Journal of Interdisciplinary Science Topics

Abi Dahlzim's Horrible Wilting Spell – Severe Dehydration

Amelia Milton
Natural Sciences (Life and Physical Sciences), School of Biological Sciences, University of Leicester
19/02/2025

Abstract
One spell in the fantasy world of Dungeons & Dragons, is "Abi Dahlzim's Horrible Wilting" spell. When cast, this spell sucks the moisture out of all creatures within a 30ft cube, inflicting 12d8 damage. However, in reality, losing moisture from the body would not result in arbitrary damage. Instead, it would trigger a series of biological failures with severe biological and physical consequences. This paper will categorise the level of dehydration based on damage to allow these symptoms to be implemented within the game.

Keywords: *Role-Playing Game; Biology; Dehydration; Dungeons and Dragons;*

Introduction
Dungeons & Dragons (DND) is a table-top role-playing game set in a fantasy world. Within the game, players (of certain classes) and enemies can both use magic and cast spells. One spell is "Abi Dahlzim's Horrible Wilting" spell [1]. This spell causes the moisture to be sucked out of all creatures within a 30ft cube inflicting 12d8 damage (the sum of 12 rolls of an 8-sided dice) which can be halved if they succeed at a constitution saving throw (rolling a 20-sided dice to get a constitution value over a certain threshold).

Whilst this spell inflicts significant damage in the game, it does not account for the physiological effects of dehydration. This paper will quantify water loss based on the damage taken by a character to see the impacts they should experience.

Quantifying Damage from Dehydration
Excluding instances when damage is halved (due to a successful saving throw), the average amount of damage when 12 d8s are rolled is 54 (Eq,1), with a minimum of 12×1=12 damage and a maximum of 12×8=96.

$$Average\ roll\ of\ 1d8 = \frac{1+2+3+4+5+6+7+8}{8}$$
$$Average\ roll\ of\ 1d8 = 4.5$$
$$Average\ roll\ of\ 12d8 = 12 \times 4.5 = 54\ \ (Eq, 1)$$

Using this range of 12-96 we can quantify water loss into *mild* (12-40 damage), *moderate* (41-68 damage) and *severe* (69-96 damage). We also assume the effects are cumulative and as the level of dehydration increases, previous symptoms will still be experienced as well as new symptoms.

Mild Dehydration (12-40 points of damage)
Symptoms of mild dehydration can occur after only a small loss of about 1-2% of total body weight of water [2]. Even mild dehydration can lead to a decrease in cognitive function, especially in tasks relying on attention, short-term memory and psychomotor skills [3]. There are different theories suggesting why dehydration could decrease cognitive performance. For example, the body releases more cortisol when dehydrated, worsening active learning and compromising short-term memory [4]. As well as this, dehydration can modify the permeability of the blood-brain barrier, reducing the supply of glucose and oxygen to the brain vital for biochemical processes, such as respiration [5].

Moderate Dehydration (41-68 points of damage)
As the level of dehydration increases, blood water content decreases leading to a variety of impacts.

This decrease in blood water concentration results in a net movement of water out of the cells and into the blood (Figure 1). Consequently, the volume of the cells decreases, increasing the osmotic pressure, causing the cytoplasm to become over-crowded. The distance between molecules is now smaller, leading to aggregation and the occurrence of unwanted chemical reactions depleting cell resources, and

leading to irreversible precipitation of molecules [6].

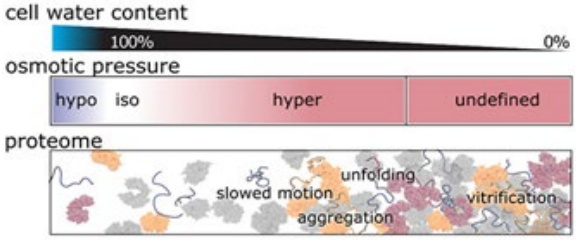

Figure 1 – Diagram showing the impacts of decreasing cell water content on osmosis, and the proteome of the cell [6].

The decrease in water concentration in cells also impacts proteins (including enzymes which drive metabolic reactions) within the cell, causing electrostatically driven complexes to dissociate, proteins with like charges to aggregate and protein unfolding to occur at a higher rate [6]. As well as this, the cytoplasm becomes more viscous slowing protein motion [6]. This will slow cellular processes that rely on proteins, especially enzymes, such as respiration and DNA replication.

The cardiovascular system is also impacted by the decrease in blood water concentration and consequently blood plasma volume. This leads to a decrease in the transport of nutrients, oxygen and waste products. This triggers compensatory measures such as an increase in heart rate attempting to maintain blood circulation, which increases cardiac strain and the chances of developing cardiovascular disease [7].

With a decrease in blood water concentration, more antidiuretic hormone (ADH) is released. ADH binds to receptors on the collecting duct of the kidney initiating a cascading signalling response that leads to more water being reabsorbed into the blood [8]. This leads to the production of more concentrated urine which increases the risk of kidney stones and urinary tract infections (UTIs) [9].

In general, the decreased blood volume caused by dehydration leads to a decrease in the transport of oxygen, nutrients and waste. This means that organs do not receive enough products for necessary reactions and causes a build-up of waste products [10].

Severe Dehydration (69-96 damage)

As the level of dehydration increases the gravity of these impacts increase, until death occurs around a water loss of 20% of body mass [11].

Severe dehydration can lead to hypovolemic shock where the heart cannot supply enough blood to the body due to the decreased blood volume and pressure. In cases of severe dehydration, this can lead to multiple-organ failure as they no longer receive enough oxygen to function [12]. A limited supply of blood to the kidneys reduces the amount of waste excreted from the body, and in extreme cases, urination stops completely [13].

This leads to a build-up of urea and other toxins in the blood leading to organ poisoning (uraemia) and potential metabolic collapse as these waste products can alter the pH of the environment where these reactions occur [14].

Brain damage can also occur due to the brain not receiving enough oxygen (hypoxia) [15] and brain cells shrinking due to hypernatremia [16].

Implementing in Game

These symptoms can be implemented into DND to increase immersion. This can be done by giving players a temporary disadvantage on ability checks which would be impacted by said symptoms or long-term effects on health. Symptoms of dehydration and potential ways to implement in game are as follows:

Mild: confusion and fatigue – *disadvantage on intelligence, wisdom, intuition until water is consumed.*

Moderate: increased heartrate, decreased rate of urination, kidney stones, UTIs, dried out skin, as well as mild symptoms – *disadvantage on all checks until water is consumed.*

Severe: brain damage (seizures, difficulty moving, memory loss [15]) organ failure, metabolic collapse as well as mild and moderate symptoms – *previous disadvantages and max health decreased to half health to account for long-term damage.*

Conclusion

Overall, quantifying the levels of dehydration based on damage done by the spell can increase immersion as it allows players to implement different symptoms into the game using existing gameplay mechanics. Players can use the symptoms described, the suggested ways of implementing and their own game knowledge to add immersion tailored to their play style.

References

[1] Wizards of the Coast. (2015). *Elemental Evil Player's Companion*, Wizards of the Coast, Chapter 2 (Spells), p. 150.

[2] Riebl, S.K. & Davy, M.D. (2013) *The Hydration Equation: Update on Water Balance and Cognitive Performance.* ACSM's Health & Fitness Journal, vol. 17, pp. 21–28. DOI: 10.1249/FIT.0b013e3182a9570f

[3] Adan, A. (2012*) Cognitive Performance and Dehydration.* Journal of the American College of Nutrition, vol. 31, pp. 71–78, DOI: 10.1080/07315724.2012.10720011

[4] Wilson, M-M.G. & Morley, J.E. (2003). *Impaired Cognitive Function and Mental Performance in Mild Dehydration."* European Journal of Clinical Nutrition, vol. 57, pp. S24-29, DOI: 10.1038/sj.ejcn.1601898

[5] Faraco, G., Wijasa, T.S., Park, L., Moore, J., Anrather, J. & Iadecola, C. (2014) *Water Deprivation Induces Neurovascular and Cognitive Dysfunction through Vasopressin-Induced Oxidative Stress*. Journal of Cerebral Blood Flow & Metabolism, vol. 34, pp. 852–860, DOI: 10.1038/jcbfm.2014.24

[6] Romero-Perez, P.S., Dorone, Y., Flores, E. Sukenik, S. & Boeynaems, S. (2023) *When Phased without Water: Biophysics of Cellular Desiccation, from Biomolecules to Condensates*. Chemical Reviews, vol. 123, pp. 9010–9035, DOI: 10.1021/acs.chemrev.2c00659

[7] Watso, J.C. & Farquhar, W.B. (2019) *Hydration Status and Cardiovascular Function.* Nutrients, vol. 11, p. 1866, DOI: 10.3390/nu11081866.

[8] Cuzzo, B., Padala, S.A. & Lappin, S.L. (2023) *Physiology, Vasopressin*. *StatPearls*, StatPearls Publishing, Available at: www.ncbi.nlm.nih.gov/books/NBK526069/. [Accessed: 11 February 2025]

[9] Martin, L. (2024) *What to Know about Kidney Failure and Dehydration*. Medicalnewstoday.com, Medical News Today, [online] www.medicalnewstoday.com/articles/kidney-failure-dehydration#causes-of-dehydration [Accessed: 11 February 2025]

[10] Tyagi, A. & Aeddula, N.R. (2019). *Azotemia*. *StatPearls*, StatPearls Publishing, Available at: www.ncbi.nlm.nih.gov/books/NBK538145/ [Accessed: 11 February 2025]

[11] Otsuka Pharmecutical Co., LTD. (n.d.) *When the Body Lacks Water*. Otsuka Pharmaceutical Co., Ltd., [online] www.otsuka.co.jp/en/nutraceutical/about/rehydration/water/dehydration-signs/. [Accessed: 11 February 2025]

[12] Taghavi, S., Nassar, A-k. & Askari, R. (2023) *Hypovolemic Shock*. *StatPearls*, StatPearls Publishing, Available at: www.ncbi.nlm.nih.gov/books/NBK513297/ [Accessed: 11 February 2025]

[13] Roland, J. (2019) *How to Recognize Severe Dehydration and What to Do.* Healthline. [online] www.healthline.com/health/severe-dehydration#causes [Accessed: 11 February 2025]

[14] Zemaitis, M.R., Foris, L.A., Katta, S. & Bashir, K. (2022) *Uremia* StatPearls, StatPearls Publishing. Available at: https://www.ncbi.nlm.nih.gov/books/NBK441859/ [Accessed: 11 February 2025]

[15] Badii, C. (2018) *Brain Hypoxia.* Healthline, Healthline Media [online] www.healthline.com/health/cerebral-hypoxia#causes [Accessed: 11 February 2025]

[16] Muhsin, S.A. & Mount, D.B. (2016) *Diagnosis and Treatment of Hypernatremia*. Best Practice & Research Clinical Endocrinology & Metabolism, vol. 30, pp. 189–203, DOI: 10.1016/j.beem.2016.02.014