeSH descriptor: [Thirst] explode all trees	261
#26	MeSH descriptor: [Drinking Water] explode all trees	201
#27	MeSH descriptor: [Drinking] explode all trees	1,141
#28	water	38,442
#29	((fluid* or beverage*) NEAR/3 (require* or consum* or intake* or drink* or suppl* or resource* or scarce or scarcity or depriv* or shortage* or quality or quantit* or availab* or amount* or per person or allocat* or allowance*))	7,794
#30	MeSH descriptor: [Dehydration] explode all trees	855
#31	dehydrat*	4,094
#32	thirst*	1,477
#33	MeSH descriptor: [Sanitary Engineering] explode all trees	439
#34	(sanitation or sanitary or hygien* or wash* or clean* or wastewater*)	78,488
#35	MeSH descriptor: [Water Supply] explode all trees	235
#36	MeSH descriptor: [Water Resources] explode all trees	0
#37	MeSH descriptor: [Water Pollution] explode all trees	90
#38	{OR #23-#37}	120,737
#39	drinking habit*	892
#40	(recommend* or guideline* or reference intake*)	136,480
#41	dietary allowance*	725
#42	hydration criteria	1,078

#43	MeSH descriptor: [Guideline] explode all trees	1,015
#44	MeSH descriptor: [Drinking Behavior] explode all trees	5,460
#45	MeSH descriptor: [Nutrition Policy] explode all trees	567
#46	MeSH descriptor: [Recommended Dietary Allowances] explode all trees	142
#47	MeSH descriptor: [Water] explode all trees and with qualifier(s): [administration & dosage - AD]	361
#48	MeSH descriptor: [Drinking Water] explode all trees and with qualifier(s): [standards - ST]	18
#49	{OR #39-#48}	143,294
#50	#22 AND #38	1,325
#51	{OR #23-#32}	48,758
#52	#49 AND #51	7,437
#53	#50 OR #52	8,422

Filtered to Cochrane Systematic Reviews only: 1,951 results

Epistemonikos

2 separate searches run, with results downloaded separately and then de-duplicated along with results from all other databases searched.

Search 1

(blackout* OR power cut* OR power failure* OR power outage* OR power suppl* OR power insecurity OR power loss OR electric* cut* OR electric* failure* OR electric* outage* OR electric* suppl* OR electric* insecurity OR electric* loss OR disaster* OR emergency OR emergencies OR drought* OR hurricane* OR flood* OR forest fire* OR tidal wave* OR volcanic eruption* OR tsunami* OR landslide* OR avalanche* OR earthquake* OR storm* OR wildfire* OR snowstorm* OR heat wave* OR cold wave* OR land fire* OR sandstorm* OR cyclone* OR typhoon* OR extreme heat* OR extreme cold* OR extreme temperature* OR refugee* OR camp OR camps OR internal* displac*) AND (water OR fluid OR beverage* OR drinking OR dehydration OR sanitation OR sanitary OR hygien* OR wash* OR clean* OR wastewater*)

Limited to systematic reviews: 59 results

Search 2

(water OR fluid OR beverage* OR drinking OR dehydration) AND (guideline* OR recommendation* OR reference intake* OR dietary allowance*)

Limited to systematic reviews: 558 results

Annexe B. Data extraction table

Study	Review type, context, time period	Inclusion criteria	Outcome
Behnke 2020 (4)	Scoping review Environmental health in displaced populations (worldwide) Searches conducted between September 2017 and January 2018	Forcibly displaced populations Concerning environmental health/human health Focused on the setting in which displaced people reside (unless setting intended for permanent resettlement) Articles prior to 1945 excluded	18 articles were found concerning average water consumption per day (ranged from 1to 40 litres). One systematic review found which assessed minimum water allocation needed in post-disaster settings but with no primary data to present.
De Buck 2015 (1)	Systematic review Amount of water needed to prevent morbidity and mortality in post-disaster settings (worldwide) Searches conducted from database inception to September 2014	Studies conducted in disasters and refugee camp settings Provision of a specified amount of water described, compared to provision of another amount of water, or none Health-related outcomes	Minimum standards for drinking water per person per day range from 1.89 to 7 litres. Two studies suggestive of a relationship between the amount of water provided and diarrhoeal disease or mortality rates in those under 5 years; however, there was inadequate data to recommend a specific quantity of water, and very low certainty in the evidence.
Carmichael 2013 (2)	Systematic review Extreme events, water shortages, and resultant impacts Searches conducted 2005 to the present, date not otherwise specified	Not presented	Sphere project (guidelines on minimum standards in disaster response) suggests 15 to 20 litres of water per person per day, and less than a 30-minute wait for water collection. However, unclear what the evidence base for these recommendations was. Authors also note that in the event of supply failure, under the Security and Emergency Measures Direction (SEMD) in the UK, water companies required to provide a minimum of 10 litres per day.
Hodgkinson 2003 (3)	Systematic review Oral hydration in older adults Searches from 1966 to February 2002	Adults under 60 years of age in acute care, residential, or community settings	Several different recommended daily intakes of water were found among the literature, numerous studies used 1,600 ml/day or 1,500 ml/day for adequate hydration.

About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation heath secure.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

Prepared by Stefano Brini, Naomi Carter, Jennifer Hill, Katie Kerr, Maheen Qureshi and Caroline De Brun, Serena Carville, July 2023.

For queries relating to this document, contact: enquiries@ukhsa.gov.uk

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