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العدد الثالث

والأربعون

المعرفة بالتهاب المعدة والأمعاء لدى الأطفال بين مقدمي الرعاية في محافظة ديالى، العراق

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المستخلص:

الخلفية: يُعد التهاب المعدة والأمعاء الحاد من الأسباب الرئيسية للمراضة والوفيات لدى الأطفال دون سن الخامسة على مستوى العالم. تؤثر معرفة مقدمي الرعاية بشكل مباشر على النتائج السريرية، إلا أن البيانات الوبائية التي تدرس هذه العلاقة في بيئة الشرق الأوسط (بما في ذلك العراق) لا تزال محدودة.

الهدف: تقييم مستوى معرفة مقدمي الرعاية المتعلقة بالتهاب المعدة والأمعاء لدى الأطفال، وتحديد العوامل الاجتماعية الديموغرافية والسريرية المؤثرة في هذه المعرفة.

المواد وطرائق البحث: شملت الدراسة عينة مكونة من ١٥٠ من مقدمي الرعاية المراجعين لمستشفى البتول التعليمي في محافظة ديالى، العراق، باستخدام تصميم مقطعي عبر استبيان مُحقق مكون من ٣٨ فقرة تغطي ستة مجالات معرفية، وذلك خلال الفترة من ٢٩ تشرين الأول ٢٠٢٥ إلى ١٥ كانون الثاني ٢٠٢٦. كما تم الإجابة على الاستبيان من قبل ٣٠ طبيب أطفال و ٣٠ ممرضاً في قسم الطوارئ لمقارنة الدرجات من أجل التحقق من الصدق البنائي. استُخدم تحليل الانحدار اللوجستي لتحديد المتنبئات بمستوى المعرفة.

النتائج: كانت غالبية المشاركين (٦٩,٣%) من الأمهات، بمتوسط عمر بلغ $29,6 \pm 7,5$ سنة. بلغ متوسط درجة المعرفة $20,84 \pm 3,267$ (بنسبة إجابات صحيحة ٥٥%)، وكان لدى ٧٥,٣% مستوى معرفة جيد ($\leq 38/19$). كان المصدر الرئيسي للمعلومات لدى المشاركين هو وسائل التواصل الاجتماعي (٣٠,٧%). تمثلت أبرز فجوات المعرفة في التعرف على الجفاف، والعلامات



التي تستدعي إعطاء محلول الإمهامة الفموية، والاستخدام المناسب للمضادات الحيوية. لم يُظهر تحليل الانحدار اللوجستي أي متنبئات ذات دلالة إحصائية لمستوى المعرفة.

الاستنتاج: على الرغم من أن غالبية مقدمي الرعاية أظهروا مستوى معرفة مقبول، إلا أن هناك فجوات مستمرة في جميع المجالات. يشير غياب المتنبئات الاجتماعية الديموغرافية إلى وجود نقص واسع النطاق في المعرفة، مما يستدعي الحاجة إلى إدخال تدخلات تعليمية شاملة تجمع بين التوعية خلال اللقاءات السريرية والمنصات الإلكترونية.

الكلمات المفتاحية: مقدم الرعاية؛ صحة الطفل؛ التهاب المعدة والأمعاء؛ العراق؛ المعرفة؛ الإمهامة الفموية؛ أطفال ما قبل المدرسة

Pediatric Gastroenteritis Knowledge among Caregivers from Diyala Province, Iraq

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Abstract

Background: Acute gastroenteritis is a major cause of morbidity and mortality in children below the age of five worldwide. The knowledge of caregivers has a direct impact on the clinical outcomes, but the epidemiologic data synthesizing this correlation in the Middle East environment (including Iraq) are limited.

Objective: To assess the knowledge of caregivers related to pediatric gastroenteritis and to identify the sociodemographic and clinical factors that determine the knowledge.

Subjects and Methods: A sample of 150 caregivers visiting Al-Batool Teaching Hospital in Diyala Province, Iraq was utilized in a cross-sectional



design through a validated 38-item questionnaire with six domains of knowledge between 29 October 2025 and 15 January 2026. The questionnaire was answered by 30 pediatricians and 30 emergency department nurses to compare the scoring for construct validity. The logistic regression analysis was used to determine the predictors of knowledge level.

Results: Majority (69.3%) of the respondents were mothers with a mean age of 29.6 ± 7.5 years. The average knowledge score was 20.84 ± 3.267 (55% correct), and 75.3% had a good knowledge standard ($\geq 19/38$). The main source of information among the participants was social media (30.7%). The areas where severe knowledge gaps were found were the identification of dehydration, the signs that required oral rehydration therapy, and the appropriate use of antibiotics. The logistic regression could not provide any statistically significant predictors of knowledge level.

Conclusion: Despite the fact that the majority of caregivers demonstrated sufficient knowledge, the gaps that persisted in all the areas were observed. The lack of sociodemographic predictors is an indication of knowledge deficits on a large scale, which merits the need to introduce comprehensive educational interventions combining clinical encounters and online platforms.

Keywords: Caregiver; child health; gastroenteritis; Iraq; knowledge; oral rehydration therapy; preschool



Introduction

Acute gastroenteritis has been one of the most common childhood diseases in the world and a major etiology of morbidity and mortality in children below the age of five (GBD 2019 Under-5 Mortality Collaborators, 2021). The World Health Organization (WHO) estimates that in this age group, diarrheal diseases cause about 9% of all deaths, which is equivalent to about 444,000 deaths annually, with disproportionate burden in low- and middle-income countries (UNICEF, 2024). Despite the fact that the clinical course of acute gastroenteritis has been transformed significantly by the introduction of oral rehydration therapy (ORT) that has been used to reduce the diarrheal mortality rates by a significant percentage (Khan *et al.*, 2020; Nalin & Cash, 2018), optimum home-based care remains suboptimal in many locales.

The basis of the successful management of pediatric gastroenteritis is in the early detection and correction of dehydration by the use of the right ORT, continued feeding, and early detection of the signs of danger leading to the necessity of medical intervention (Guarino *et al.*, 2014; King *et al.*, 2003). Since most children with acute gastroenteritis receive home-based treatment, with or without expert advice, caregivers are central to this spectrum of care (Weghorst *et al.*, 2024). The information regarding the symptom identification, the correct rehydration method, and signs of a need to seek medical care directly influence clinical outcomes and health-service use (Ulrickson, 2005; Wittenberg, 2012). Lack of knowledge among caregivers may trigger the late presentation, improper medication administration, incorrect ORT preparation, and, as a result, increased susceptibility to severe dehydration and hospitalization (Chow *et al.*, 2010; Freedman *et al.*, 2015).

The literature on investigating the knowledge of caregivers in the Middle Eastern context, in particular, in Iraq, is scarce. The Iraqi health system has been facing severe issues over the past several decades such as



the decline of infrastructure, insufficiency of resources, displacement of professionals, and all of this can potentially threaten the health literacy and access to reliable health information (World Health Organization, 2024). As a heterogeneous population of urban and rural settlements with fluctuating health-service accessibility, Diyala Province, which is located northeast of Baghdad, is a suitable location to evaluate the knowledge of caregivers and the factors that determine it.

Past studies in various settings have found maternal education level as a strong predictor of health literacy and the ability to seek care appropriately (Huq & Tasnim, 2008; Sultana *et al.*, 2019), and urban residence, past experience of childhood illness and access to credible sources of information have also emerged as potential predictors (Kyanjo *et al.*, 2025). However, the comparative role of all these factors can vary between cultural and health-system contexts, thus requiring context-specific research to support the development of interventions.

The sharp rise in the use of social media as a tool of health information dissemination presents both opportunities and challenges. Digital platforms have the ability to be used to spread health information fast and far, but they can also be used to spread misinformation unintentionally unless they are regulated (Moorhead *et al.*, 2013). The fidelity of information obtained through the preferred sources of information and the overall preference of caregivers to those information sources are essential in developing effective health-education strategies.

In this regard, this study aimed to assess the knowledge of the caregivers in several respects of gastroenteritis in children below the age of five who present to one of the teaching hospitals in Diyala Province. In particular, it aimed to determine the level of knowledge in six areas, i.e., the level of recognition of dehydration signs, physician contact indicators, ORT knowledge and use, appropriate feeding during diarrhea, medication use and misconceptions, and disease transmission, and determine sociodemographic



and clinical factors related to the level of knowledge, which would guide specific educational interventions.

Subjects and Methods

Study Design

It is an observational cross-sectional study that is carried out in Al-Batool Teaching Hospital in Diyala Province in Iraq. The researcher used the questionnaire-based survey design in the study to determine the knowledge of caregivers about different aspects of pediatric gastroenteritis management.

Setting

The investigation was conducted over two and a half months (from October 29, 2025, to January 15, 2026). Al-Batool Teaching Hospital is a large pediatric emergency referral center in Diyala Province, which accepts patients not only from the urban areas of the region but also from the rural areas.

Participants

Eligibility Criteria: The inclusion criteria were caregivers of children aged 3 months to 5 years who were presented to the emergency department with a diagnosis of gastroenteritis. Other inclusion criteria were: (1) children who came with the complaint of dehydration or acute diarrhea, and (2) caregivers who were willing to take part and who gave written informed consent.

The exclusion criteria included: (1) caregivers whose children had chronic gastrointestinal conditions, (2) caregivers who could not finish the interview process because of language barriers or medical conditions, and (3) children with severe comorbidities who needed continuous medical attention, which might in turn affect the knowledge or management techniques of the caregiver.



Sampling Method: The study used a consecutive sampling plan wherein all the caregivers who met the research criteria as they came forward at the time of research were invited to join the study until the required sample size was attained. There was no a priori calculation of the sample size, but due to the similarity of the knowledge assessment studies in the literature, 150 was considered a sufficient sample size to conduct the intended statistical analysis.

Variables

The knowledge of the caregivers about pediatric gastroenteritis was selected as the primary outcome variable and operationalized as a continuous score (range 0-38) to reflect the correct answers to 38 items, covering six domains of knowledge: (1) signs of dehydration, (2) signs to consult a physician, (3) oral rehydration therapy (ORT), (4) solid intake and refeeding practices, (5) medication use, and (6) disease transmission. The independent variables were caregiver age, sex, level of education (illiterate, literate, primary school, middle school, high school, college/institute, postgraduate), place of residence (urban/rural), occupation (education field, medical field, others), child relationship (mother/father), number of children in the household, and self-reported income adequacy (does not cover necessary expenses, barely covers, easily covers). Clinical variables consisted of the number of previous emergency department visits because of gastroenteritis, the number of occurrences of vomiting and diarrhea in the 24 hours before presentation, and the sequelae of management during the current visit (IV fluid administration, hospital admission).

Data Sources and Measurement

Face-to-face interviews using a preconstructed, structured questionnaire were used to collect data. The questionnaire was designed after reviewing the existing literature and the existing clinical guidelines on the management of pediatric gastroenteritis. There were four sections in the instrument: (1) an introduction statement specifying the rights of the participants and their anonymity, (2) child demographic and clinical data, (3)



demographic data of the caregivers, and (4) 38 items in six defined domains of knowledge.

Participants were given a score of 1 when they were correct and 0 when they were wrong on each of the knowledge items. The questionnaire was administered by trained interviewers in Arabic, the local language, and with a standardized approach being used.

Validation Procedures: There were two ways of measuring construct validity. First, the questionnaire was completed by 30 pediatricians and 30 nurses in the emergency department in the final version, and the a priori hypothesis was that the mean scores would rise in a progressive manner with the caregivers, nurses, and pediatricians. Second, the item difficulty indices of every question were computed, and acceptable items were those whose answers were correct by 20-80% of the caregiver sample.

Bias

In order to reduce the selection bias, the eligible and available participants were recruited in a sequential manner during the study period, including on weekends and during different shifts. Interviewers were also trained with a standardized training on questionnaire administration to minimize information bias. The possibility of social desirability bias was mitigated by assuring the participants of the confidentiality of their answers clearly and underlining the fact that there were no correct or incorrect answers in terms of their clinical care. The issue of recall bias was admitted as one of the natural limitations of self-reporting.

Study Size

There was no actual calculation of a sample size. The 150 caregivers sample was selected according to the feasibility and past related research in the area. This sample size was sufficient to achieve the intended power of the intended logistic regression analysis, which usually needs at least 10 events per predictor variable (Wynants *et al.*, 2015).



Quantitative Variables

The initial normality test of continuous variables (age of caregiver, age of child, number of children, frequency of vomiting, and diarrhea) was conducted. The normally distributed variables were introduced in terms of means with standard deviations (SD); non-normally distributed variables were introduced in terms of median and interquartile ranges. In the regression analysis, the age of caregivers was grouped into three subgroups (16-25, 26-35, and ≥ 36 years) to simplify the interpretation and to make the regression model capable of accommodating the possibility of non-linear relationships between age and knowledge scores.

The overall knowledge score was categorized into good (equal to or greater than 19) and poor (less than 19) according to a 50 percent cutoff point, which was in line with the methodology used in prior research of knowledge assessment (Dorji *et al.*, 2020; J S *et al.*, 2021). This was set a priori, and it was the middle point in the range of the potential scores.

Statistical Methods

All the variables were introduced using descriptive statistics, with frequencies and percentages of categorical variables and measures of central tendency and dispersion of continuous variables.

One-way analysis of variance (ANOVA) was used to determine construct validity by comparing the mean total scores of the three groups (caregivers, nurses, pediatricians). A critical omnibus test was followed by Tukey post hoc comparisons to obtain specific between-group differences.

The item difficulty indices were then determined based on the percentage of caregivers who responded correctly on each knowledge item, with acceptable items established to be between 20 and 80%.

Binary logistic regression was used to assess the relationship between sociodemographic and clinical variables and knowledge category (good vs. poor). All the variables in Table 1 were used in the model at the same time



(enter method) to analyze their independent effects and eliminate possible confounding. The findings were in the form of odds ratios and confidence intervals.

The Hosmer-Lemeshow goodness-of-fit test was used to estimate model fit, and Cox and Snell and Nagelkerke R^2 statistics were used to estimate the proportion of variance explained. Sensitivity and specificity, as well as classification accuracy, were also computed.

All statistical tests were two-tailed, with statistical significance defined as $p \leq 0.05$. Analyses were conducted using SPSS (Statistical Package for the Social Sciences) version 28 (IBM Corp., Armonk, NY, USA).

Ethical Considerations

The study protocol was approved by the Ethical Committee of the College of Medicine, University of Diyala. Written informed consent was obtained from all participants following a detailed explanation of study objectives, procedures, and the voluntary nature of participation. Participants were assured of their right to withdraw at any point without consequence to their child's medical care. Confidentiality of all personal information was guaranteed, and data were anonymized before analysis.

Results

A total of 150 caregivers were enrolled in the study; additionally, 30 E.D. nurses and pediatricians answered the questionnaire. The children's mean age $\pm$ SD was 2.34 ± 1.34 years (ranging from 39 days to 4.83 years), and 59 (39.3%) of them were males, and the rest (91, 60.7%) were females.

Caregiver's characteristics are displayed in Table 1. The mean age $\pm$ SD was 29.60 ± 7.50 years, ranging from 19.81 to 59.16 years. Regarding the relationship to the child, all caregivers interviewed in this study fell into one of two categories: mothers (104, 69.3%) or fathers (46, 30.7%). Literacy was the predominant highest level of education achieved by caregivers (54,



36.0%). Residence-wise, 88 (58.7%) lived in urban areas, as opposed to the remaining 62 (41.3%) who lived in rural areas. Most caregivers had occupations outside the education and medical field (132, 88.0%). Sixty-nine (64%) of the children enrolled in the study had visited the emergency department for gastroenteritis at least once before their current visit. Social media was the most preferred source of information about gastroenteritis for caregivers in this study (46, 30.7%), followed by news media (38, 25.3%).

Table 1: Characteristics of caregivers (n = 150).

Characteristic	Value
Caregiver age (year), mean $\pm$ SD	29.6 $\pm$ 7.5
Caregiver sex, male, n (%)	46 (30.7)
Level of education, n (%)	
Illiterate	19 (12.7)
Literate	54 (36.0)
Primary school	33 (22.0)
Middle school	17 (11.3)
High school	11 (7.3)
College/institute	5 (3.3)
Postgraduate	11 (7.3)
Residence, n (%)	
Rural	62 (41.3)
Urban	88 (58.7)
Occupation, n (%)	
Education field	8 (5.3)
Medical field	10 (6.7)
Others	132 (88.0)
Relationship to child, n (%)	
Mother	104 (69.3)
Father	46 (30.7)
Number of children in the household, median (interquartile)	3 (2-4)



range)

Income, n (%)

Doesn't cover necessary expenses 41 (27.3)

Barely covers necessary expenses 73 (48.7)

Easily covers necessary expenses 36 (24.0)

Previous emergency department visits for gastroenteritis for the same child, n (%)

0 54 (36.0)

1 57 (38.0)

≥2 39 (26.0)

Previous IV rehydration for gastroenteritis, yes, n (%) 83 (55.3)

Vomiting episodes in the past 24 hours, median (interquartile range) 3 (2-4)

Diarrhea episodes in the past 24 hours, median (interquartile range) 6 (5-8)

IV fluid administration in the current visit, yes, n (%) 94 (62.7)

Admission to hospital in the current visit, yes, n (%) 80 (53.3)

Source of information about gastroenteritis, n (%)

Family and friends 31 (20.7)

Social media 46 (30.7)

News media 38 (25.3)

Healthcare professionals 20 (13.3)

Official health organizations 15 (10.0)

Questionnaire content validity was demonstrated as the mean total scores improved incrementally among caregivers, nurses, and pediatricians (Table 2). One-way ANOVA test was used to show the content validity by comparing the mean total scores among the three groups, yielding a statistically significant difference ($F(2,207) = 338.294, p < 0.001$). A Tukey post hoc test revealed that the mean scores were statistically significantly higher among nurses ($31.70 \pm 1.685, p < 0.001$) and pediatricians ($33.53 \pm 2.360, p < 0.001$) compared to caregivers (20.84 ± 3.267). Moreover, the mean scores were statistically significantly higher among pediatricians ($p =$



0.047) compared to nurses. In the item difficulty index (Table 3), the questionnaire performed very well with all questions answered correctly by no less than 20%, and no more than 80% of participants, indicating that all questions were not too easy nor too hard to answer.

Table 2: Performance characteristics of the gastroenteritis knowledge questionnaire by domain and mean scores by group.

Domain	Number of questions	Caregiver score (n = 150), mean $\pm$ SD	Nurses score (n = 30), mean $\pm$ SD	Pediatricians score (n = 30), mean $\pm$ SD
Signs of dehydration	5	2.84 $\pm$ 1.030	3.70 $\pm$.702	4.47 $\pm$.629
Indications to see a physician	6	3.33 $\pm$ 1.201	4.87 $\pm$.860	5.33 $\pm$.884
Oral rehydration therapy (ORT)	9	4.93 $\pm$ 1.627	7.70 $\pm$ 1.236	8.03 $\pm$.850
Solid intake/refeeding	6	3.21 $\pm$ 1.251	5.00 $\pm$.871	5.37 $\pm$.718
Medication use	5	2.71 $\pm$ 1.089	4.43 $\pm$.774	4.27 $\pm$.691
Disease transmission	7	3.82 $\pm$ 1.326	6.00 $\pm$.830	6.07 $\pm$ 1.081
Total Score	38	20.84 $\pm$ 3.267	31.70 $\pm$ 1.685	33.53 $\pm$ 2.360



Table 3: Item analysis for the gastroenteritis knowledge questionnaire, caregiver responses (n = 150).

Domain	Item	Item difficulty (caregivers answering correctly)	
		No.	%
Signs of dehydration	Child is fatigued or restless	100	66.7
	Child has increased urination	85	56.7
	Child has bulging eyes	81	54.0
	Child has fast deep breathing	79	52.7
	Child has moist mouth and salivates a lot	81	54.0
Indications to see a physician	Diarrhea 3-5 times a day, no abdominal pain	81	54.0
	Dark green vomit	84	56.0
	Warm hands and feet	84	56.0
	Excessive sleepiness or drowsiness	82	54.7
	Child age <6 months or weight <8 kg	79	52.7
	Mild uncomplicated gastroenteritis can be managed at home	89	59.3
Oral rehydration therapy (ORT)	ORS is made of water, sugar, and electrolytes	84	56.0
	Intravenous rehydration is more effective than ORT	78	52.0
	Importance of salt-sugar ratio	93	62.0
	Administer as much as the child can drink	76	50.7
	Homemade solutions should never be used, even when commercial preparations are not available	78	52.0
	Diarrhea will not stop immediately	80	53.3
	Less need for intravenous rehydration	92	61.3
	Less diarrhea compared with juice	83	55.3



	Should not be administered in cases of bloody diarrhea (dysentery)	75	50.0
Solid intake/refeeding	Eating is beneficial	86	57.3
	Prioritize foods high in simple sugars (such as desserts and commercial juices)	82	54.7
	Supplementing with ORT prevents dehydration	76	50.7
	Continue breastfeeding	82	54.7
	Ongoing breastfeeding reduces dehydration risk	75	50.0
	Use a diluted formula	81	54.0
Medication use	Antidiarrheal medications (e.g., adsorbents such as kaolin-pectin) are not routinely required	83	55.3
	Lactose avoidance is usually necessary	79	52.7
	Antimotility agents (e.g., loperamide) are not routinely required	86	57.3
	Antibiotics are routinely required	78	52.0
	Antibiotic overuse results in resistance	81	54.0
Disease transmission	Antibiotic administration prevents transmission	85	56.7
	Acute diarrhea is predominantly bacterial	88	58.7
	Gastroenteritis is highly contagious	80	53.3
	Handwashing does not reduce transmission	77	51.3
	Contact with infected individuals does not promote transmission	76	50.7
	Outbreaks occur in childcare and schools	84	56.0
	Vaccines (such as the rotavirus vaccine) can prevent catching gastroenteritis	83	55.3

When it comes to the knowledge domains, one-way ANOVA test revealed that caregivers performed equally well across all 6 domains, indicating that the questionnaire was well tailored to consistently and equally cover all domains with equal difficulty index, as the test result failed to show statistically significant difference among the mean score percentage of all 6 domains ($F(5,894) = 0.465$, $p = 0.803$), as illustrated in Figure 1.

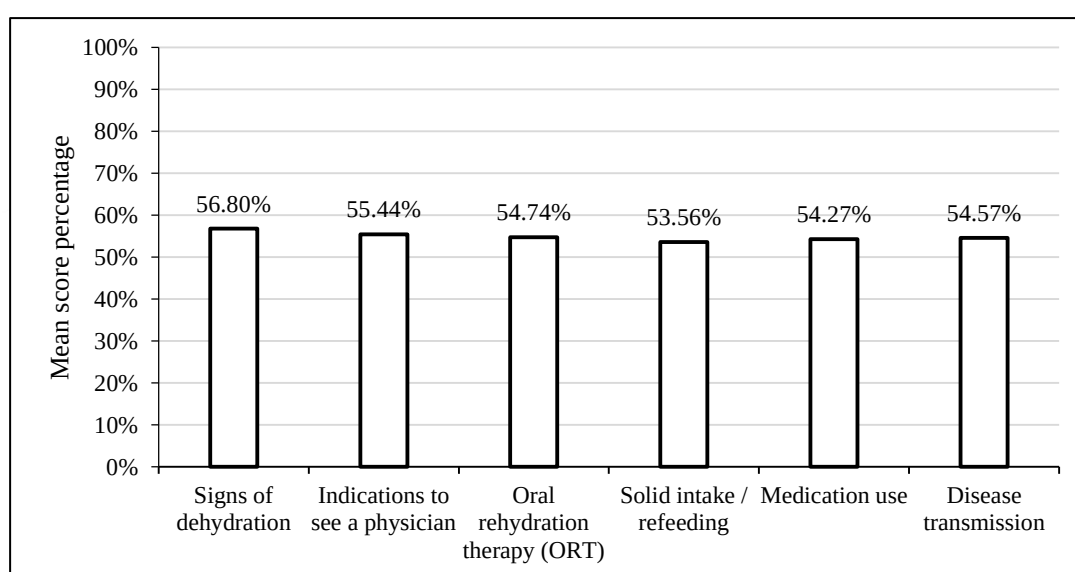


Figure 1: Caregivers' mean score percentage by knowledge domains.

Regarding the total knowledge score, 113 (75.3%) had a “good” score and 37 (24.7%) had a “poor” score. A logistic regression analysis (demonstrated in Table 4) shows that there is an influence, however insignificant, of caregiver age group, sex, level of education, residence, occupation, number of children in the household, income, previous emergency department visits for gastroenteritis for the same child, previous I.V. rehydration for gastroenteritis, vomiting and diarrhea episodes in the past 24 hours, I.V. fluid administration and admission to hospital in the current visit, and source of information about gastroenteritis on caregivers' total knowledge score ($\chi^2(26) = 20.590$, $p = 0.763$). The model explained 19.1% of the variability in knowledge score (Nagelkerke R^2) and was able to identify 77.3% of cases accurately. The sensitivity of the model was 96.5%, and the specificity was 18.9%. The results show that the odds of having a



good knowledge score are 1.780 times for caregivers 36 years of age or older compared to those aged 16 to 25 years, 1.355 times for females compared to males, 1.585 times for postgraduates compared to illiterates, 1.534 times for caregivers living in urban areas compared to those living in rural areas, and 2.318 times for those working in the education field compared to other occupations.

Table 4: Results of the logistic regression analysis of the association of socio-demographic variables with caregivers' knowledge about gastroenteritis (n = 150).

Variable	Category	Knowledge			Odds ratio (95% C.I.)	p-value
		Poor	Good	Total		
Caregiver age group (year)	16-25	15	43	58	1	1
	26-35	18	52	70	1.163 (0.468, 2.892)	0.745
	≥36	4	18	22	1.780 (0.427, 7.419)	0.429
Caregiver sex	Male	13	33	46	1	1
	Female	24	80	104	1.335 (0.498, 3.582)	0.566
Level of education	Illiterate	3	16	19	1	1
	Literate	16	38	54	0.240 (0.048, 1.189)	0.080
	Primary school	7	26	33	0.464 (0.086, 2.504)	0.372
	Middle school	2	15	17	1.227 (0.139, 10.875)	0.854
	High school	5	6	11	0.136 (0.017, 1.092)	0.061
	College / institute	1	4	5	0.919 (0.008, ...)	0.972



					105.686)	
	Postgraduate	3	8	11	1.585 (0.019,	0.838
					131.453)	
Residence	Rural	16	46	62	1	1
	Urban	21	67	88	1.534 (0.631,	0.346
					3.729)	
Occupation	Others	32	100	132	1	1
	Education field	1	7	8	2.318 (0.043,	0.679
					124.390)	
	Medical field	4	6	10	0.189 (0.003,	0.420
					10.871)	
No. of children					0.869 (0.618,	0.417
					1.221)	
Income	Doesn't cover necessary expenses	10	31	41	1	1
	Barely covers necessary expenses	19	54	73	1.506 (0.508,	0.461
					4.470)	
	Easily covers necessary expenses	8	28	36	1.192 (0.342,	0.783
					4.147)	
Previous E.D. visits	0	15	39	54	1	1
	1	13	44	57	1.133 (0.416,	0.807
					3.085)	
	≥2	9	30	39	1.402 (0.450,	0.561
					4.370)	
Previous I.V. rehydration	No	19	48	67	1	1
	Yes	18	65	83	1.881 (0.771,	0.165
					4.587)	
Vomiting episodes					0.797 (0.571,	0.180
					1.110)	
Diarrhea episodes					0.840 (0.651,	0.181
					1.084)	
I.V. fluid in the current	No	12	44	56	1	1
	Yes	25	69	94	0.603 (0.241,	0.280



visit					1.509)	
Admission	No	16	54	70	1	1
to hospital	Yes	21	59	80	0.707 (0.298,	0.432
					1.677)	
Source of	Family and friends	7	24	31	1	1
information	Social media	10	36	46	1.054 (0.301,	0.934
					3.690)	
	News media	9	29	38	0.699 (0.189,	0.592
					2.590)	
	Healthcare	5	15	20	0.750 (0.168,	0.707
	professionals				3.354)	
	Official health	6	9	15	0.207 (0.042,	0.052
	organizations				1.014)	

Omnibus χ^2 (26) = 20.590, $p = 0.763$, $R^2 = 0.128$ (Cox & Snell), 0.191 (Nagelkerke).

Discussion

In a cross-sectional study, the knowledge of caregivers of pediatric gastroenteritis was assessed in 150 caregivers visiting a tertiary care hospital located in Diyala Province, Iraq. Findings showed that, despite 75.3% of caregivers passing a 50% correctness threshold and thus having sufficient overall knowledge, there were still significant gaps in many areas. Also, multivariate modelling did not find an independent predictor of the knowledge level of any sociodemographic or clinical characteristic. These implications of the findings on health-education programs and clinical practice in this context are enormous.

Overall Knowledge and Domain-Specific Performance

The average combined knowledge score of caregivers was 20.84, with a standard deviation of 3.267 of the possible 38 points, representing a general percentage of correct answers of approximately 55%. This observation is not new and is similar to other studies carried out in similar



environments. A systematic review of home-based management of childhood gastroenteritis was used to determine the lack of knowledge among caregivers as an impediment to better care in various countries (Weghorst *et al.*, 2024). The item-difficulty analysis of the current research, where all the questions were answered correctly by 20-80 percent of interviewees, proves the point that the questionnaire was adjusted to fit this population, neither being too easy nor too difficult.

Domain-specific analysis showed that the relatively homogeneous performance was observed in all six areas of knowledge, with no statistically significant difference in the mean score percentages ($p = 0.803$). This homogeneity implies that knowledge gaps are not localized to specific areas, but instead generalized, and require comprehensive, but not targeted, educational interventions. However, analysis of individual item responses also suggests specific areas of concern that can be given special attention.

Only 66.7 percent of the caregivers indicated fatigue or restlessness correctly as a sign of dehydration, and fewer indicated increased urination (56.7 percent), and bulging eyes (54.0 percent) as non-relevant signs, and fast deep breathing (52.7 percent) as a relevant sign in the dehydration-recognition domain. More importantly, 46 percent of the caregivers falsely thought that a moist mouth and excessive salivation were the symptoms of dehydration, a misrepresentation that might lengthen the time to realize the seriousness of the situation. Proper identification of the signs of dehydration is core in seeking care and proper management at home, as late identification can result in further development of severe dehydration, which requires intravenous intervention (Alrafiaah *et al.*, 2022).

Knowledge of ORT, despite being the foundation of gastroenteritis management over the last forty years (Nalin & Cash, 2018), showed significant gaps. Half of caregivers had the right understanding regarding the administration of ORS in the instances of bloody diarrhea (dysentery), and a comparable number had the wrong perception of intravenous rehydration being more effective than ORT. The false belief that ORS should not be used



in cases of dysentery is especially dangerous because these children are still in danger of dehydration and need to be supplied with fluid (World Health Organization, 2005). The results that only 56 percent identified the correct ORS composition and 62 percent identified the significance of the salt-sugar ratio bring up an issue of the possibility of making wrongly prepared homemade solutions, which can cause hyponatremia or ineffective rehydration (Okechukwu & Briggs, 2020; Ozongwu, 2024).

Misconceptions about medication were also common, with only 55.3% of the caregivers correctly reporting that antidiarrheal drugs are not regularly required and 48% reporting falsely that antibiotics are regularly indicated in gastroenteritis. The latter observation is quite alarming considering the fact that most cases of pediatric gastroenteritis are viral in nature and are not responsive to antibiotic treatment (Bruzzeze *et al.*, 2018). The overuse of antibiotics is not only subjecting children to undue negative consequences but also is a global risk to antimicrobial resistance (World Health Organization, 2014). The relatively poor correct response (54%) on antibiotic resistance indicates an inadequate knowledge of the issue of antibiotic resistance, a consequence of vital public health importance.

There were also acute shortages in disease-transmission knowledge. Only 53.3% of caregivers understood that gastroenteritis is highly contagious, and only a smaller proportion of participants knew that handwashing lowers the spread (51.3%), and that contact with infected individuals increases the spread (50.7%). These gaps have consequences in the context of secondary prevention and household transmission because caregivers with a poor understanding of transmission mechanisms are not likely to take effective measures to control infections (Curtis & Cairncross, 2003).



Comparison with Validation Groups

The construct validity test that revealed an increasing score of nurses (31.70 ± 1.685) and pediatricians (33.53 ± 2.360) in comparison to caregivers proves the argument that the questionnaire was able to distinguish the groups that were known to differ in gastroenteritis knowledge. The statistically significant differences between all three groups ($p < 0.001$) and the progressive growth of the mean scores over all six domains are solid arguments in favor of the instrument's validity. This is a rigorous method of establishing construct validity in knowledge-assessment research since this method of validation compares target populations to expert groups (Kyriazos *et al.*, 2018).

Factors Associated with Knowledge Level

The logistic-regression analysis did not show any statistically significant predictors of good versus poor knowledge; the entire model was not significant ($\chi^2(26) = 20.590$, $p = 0.763$) and did not explain much of the variance in knowledge scores (19.1 percent). This is rather unexpected considering that a lot of literature has demonstrated the correlations between education, socioeconomic status, and health literacy (Berkman *et al.*, 2011; Huq & Tasnim, 2008). There are several reasons that should be considered to justify this null result.

To begin with, the sample size ($n = 150$) was rather small, and the knowledge scores were dichotomized which probably restricted the statistical power to reveal small associations. The large confidence ranges of most odds ratios (e.g., postgraduate education OR: 1.585, 95 % CI: 0.019-131.453) imply the lack of precision, which is also in line with insufficient power to detect effect in subgroups with small sizes. Second, the homogeneity of the study population, that is, limited to caregivers who came to one hospital where children required emergency care, could have limited variability in the key predictors, which weakened the observed associations. Third, confounding factors that are not measured, including health literacy, not limited to gastroenteritis-specific information, prior health education, or



cognitive influences, might have a greater effect than the sociodemographic variables measured.

Although the observed associations are not statistically significant, their direction is worth discussing. Good knowledge was more likely in caregivers aged ≥ 36 years versus 16-25 years (OR = 1.780), in females versus males (OR = 1.335), in postgraduates versus illiterates (OR = 1.585), in urban residents versus rural residents (OR = 1.534), and in those in the education field versus other occupations (OR = 2.318). These trends are consistent with past studies (Sreeramareddy *et al.*, 2006) and indicate that with greater sample sizes, some of these relationships may become statistically significant.

It is worth noting that the previous exposure to the occurrence of gastroenteritis, either in terms of prior emergency department visits or intravenous rehydration, or intensity of the current episode, did not correlate with knowledge improvement. This finding suggests that passive exposure to the healthcare environment in the state of acute illness might not result in a better understanding, which highlights the importance of organized, purposeful health education as opposed to the application of experiential learning (Nutbeam, 2000).

Information Sources and Health Education Implications

The percentage of caregivers who referred to social media (30.7%) and news media (25.3%) as the primary sources of information regarding gastroenteritis was higher than that of those who referred to healthcare professionals (13.3%) and official health organizations (10.0%). This distribution has important implications for how health-education interventions are designed. It is probably an indication of the growing infiltration of digital media into the Iraqi culture and possible impediments to the ability to find credible information in the traditional media.

The fact that social media is the most commonly used source of information is alarming, considering the inconsistent nature of the health



information that is shared in such media (Swire-Thompson & Lazer, 2020). Although social media has benefits in the form of potential reach and accessibility, unregulated content can reinforce misconceptions and encourage practices that are not aligned with the evidence-based guidelines (Moorhead *et al.*, 2013). The underuse of healthcare professionals as sources of information is a lost opportunity to deliver the right and personalized education on clinical encounters.

These results propose a multifaceted approach to educating caregivers. First, medical institutions must take every clinical encounter as a health-education presentation opportunity, which provides clear, practical information on the detection and treatment of gastroenteritis. Second, the digital presence of official health organizations should be strengthened, and the provision of reliable information should take place via the already used platforms by caregivers. Third, partnerships with social media influencers and credible individuals in the community might enhance evidence-based messages (Abroms, 2019).

Strengths and Limitations

This study has a set of strong points, such as thorough evaluation of the knowledge in many fields, strict questionnaire validation processes, and the comparison of the answers to the panels of experts. The use of item-difficulty analysis provides a methodological strength as it will mean that the results reported will be those based on real knowledge differences and not measurement errors.

Nonetheless, there are some shortcomings that have to be considered. To begin with, the research was done in one urban hospital, which may not be representative of the entire Iraqi population or even of caregivers who treat gastroenteritis at home without visiting a hospital. The exclusion of the subset of caregivers who treated illness alone could have resulted in selection bias since they might have different knowledge profiles compared to their counterparts who present themselves to emergency departments (Weghorst *et al.*, 2024).



Second, the cross-sectional design does not allow making causal inferences about the relationships between sociodemographic variables and knowledge; the identified relationships can be either bidirectional or confounded by unmeasured variables. Third, self-reported knowledge might not be a valid indicator of what really happens when an individual becomes ill; social desirability bias might encourage caregivers to claim to be competent or to follow the recommended steps (Tourangeau & Yan, 2007).

Fourth, the research has failed to examine the more general constructs like general health literacy, cognitive functioning, or prior experience of formal health-education programs, which may confound the results. Fifth, it has the disadvantage of a relatively small sample size and consequent broad confidence intervals on some estimates, limiting their statistical accuracy and possibly hiding clinically relevant relationships.

Lastly, the period of data collection was simultaneous with the instability of the region, which may have influenced the results by interfering with the healthcare provision and educational access and, therefore, health literacy in a manner that is not readily measured by standard demographic variables.

Generalizability

This research has the greatest relevance to the caregivers of young children who report to the emergency departments of hospitals with acute gastroenteritis in urban and periurban Iraqi locations. It might be safe to assume generalizability to other Middle Eastern settings with similar healthcare infrastructure and cultural dynamics, but caution should be exercised with extrapolation to high-income countries with different healthcare systems and information environments. The preclusion of caregivers who dealt with illness alone is restrictive to the applicability to the general population of caregivers of children with gastroenteritis, many of whom do not obtain hospital assistance.



Conclusions

The results have shown that although most of the caregivers who show up to the tertiary hospital in Diyala Province have a satisfactory level of general information on pediatric gastroenteritis, with over 50% level, there are still major gaps in all the areas studied. The most frequently encountered problems of caregivers are the inability to recognize particular signs of dehydration, to determine the correct needs and composition of ORT, and to understand when antibiotics are unnecessary. Multivariate analysis did not show any significant predictors of sociodemographics, and it is possible to state that knowledge deficits are not concentrated in a few subgroups.

The excessive use of social media and news media, and the lack of interaction with health-care providers to obtain information about gastroenteritis, demonstrate the potential of strengthening health-education provision by both standard clinical interactions and new digital channels. The validation of the knowledge questionnaire on health-professional cohorts offers an affirmation of its measurement faithfulness as well as offers a practical tool to be used in future studies and intervention assessment in similar contexts.

Finally, the improvement of the knowledge of the caregivers is a necessary but inadequate requirement to improve the sequelae of gastroenteritis. Knowledge should be converted into proper action, and this means not only knowing but also having the necessary resources (ORS, clean water), trust in care-giving skills, and the health care systems that strengthen, instead of weakening, home management (Michie *et al.*, 2011).

Recommendations

According to the research results, a number of recommendations are given regarding clinical practice, health-systems policy, and future research. Clinically, medical practitioners need to incorporate organized health education in each gastroenteritis emergency department encounter,



systematically evaluating caregiver understanding and providing specific training on dehydration recognition, oral rehydration therapy preparation and administration, proper feeding during illness, and return to care indicators. The different literacy levels would be accommodated by the creation and use of standardized discharge instructions with visual aids and plain-language explanations, whereas the demonstration of how to prepare oral rehydration solution during encounters and the use of oral rehydration solution preparations as opposed to using verbal instructions only would allow caregivers to practice and be assessed.

On a health-system and policy level, formal health-education initiatives need to be implemented in the primary-care setting to address caregivers before the acute illness events and focus on prevention, early detection, and proper management at home. The official health organizations need to empower their digital health information technology by developing and marketing evidence-based material through the existing platforms already used by caregivers such as social media, messaging apps, and web pages. Collaborations with social-media and content producers may be useful to spread the correct information about gastroenteritis and to refute the myths. The introduction of gastroenteritis management into community-health-worker training programs would use the trusted members of the community to expand the scope of health education beyond the healthcare facilities.

The next step in research should be bigger, multicenter studies in different parts of Iraq to support these results and determine the regional differences in knowledge and information sources. Caregivers who treat gastroenteritis at home without presenting to the hospital should also be incorporated in the studies to give a better picture of the knowledge and practices of the community. Qualitative research would be useful in addressing contextual issues, beliefs, and decision-making processes that underlie the knowledge gaps and inform culturally competent interventions. Moreover, a stringent appraisal of the efficacy of various health education interventions through randomized controlled trials, the relationship between



knowledge gain and real practices when experiencing bouts of gastroenteritis, and the details and quality of gastroenteritis-related information shared on social media that is rife in Iraq would provide evidence that is essential in the formulation of specific interventions.

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Conflict of Interest

None.

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References

1. Abroms L. C. (2019). Public Health in the Era of Social Media. *American journal of public health*, 109(S2), S130–S131. <https://doi.org/10.2105/AJPH.2018.304947>
2. Alrafiaah, A. S., Albraikan, A., AlJaafari, A., AlAbbad, A., Alfehaid, H., Alqueflie, S., & Omair, A. (2022). Assessment of Maternal Knowledge and Practices Regarding Acute Diarrheal Illnesses in Children in Saudi Arabia: A Tertiary Care Center Survey. *Cureus*, 14(12), e33116. <https://doi.org/10.7759/cureus.33116>
3. Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: an updated systematic review. *Annals of internal medicine*, 155(2), 97–107. <https://doi.org/10.7326/0003-4819-155-2-201107190-00005>



4. Bruzzese, E., Giannattasio, A., & Guarino, A. (2018). Antibiotic treatment of acute gastroenteritis in children. *F1000Research*, 7, 193. <https://doi.org/10.12688/f1000research.12328.1>
5. Chow, C. M., Leung, A. K., & Hon, K. L. (2010). Acute gastroenteritis: from guidelines to real life. *Clinical and experimental gastroenterology*, 3, 97–112. <https://doi.org/10.2147/ceg.s6554>
6. Curtis, V., & Cairncross, S. (2003). Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *The Lancet. Infectious diseases*, 3(5), 275–281. [https://doi.org/10.1016/s1473-3099\(03\)00606-6](https://doi.org/10.1016/s1473-3099(03)00606-6)
7. Dorji, T., Tshering, T., & Wangdi, K. (2020). Assessment of knowledge, attitude and practice on tuberculosis among teacher trainees of Samtse College of Education, Bhutan. *PloS one*, 15(11), e0241923. <https://doi.org/10.1371/journal.pone.0241923>
8. Freedman, S. B., Pasichnyk, D., Black, K. J., Fitzpatrick, E., Gouin, S., Milne, A., Hartling, L., & Pediatric Emergency Research Canada Gastroenteritis Study Group (2015). Gastroenteritis Therapies in Developed Countries: Systematic Review and Meta-Analysis. *PloS one*, 10(6), e0128754. <https://doi.org/10.1371/journal.pone.0128754>
9. GBD 2019 Under-5 Mortality Collaborators (2021). Global, regional, and national progress towards Sustainable Development Goal 3.2 for neonatal and child health: all-cause and cause-specific mortality findings from the Global Burden of Disease Study 2019. *Lancet (London, England)*, 398(10303), 870–905. [https://doi.org/10.1016/S0140-6736\(21\)01207-1](https://doi.org/10.1016/S0140-6736(21)01207-1)
10. Guarino, A., Ashkenazi, S., Gendrel, D., Lo Vecchio, A., Shamir, R., Szajewska, H., European Society for Pediatric Gastroenterology, Hepatology, and Nutrition, & European Society for Pediatric Infectious Diseases (2014). European Society for Pediatric Gastroenterology, Hepatology, and Nutrition/European Society for Pediatric Infectious Diseases evidence-based guidelines for the management of acute gastroenteritis in children in Europe: update 2014. *Journal of pediatric gastroenterology and nutrition*, 59(1), 132–152. <https://doi.org/10.1097/MPG.0000000000000375>
11. Huq, M. N., & Tasnim, T. (2008). Maternal education and child healthcare in Bangladesh. *Maternal and child health journal*, 12(1), 43–51. <https://doi.org/10.1007/s10995-007-0303-3>
12. J S, D., Gupta, A. K., Veeri, R. B., Garapati, P., Kumar, R., Dhingra, S., Murti, K., Ravichandiran, V., & Pandey, K. (2021). Knowledge, attitude and practices towards visceral leishmaniasis among HIV patients: A cross-sectional study from Bihar, India. *PloS one*, 16(8), e0256239. <https://doi.org/10.1371/journal.pone.0256239>



13. Khan, A. M., Wright, J. E., & Bhutta, Z. A. (2020). A Half Century of Oral Rehydration Therapy in Childhood Gastroenteritis: Toward Increasing Uptake and Improving Coverage. *Digestive diseases and sciences*, 65(2), 355–360. <https://doi.org/10.1007/s10620-019-05921-y>
14. King, C. K., Glass, R., Bresee, J. S., Duggan, C., & Centers for Disease Control and Prevention (2003). Managing acute gastroenteritis among children: oral rehydration, maintenance, and nutritional therapy. *MMWR. Recommendations and reports : Morbidity and mortality weekly report. Recommendations and reports*, 52(RR-16), 1–16.
15. Kyanjo, J. L., Turinawe, A., Hörnell, A., & Lindvall, K. (2025). Balancing maternal employment and child nutrition and health: a grounded theory study of rural communities in Northeastern Uganda. *BMC public health*, 25(1), 769. <https://doi.org/10.1186/s12889-025-21978-z>
16. Kyriazos, T., Stalikas, A., Prassa, K., Yotsidi, V., Galanakis, M., & Pezirkianidis, C. (2018). Validation of the Flourishing Scale (FS), Greek Version and Evaluation of Two Well-Being Models. *Psychology*, 9(7), 1789–1813. <https://doi.org/10.4236/psych.2018.97105>
17. Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science* : IS, 6, 42. <https://doi.org/10.1186/1748-5908-6-42>
18. Moorhead, S. A., Hazlett, D. E., Harrison, L., Carroll, J. K., Irwin, A., & Hoving, C. (2013). A new dimension of health care: systematic review of the uses, benefits, and limitations of social media for health communication. *Journal of medical Internet research*, 15(4), e85. <https://doi.org/10.2196/jmir.1933>
19. Nalin, D. R., & Cash, R. A. (2018). 50 years of oral rehydration therapy: the solution is still simple. *Lancet (London, England)*, 392(10147), 536–538. [https://doi.org/10.1016/S0140-6736\(18\)31488-0](https://doi.org/10.1016/S0140-6736(18)31488-0)
20. Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), 259–267. <https://doi.org/10.1093/heapro/15.3.259>
21. Okechukwu, C., & Briggs D. C. (2020). Symptomatic Hypernatraemia Secondary to Ingestion of Poorly Constituted Oral Rehydration Solution – A Case Report. *Asian Journal of Pediatric Research*, 3(1), 1–5. <https://doi.org/10.9734/ajpr/2020/v3i130117>
22. Ozongwu, C. (2024). 6401 Evaluating ORT preparation practices among caregivers in the management of diarrhoea at home in children under five in a



- LMIC: a critical literature review. *Archives of Disease in Childhood*, 109(Suppl 1), A278–A279. <https://doi.org/10.1136/archdischild-2024-rcpch.438>
23. Sreeramareddy, C. T., Shankar, R. P., Sreekumaran, B. V., Subba, S. H., Joshi, H. S., & Ramachandran, U. (2006). Care seeking behaviour for childhood illness--a questionnaire survey in western Nepal. *BMC international health and human rights*, 6, 7. <https://doi.org/10.1186/1472-698X-6-7>
24. Sultana, M., Sarker, A. R., Sheikh, N., Akram, R., Ali, N., Mahumud, R. A., & Alam, N. H. (2019). Prevalence, determinants and health care-seeking behavior of childhood acute respiratory tract infections in Bangladesh. *PloS one*, 14(1), e0210433. <https://doi.org/10.1371/journal.pone.0210433>
25. Swire-Thompson, B., & Lazer, D. (2020). Public Health and Online Misinformation: Challenges and Recommendations. *Annual review of public health*, 41, 433–451. <https://doi.org/10.1146/annurev-publhealth-040119-094127>
26. Tourangeau, R., & Yan, T. (2007). Sensitive questions in surveys. *Psychological bulletin*, 133(5), 859–883. <https://doi.org/10.1037/0033-2909.133.5.859>
27. Ulrickson M. (2005). Oral rehydration therapy in children with acute gastroenteritis. *JAAPA : official journal of the American Academy of Physician Assistants*, 18(1), 24–40. <https://doi.org/10.1097/01720610-200501000-00004>
28. UNICEF. (2024). *Diarrhoea*. <https://data.unicef.org/topic/child-health/diarrhoeal-disease/>
29. Weghorst, A. A. H., Lawrence, J., Jansen, D. E. M. C., Holtman, G. A., Sanci, L. A., Berger, M. Y., & Hiscock, H. (2024). Enablers and Barriers to Home Management for Children with Gastroenteritis: Systematic Review. *Journal of pediatrics. Clinical practice*, 14, 200115. <https://doi.org/10.1016/j.jpdc.2024.200115>
30. Wittenberg D. F. (2012). Management guidelines for acute infective diarrhoea / gastroenteritis in infants. *South African medical journal = Suid-Afrikaanse tydskrif vir geneeskunde*, 102(2), 104–107. <https://doi.org/10.7196/samj.5243>
31. World Health Organization. (2005). *The treatment of diarrhoea: a manual for physicians and other senior health workers*, 4th rev. <https://iris.who.int/items/b1c8b018-4993-4f93-aa22-c592587d6253>
32. World Health Organization. (2014). *Antimicrobial resistance: global report on surveillance*. <https://iris.who.int/items/d0b8aea6-59f6-49d9-9c8d-05fc22bffc8a>



33. World Health Organization. (2024). *Iraq: Health data overview for the Republic of Iraq*. <https://data.who.int/countries/368>
34. Wynants, L., Bouwmeester, W., Moons, K. G., Moerbeek, M., Timmerman, D., Van Huffel, S., Van Calster, B., & Vergouwe, Y. (2015). A simulation study of sample size demonstrated the importance of the number of events per variable to develop prediction models in clustered data. *Journal of clinical epidemiology*, 68(12), 1406–1414. <https://doi.org/10.1016/j.jclinepi.2015.02.002>

