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Short Communication

The Household Water Insecurity Experiences (HWISE) Scale: comparison scores from 27 sites in 22 countries

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ABSTRACT

Household survey data from 27 sites in 22 countries were collected in 2017–2018 in order to construct and validate a cross-cultural household-level water insecurity scale. The resultant Household Water Insecurity Experiences (HWISE) scale presents a useful tool for monitoring and evaluating water interventions as a complement to traditional metrics used by the development community. It can also help track progress toward achievement of Sustainable Development Goal 6 'clean water and sanitation for all'. We present HWISE scale scores from 27 sites as comparative data for future studies using the HWISE scale in low- and middle-income contexts. Site-level mean scores for HWISE-12 (scored 0–36) ranged from 1.64 (SD 4.22) in Pune, India, to 20.90 (7.50) in Cartagena, Colombia, while site-level mean scores for HWISE-4 (scored 0–12) ranged from 0.51 (1.50) in Pune, India, to 8.21 (2.55) in Punjab, Pakistan. Scores tended to be higher in the dry season as expected. Data from this first implementation of the HWISE scale demonstrate the diversity of water insecurity within and across communities and can help to situate findings from future applications of this tool.

Key words: global health, measurement, metrics, water insecurity

HIGHLIGHTS

- We present comparison scores of the Household Water Insecurity Experiences (HWISE) scale, a novel household water insecurity index validated for use in low- and middle-income countries.
- These scores can aid interpretation of future implementation of the HWISE scale.
- The HWISE scale should still be evaluated in new contexts, such as high-income settings.

INTRODUCTION

Household-level water insecurity – the inability to access and benefit from adequate, reliable, and safe water for well-being and a healthy life – affects billions of people globally, but until recently, there were few metrics that could facilitate its household-level monitoring and evaluation (Jepson *et al.* 2017; Wutich *et al.* 2017). Freshwater availability has traditionally been reported at the community, watershed, or national level using resource-based metrics, but advances in water insecurity measurement have led to the creation of at least 13 different scales that measure household water experiences with availability, accessibility, reliability, and use, in contrast with at least 67 resource-based metrics that assess freshwater availability at larger geographic scales (Octavianti & Staddon 2021). These experiential metrics are particularly crucial for understanding human adaptation to natural resource stressors associated with climate change (Maja & Ayano 2021).

The Household Water Insecurity Experiences Research Coordination Network (HWISE-RCN; www.hwise-rcn.org) was formed in 2018 to promote scholarship and practice related to mitigating household-level water insecurity. Investigators collected data from 27 sites in low- and middle-income countries between 2017 and 2018 as part of a larger project that created and validated a cross-culturally comparable household water insecurity scale (Young *et al.* 2019b). This 12-item experiential scale, known as the HWISE scale or HWISE-12 (Young *et al.* 2019a), has received interest throughout the international development communities as a monitoring and evaluation tool that can complement the household-level metrics produced by the World Health Organization's (WHO) Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) (Slaymaker *et al.* 2020). A shortened 4-item version of the scale (the HWISE-4) was recently validated to facilitate rapid deployment in field survey settings with constrained resources (Young *et al.* 2021).

Several HWISE-RCN-affiliated studies have focused on how these new metrics are associated with water governance (Miller *et al.* 2020), water sharing (Rosinger *et al.* 2020), financial expenditures on water (Stoler *et al.* 2020), injuries (Venkataramanan *et al.* 2020), and self-reported health (Jepson *et al.* 2021). Research on the measurement of water insecurity, however, has not fully considered how the HWISE scale varies within and across sites. For instance, while studies have demonstrated the validity of the HWISE scale and its relationship with economic, health, and social outcomes, none have provided site-level scores. This brief provides a site-wise summary of the different HWISE scale scores as points of comparison for future research that uses these metrics to study household water insecurity – and better understand these scales' utility – in diverse global settings.

METHODS

Cross-sectional survey data were collected from 7,709 households in 27 sites across 22 countries in two waves. Sites were selected through existing professional networks to maximize variation in local climate, water infrastructure, and typical

water problems (Young *et al.* 2019b). Most sites targeted approximately 250 households and used simple random sampling to select households, with four exceptions (purposive sampling in Singida, Tanzania; Kampala, Uganda; and Upolu, Samoa; parallel assignment in Pune, India) for ongoing studies that required different sampling strategies to achieve their research objectives. Adults were eligible respondents if they reported being 'knowledgeable about their household's water situation' (Young *et al.* 2019a). The HWISE survey provided a much more detailed view of household water insecurity than other standard household surveys, such as Demographic and Health Surveys or Multiple Indicator Cluster Surveys, because it also probed experiences that demonstrate the *consequences* of inadequate, unreliable, or unsafe water. All participants provided verbal or written informed consent in the respective local language, and all study activities were reviewed and approved by the appropriate ethical review boards (Young *et al.* 2019b).

Enumerators used paper- and tablet-based surveys to collect data on sociodemographic characteristics and experiences with water availability, accessibility, reliability, and use, which are core components of household water insecurity (Jepson *et al.* 2017). Table 1 presents the composition of the HWISE-12, HWISE-11, and HWISE-4 scales with the full wording of each item. Each item reflects an experience related to water adequacy (having sufficient quantity for drinking and household consumption), reliability (the availability of water when needed), safety (water that is fit-for-use, such as drinking or bathing), or psychosocial experiences related to these problems.

Each survey item elicited the frequency of household experiences related to water in 4 weeks prior to the survey and categorized responses as: *never* (0 times) scored as '0', *rarely* (1–2 times) scored as '1', *sometimes* (3–10 times) scored as '2', and *often* (11–20 times) or *always* (more than 20 times) which were combined and scored as '3'. The HWISE-12 is calculated by summing the scores of 12 items, yielding a range of 0–36 (Young *et al.* 2019a), and the HWISE-4 is the sum of four items from

Table 1 | Item composition of the HWISE-12, HWISE-11, and HWISE-4 scales

Label	Survey item	HWISE-12	HWISE-11	HWISE-4
Worry	In the last 4 weeks, how frequently did you or anyone in your household **worry** you would not have enough water for all of your household needs?	X	X	X
Hands	In the last 4 weeks, how frequently have you or anyone in your household had to go **without washing hands after dirty activities** (e.g., defecating or changing diapers, cleaning animal dung) because of problems with water?	X	X	X
Plans	In the last 4 weeks, how frequently has you or anyone in your household had to **change schedules/plans** due to problems with your water situation, such as problems getting or distributing water within the household? (Activities that may have been interrupted include caring for others and doing household chores)	X	X	X
Drink	In the last 4 weeks, how frequently has there not been **as much water to drink** as you would like for you or anyone in your household?	X	X	X
Interrupt	In the last 4 weeks, how frequently has your household water supply from your main water source been **interrupted** or **limited** (e.g., water pressure, less water than expected)?	X	X	
Clothes	In the last 4 weeks, how frequently has there not been enough water in the household to **wash clothes**?	X	X	
Food	In the last 4 weeks, how frequently have you or anyone in your household had to **change what was being eaten** because there were problems with water (e.g., for washing foods and cooking)?	X	X	
Bathe	In the last 4 weeks, how frequently have you or anyone in your household had to go without **washing their body** because of problems with water (e.g., not enough water, dirty, and unsafe)?	X	X	
Angry	In the last 4 weeks, how frequently did you or anyone in your household feel **angry** about your water situation?	X	X	
Sleep	In the last 4 weeks, how frequently have you or anyone in your household gone to **sleep thirsty** because there was not any water to drink?	X	X	
None	In the last 4 weeks, how frequently has there been **no useable or drinkable water** whatsoever in your household?	X	X	
Shame	In the last 4 weeks, how frequently have problems with water caused you or anyone in your household to **feel ashamed**/excluded/stigmatized?	X		

Note: Items classified as never (0 times), rarely (1–2 times), sometimes (3–10 times), and often/always (11 times or more); score ranges are 0–36 for HWISE-12, 0–33 for HWISE-11, and 0–12 for HWISE-4.

the HWISE-12 with a range of 0–12 (Young *et al.* 2021). One HWISE-12 item, related to experiencing shame about one's water situation, was introduced in late-2017 during the second wave of data collection. As a result, the HWISE scale in study sites surveyed during the first wave has typically been represented as the HWISE-11 without the *shame* item (range 0–33); the HWISE-11 accounted for 99.3% of the variation in HWISE-12 scores with minimal additional error (Stoler *et al.* 2020).

This research brief presents the mean, standard deviation, and additional descriptive information of 27 sites for (1) HWISE-12 (where available), (2) HWISE-11, (3) HWISE-4, and (4) the Household Food Insecurity Access Scale (HFIAS, range 0–27) (Coates *et al.* 2007). We provide HFIAS scores for additional context given the wide availability of HFIAS reference data globally and its cross-cultural applicability, and because HFIAS and HWISE scores have been associated with each other in prior studies (Young *et al.* 2019a; Stoler *et al.* 2020).

RESULTS AND DISCUSSION

Table 2 presents the four indicators as well as season (wet, dry, both, or neither) and sample size information. There were 3,293 households from 13 sites with complete HWISE-12 data (i.e., the 11 sites used to derive HWISE-12 in Pune, India, and Dhaka and Chakaria, Bangladesh), yielding an aggregate mean score of 9.32 (standard deviation [SD] = 8.81). Site-level mean HWISE-12 scores ranged from 1.64 (SD = 4.22) in Pune, India, to 20.90 (SD = 7.50) in Cartagena, Colombia. HWISE-12 can offer a more nuanced view of water insecurity than WHO JMP measures of drinking water service level, which do not consider sufficiency for all household uses. For instance, the HWISE-12 identified water insecurity even among households with 'basic' water services, as classified by the JMP drinking water service ladder (Young *et al.* 2019a).

Because we could only compute HWISE-12 for 13 sites, Table 1 also contains HWISE-11 estimates for all 27 sites. Among 6,484 households, the aggregated mean HWISE-11 score was 6.95 (SD = 7.50). Site-mean HWISE-11 scores ranged from 1.54 (3.78) in Pune, India, to 19.56 (5.65) in Punjab, Pakistan.

HWISE-4 scores could be computed for 7,351 households across the 27 sites, yielding an aggregate mean score of 2.84 (SD = 3.08). Site-mean HWISE-4 scores ranged from 0.51 (SD = 1.50) in Pune, India, to 8.21 (SD = 2.55) in Punjab, Pakistan.

We present a bubble plot of the mean site scores in Figure 1, and the frequency of affirmation for each item (never, rarely, sometimes, or often) by site in Supplementary Material, Figure 1, to aid interpretation of the variation within and between sites that is summarized by the means and standard deviations in Table 2. HWISE scale scores exhibited greater variation in sites surveyed during the rainy season, perhaps because household-level characteristics (e.g., differences in wealth and financial access to water storage technologies) modified households' ability to take advantage of relatively higher water availability. Sites surveyed during the dry season tended to have higher HWISE scale scores as expected, and less variability, indicating that seasonal decreases in water availability may have affected households more uniformly. Although the sites with the five highest scores across all HWISE measures were surveyed in dry conditions, household water insecurity is shaped by local context as well. For example, the marginalized community where the survey was implemented in Cartagena was, in 2018, awaiting a long-delayed piped water service expansion by the municipal water authority. The bar chart for Cartagena in Supplementary Material, Figure 1 reveals the frustration that characterized this community's water insecurity: nearly 75% of respondents reported 'worry' or 'anger' about their water situation *often or always*, by far the highest prevalence of these experiences among all sites.

Finally, we computed HFIAS scores for 7,077 households across 26 sites (HFIAS was not implemented in Upolu, Samoa), yielding an aggregate mean score of 6.10 (SD = 6.58). Site-mean HFIAS scores ranged from 1.03 (SD = 2.55) in Kathmandu, Nepal, to 16.08 (SD = 8.06) in Gressier, Haiti. The overall range was typical of HFIAS scores observed in similar low- and middle-income settings (e.g., De Cock *et al.* 2013; Roba *et al.* 2019).

CONCLUSION

This research brief presents site-level HWISE-12, HWISE-11, HWISE-4, and HFIAS scores for 27 study sites across 22 countries. Overall, there was substantial variability within and between sites, as well as by season, reflecting the many ways in which households or communities experience and adapt to water insecurity (Jepson *et al.* 2017). These scores provide comparison data for future studies that use, adapt, or improve these metrics for novel contexts. We hope that future deployment of the HWISE scale will establish test–retest or inter-rater reliability, attempt to validate a version for high-income countries, or assess its utility in dynamic scenarios such as disaster recovery. The scale is limited in that it does not illuminate

Table 2 | Mean and standard deviation (SD) of the HWISE-12, HWISE-11, HWISE-4, and HFIAS indicators by site with season (wet, dry, both, or neither), sample size (*n*), and the number of missing cases

		HWISE-12 (range: 0–36)				HWISE-11 (range: 0–33)				HWISE-4 (range: 0–12)				HFIAS (range: 0–27)			
Site	**Season**	**Mean**	**SD**	***n***	**Missing**	**Mean**	**SD**	***n***	**Missing**	**Mean**	**SD**	***n***	**Missing**	**Mean**	**SD**	***n***	**Missing**
Africa																	
Ethiopia (Bahir Dar)	Rainy					4.10	6.03	10	249	2.02	2.27	253	6	2.67	3.53	259	0
Ghana (Accra)	Rainy					5.50	6.25	221	8	1.98	2.33	227	2	6.70	6.24	225	4
Kenya (Kisumu)	Neither					11.60	5.73	245	2	4.44	2.17	247	0	12.65	4.92	239	8
Malawi (Lilongwe)	Neither					5.83	5.23	290	12	2.13	2.12	297	5	7.93	6.47	302	0
Nigeria (Lagos)	Rainy					2.49	3.33	227	12	0.99	1.48	235	4	2.70	3.81	234	5
Tanzania (Morogoro)	Rainy	4.18	4.78	256	44	4.11	4.62	256	44	1.40	2.02	269	31	6.50	5.89	274	26
Tanzania (Singida)	Dry					1.57	3.15	561	3	0.71	1.38	563	1	4.69	5.06	562	2
Uganda (Arua)	Rainy					11.89	8.02	227	23	4.71	3.22	242	8	11.90	5.58	239	11
Uganda (Kampala)	Dry					6.91	5.46	215	31	2.43	2.06	236	10	8.15	6.20	195	51
East Asia and Pacific																	
Indonesia (Labuan Bajo)	Dry	13.80	7.68	268	11	13.46	7.32	268	11	5.01	2.86	273	6	5.03	5.07	273	6
Samoa (Upolu)	Both					1.58	4.45	171	113	0.69	2.01	174	110			0	284
Europe and Central Asia																	
Tajikistan (Dushanbe)	Dry					5.84	5.13	220	5	2.23	2.22	222	3	3.01	3.35	222	3
Latin America and the Caribbean																	
Bolivia (San Borja)	Dry	17.51	7.89	171	76	15.99	7.35	177	70	5.82	2.93	202	45	7.14	5.60	175	72
Brazil (Ceará)	Neither					2.22	3.40	187	67	1.03	1.57	201	53	3.46	5.36	239	15
Colombia (Cartagena)	Dry	20.90	7.50	218	48	19.47	6.95	224	42	7.58	2.98	256	10	11.86	6.57	246	20
Guatemala (Acatenango)	Dry					3.98	6.57	93	8	1.67	2.53	95	6	4.68	6.61	82	19
Guatemala (Chiquimula)	Dry	5.21	5.28	286	28	5.13	5.20	287	27	2.32	2.50	311	3	7.54	5.63	311	3
Haiti (Gressier)	Dry	9.82	9.10	280	12	9.24	8.37	281	11	3.62	3.36	290	2	16.08	8.06	272	20
Mexico (Mérida)	Dry					3.20	4.36	234	16	1.52	1.80	247	3	3.82	3.71	241	9
Mexico (Torreón)	Dry	8.56	8.37	239	10	8.34	8.09	239	10	2.89	2.93	246	3	3.11	4.82	248	1
Middle East and North Africa																	
Iran (Sistan & Balochistan)	Rainy	6.03	6.51	132	174	5.74	6.01	133	173	2.87	2.56	305	1	5.50	5.61	303	3
Lebanon (Beirut)	Rainy	7.13	7.02	544	30	6.76	6.60	544	30	2.54	2.77	560	14	5.85	7.49	545	29

(*Continued.*)

Table 2 | Continued

Site	Season	HWISE-12 (range: 0–36)				HWISE-11 (range: 0–33)				HWISE-4 (range: 0–12)				HFIAS (range: 0–27)			
		Mean	SD	*n*	Missing	Mean	SD	*n*	Missing	Mean	SD	*n*	Missing	Mean	SD	*n*	Missing
South Asia																	
Bangladesh (Dhaka & Chakaria)	Both	6.89	7.98	473	33	5.95	7.60	502	4	2.30	2.93	506	0	4.35	5.84	506	0
India (Pune)	Both	1.64	4.22	171	9	1.54	3.78	171	9	0.51	1.50	176	4	1.04	2.47	159	21
India (Rajasthan)	Dry	13.94	7.41	208	40	12.72	6.71	209	39	5.08	2.93	235	13	4.43	6.17	244	4
Nepal (Kathmandu)	Rainy					5.49	4.61	244	19	2.29	1.81	259	4	1.03	2.55	263	0
Pakistan (Punjab)	Dry	20.36	5.92	47	188	19.56	5.65	48	187	8.21	2.55	224	11	7.63	5.87	219	16
Aggregate (all sites)		9.32	8.81	3,293	703	6.95	7.50	6,484	1,225	2.84	3.08	7,351	358	6.10	6.58	7,077	632

Note: Sites are ordered by the World Bank region.

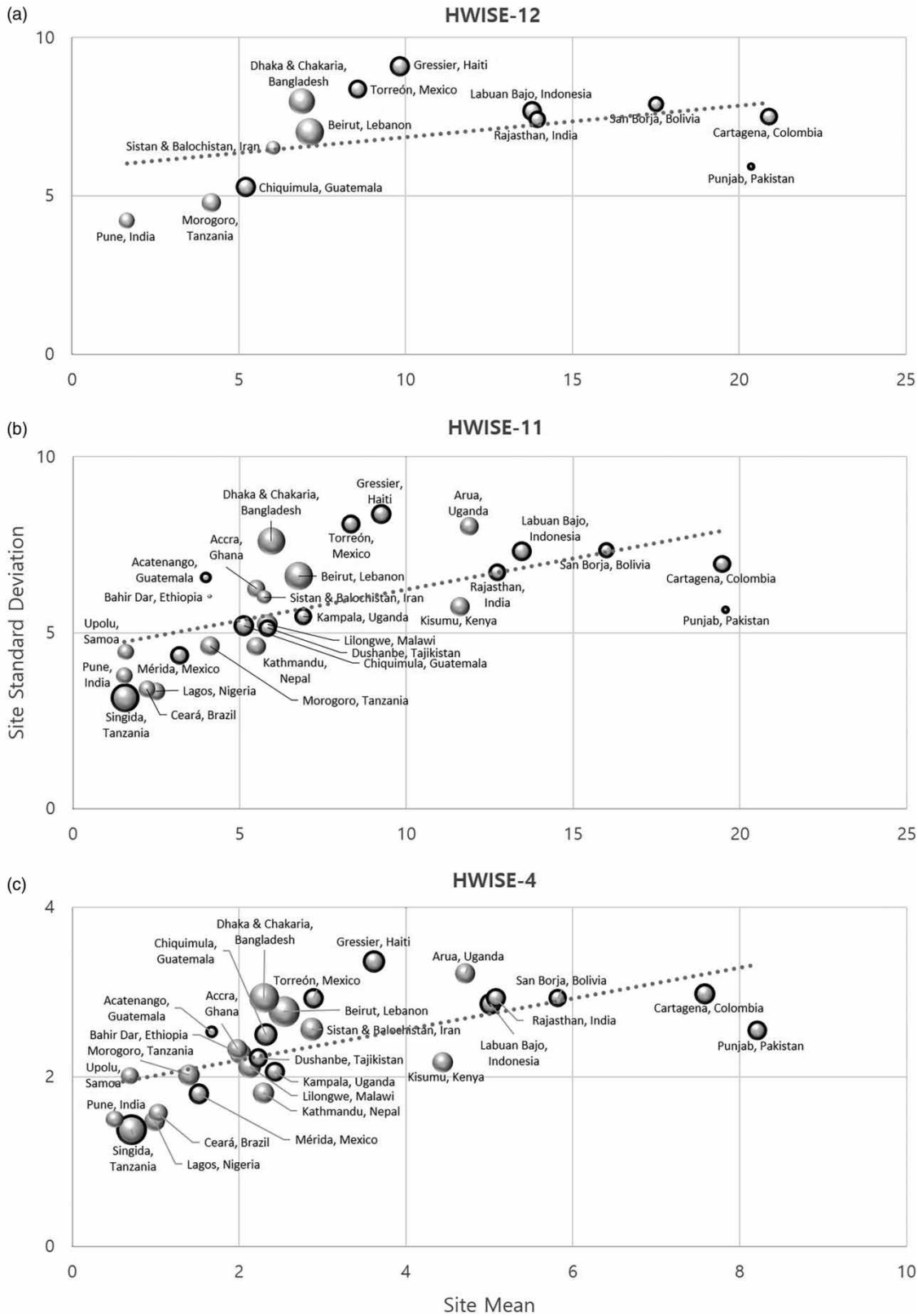

Figure 1 | Bubble plots of site-mean scores for (a) HWISE-12, (b) HWISE-11, and (c) HWISE-4, with linear trend line. Bubble size is proportionate to site sample size. Bold-outlined bubbles indicate sites surveyed exclusively in the dry season.

differences in the underlying causes of water insecurity, which may be individual in nature (e.g., the elderly being unable to lift large containers of water) or structural (e.g., exclusion due to gender or ethnic discrimination) (Slaymaker *et al.* 2020), or convey the degree of household disruption from a given water insecurity experience. Because the HWISE-12 and the HWISE-4 were intended to represent universal, but not comprehensive, experiences of household water insecurity, studies may benefit from including additional complementary metrics of water insecurity sub-domains that are not necessarily applicable to all households in a given community, such as experiences with water conflict, effects on children, or water used for agricultural livelihoods. Nonetheless, the ability to rapidly screen communities cross-culturally makes the HWISE scale an important tool that can help public health practitioners track progress toward achievement of Sustainable Development Goal 6 'clean water and sanitation for all'.

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AUTHOR CONTRIBUTIONS

J.S. is involved in the conceptualization, formal analysis, investigation, writing – original draft, and writing – review and editing. J.D.M. is involved in formal analysis, investigation, and writing – review and editing. All other authors are involved in the investigation and writing – review and editing.

CONFLICT OF INTEREST

This research does not contain any conflict of interest.

DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

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