

Diagnostic accuracy of Gorelick 10 point scale in comparison to IMCI scale in identifying significant dehydration in South Indian children? - A prospective observational study

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ABSTRACT

Background: Unavoidable cause of mortality among under 5 children in India is dehydration resulting from acute diarrhoeal diseases. In spite of various dehydration scales available across the world, the most commonly used dehydration scale in India is IMCI. Gorelick 10 point scale having more clinical indicators could also be considered using if the diagnostic accuracy of the scale in identifying the significant dehydration is in par with that of IMCI scale. Our Objective was to classify the 1 month - 60 month aged children admitted with diarrhoeal disease based on dehydration assessment using Body weight, Gorelick 10 point scale, IMCI scale and to compare the diagnostic accuracy of Gorelick 10 point scale vs IMCI scale in identifying significant dehydration. **Methods:** The prospective observational study was done among 224, 1 month to 60 month aged children admitted with acute watery diarrhea. The children were assessed for severity of dehydration using Body weight, Gorelick 10 point scale, IMCI scale. The diagnostic accuracy of Gorelick 10 point scale vs IMCI scale in identifying significant dehydration was assessed using statistical methods like, Sensitivity, Specificity, Positive Predictive Value PPV, NPV, LR+, LR-, Youden index and accuracy and Kappa statistic to detect inter-rater reliability. **Results:** The proportion of participants classified as to have no dehydration, some dehydration and severe dehydration according to Gorelick 10 point scale, IMCI and percentage of weight loss was 79.9%, 18.8%, 1.3% vs 77.7%, 21%, 1.3% vs 79.9%, 18.8%, 1.3% respectively. The diagnostic accuracy of IMCI scale in identifying Significant dehydration was higher than Gorelick 10 point scale, as noted by having Sensitivity, Specificity, PPV, NPV, LR+, LR-, Youden index and accuracy as 100%, 97.2%, 0%, 100%, 35.8, 0, 0.97, 97.7% vs 88.9%, 97.2%, 88.2%, 97.2%, 31.8, 0.11, 0.85, 95.5% respectively and k value was 0.9. **Conclusion:** Though the diagnostic accuracy of IMCI was little higher than Gorelick 10 point scale in identifying significant dehydration, having obtained k value of 0.9, indicates posing an excellent agreement. Gorelick 10 point scale can be used in place of IMCI to identify Significant dehydration.

Keywords: Dehydration, diarrhoea, weight loss

Introduction

In the developing country like India, diarrhoea still remains as a major predictor of under-five childhood morbidity and mortality.^[1] In addition to its contribution in under-five mortality, the consequences of frequent diarrhoeal episodes in the early years of life result in growth retardation of the children, manifested as

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stunting, and results in various vitamin and mineral deficiencies.^[2] It is worth noting that the most effectively manageable dehydration is sometimes largely missed out, adding up the diarrhoeal death toll.^[3]

The gold standard method for diagnosing the severity of dehydration is the percentage of weight loss; however, since baseline body weight is not usually available in the acute care setting, it is difficult to measure the percentage of weight loss^[4,5] Thus, assessment of the degree of dehydration plays a major role in the management of diarrhoea.^[6] Various dehydration assessment scales, such as the WHO scale, Gorelick scale, and clinical dehydration scale, were used worldwide; however, the most commonly used scale in India is Integrated Management of Childhood Illness (IMCI).^[7] IMCI algorithm includes general appearance, eyes, thirst, and skin pinch, whereas, Gorelick 10-point scale includes 10 clinical signs (General appearance, capillary refill, tears, mucous membranes, eyes, breathing, quality of pulses, skin elasticity, heart rate, and urine output) for assessment of dehydration. Gorelick 10-point scale is said to have more accuracy in dehydration assessment in developed countries over other scales having more clinical sign parameters, and there are also various accuracy-related controversies about IMCI assessment.^[8-10] Limited studies are comparing the severity of dehydration based on clinical scales with that of the percentage of weight difference in resources in limited settings.^[7]

With the above background, the study was planned to classify the 1–60 month aged children admitted with diarrhoeal disease based on dehydration assessment using Body weight, Gorelick 10-point scale, IMCI scale, and to compare the diagnostic accuracy of Gorelick 10-point scale vs IMCI scale in identifying significant dehydration

Materials and Methods

After getting Institutional Ethical clearance and written informed consent from the parents/caregiver of the child, this prospective observational study was conducted in the Department of Pediatrics of Tertiary Care Hospital among 224 children aged between 1 month and 60 months, admitted with acute watery diarrhoea (defined by WHO as 3 or more loose stools per day for less than 14 days). Those children with severe acute malnutrition and/or having co-morbidities affecting the dehydration assessment were excluded. The initial admission weight of the child was recorded with minimal clothing on a standard electronic weighing scale essae calibrated once a month to the nearest 10 grams. Examination and the degree of dehydration were assessed individually by applying both the IMCI Algorithm [Table 1] and the Gorelick 10-point scale [Table 2] by the principal investigator. Children were treated according to the standard IMCI treatment guidelines. Those children who were classified as having no dehydration on the IMCI algorithm but classified as having some/severe dehydration on the Gorelick scale were treated as per physician discretion. Those children were closely monitored and managed accordingly.

The weight of the child was measured daily in the ward on the same electronic weighing machine. The weight recording that was

Table 1: IMCI algorithm for classifying degree of dehydration*

Characteristic	Dehydration classification		
	No (<5%)	Some (≥ 5%)	Severe (≥10%)
General Appearance	Well, alert	Restless or irritable	Lethargic/Unconscious
Eyes	Normal	Sunken	Very sunken
Thirst	Not thirsty	Thirsty/Drinking Eagerly	Poorly drinking
Skin pinch	Goes back quickly	Goes back slowly	Goes back very slowly

*Minimum two or more clinical signs required in respective category to classify as some or severe dehydration

Table 2: Gorelick 10 point scale algorithm for classifying degree of dehydration*

Characteristic	Dehydration classification	
	No or MINIMAL	Moderate to severe
General appearance	Alert	Restless, lethargic, unconscious
Capillary refill	Normal	Minimal increase, prolonged
Mucous membranes	Moist	Dry, very dry
Eyes	Normal	Sunken, deeply sunken
Tears	Present	Absent
Breathing	Normal	Deep, Deep and rapid
Quality of pulses	Normal	Thready, Weak or impalpable
Skin elasticity	Instant recoil	Recoil slowly, Recoil >2 secs
Heart rate	Normal	Tachycardia
Urine output	Normal	Reduced, Not passed in many hours

*≥3 clinical signs - ≥5% body weight from baseline - some/moderate dehydration ; ≥7 clinical signs - ≥10% bodyweight from baseline - severe dehydration

stable for two consecutive days was considered as stable weight, if stable weight was not achieved, then discharge weight was taken as post-illness weight. Percentage weight change with rehydration is calculated using the formula, Discharge weight = Admission weight/Discharge weight ×100 and is interpreted as follows: no dehydration (<5% weight change); some dehydration (5–9% weight change); and severe dehydration (>10% weight change).

To determine the diagnostic accuracy, parameters like sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), LR+, negative likelihood ratio (LR-), Youden index, and accuracy were determined, and Kappa statistics was used to identify inter-rater reliability and level of agreement between IMCI and Gorelick 10-point scale in identifying significant dehydration.

For the study purpose, during the Kappa statistics (denoted by κ), analysis, and comparison of diagnostic accuracy, significant dehydration was considered as those when there was >5% weight loss.

Results

Among the 224, 1–5 years aged children admitted with acute diarrhoea, it was noted that on assessing dehydration according to the Gorelick 10-point scale, 179 children (79.9%) had no or minimal dehydration, and 45 children (20.1%) had moderate-to-severe dehydration.

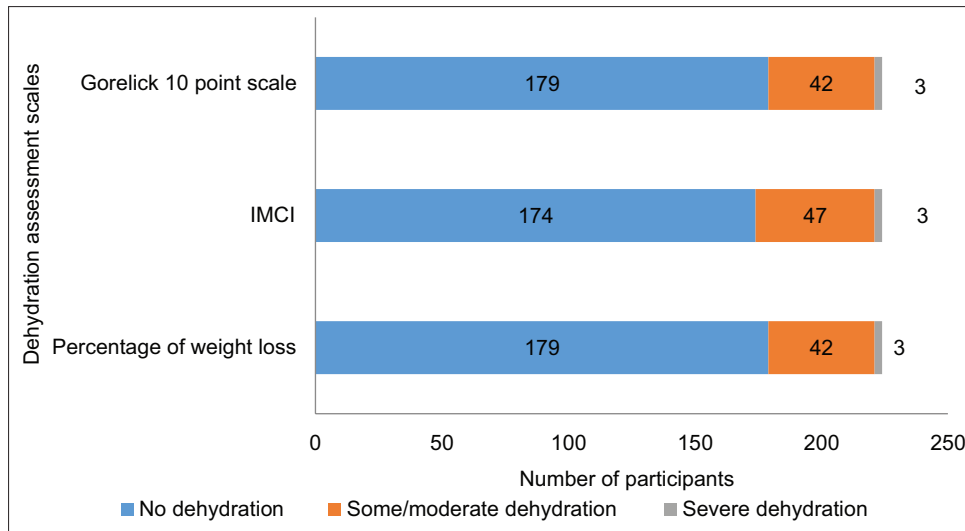


Figure 1: Distribution of participants based on the degree of dehydration assessed using the percentage of weight loss, IMCI classification, and Gorelick 10-point scale (*n* = 224)

Table 3: Comparison of diagnostic accuracy of Gorelick scale and IMCI scale in identifying significant dehydration

Dehydration scale	Significant dehydration (>5% weight loss)							
	Sensitivity	Specificity	PPV	NPV	LR +	LR-	Youden index	Accuracy
Gorelick scale	88.9%	97.2%	88.2%	97.2%	31.8	0.11	0.85	95.5%
IMCI scale	100%	97.2%	90%	100%	35.8	0	0.97	97.7%

Table 4: Kappa statistic between IMCI and Gorelick scale to identify significant dehydration*

Gorelick scale	IMCI Scale	
	Significant dehydration	Non-significant dehydration
Significant Dehydration	44	1
Non-significant dehydration	6	173

* $\kappa=0.9$

identifying significant dehydration, it was found that, having obtained percent agreement observed, percent expected by chance alone, kappa statistic value as 96.8%, 67%, 0.9, respectively, indicating that there was an excellent agreement between IMCI scale and the Gorelick 10-point scale in identifying significant dehydration ($\kappa > 0.75$ indicates excellent agreement beyond chance) [Table 4].

Discussion

In the present study, out of 224, children aged 1–5 years admitted with acute diarrhea 79.9% had <5% dehydration, 18.7% had 5–10% dehydration, and 1.3% had >10% dehydration.

Kanjanaphan T *et al.*^[11] also reported findings nearer to the present study findings pertaining to the proportion of participants with varying levels of dehydration, having 77.3% of them with less than 5% dehydration, 15.5% with 5–10% dehydration, and 7.2% with severe dehydration.

On determining the accuracy of the Gorelick 10-point scale in identifying significant dehydration, the present study showed sensitivity, specificity, LR+, and LR- of 88.9%, 97.2%, 31.8, 0.11, respectively.

In a study done by Hoxha T *et al.*^[12], it was reported that comparing the accuracy of the three dehydration scales in children with acute diarrhoea Gorelick 10-point scale showed sensitivity, specificity, LR+, LR- to be 97%, 50%, 1.97, and 0.05,

Among the 45 children who were classified under moderate to severe dehydration, 42 had more than 3 clinical signs positive with $\geq 5\%$ dehydration, and 3 had more than 7 clinical signs positive with $\geq 10\%$ dehydration, which is comparable with the IMCI's some and severe dehydration classification based on percentage of dehydration, respectively.

The proportion of participants classified as having no dehydration, some dehydration, and severe dehydration according to IMCI, and the percentage of weight loss was 77.7%, 21%, 1.3% and 79.9%, 18.8%, 1.3%, respectively [Figure 1].

The diagnostic accuracy of IMCI scale in identifying significant dehydration was higher than Gorelick 10-point scale, as noted by having sensitivity, specificity, PPV, NPV, LR+, LR-, Youden index, and accuracy as 100%, 97.2%, 0%, 100%, 35.8, 0, 0.97, 97.7% vs 88.9%, 97.2%, 88.2%, 97.2%, 31.8, 0.11, 0.85, 95.5%, respectively [Table 3].

Based on the Kappa statistics, which was done to determine the inter-rater reliability between the IMCI scale and the Gorelick 10-point scale in

respectively; they also concluded in their study that Gorelick 10-point scale was a fair predictor of dehydration in diarrheal children.

Saha A *et al.*^[13] and Falszewska A *et al.*^[14] based on their study findings reported that Gorelick scale was found not helpful for dehydration assessment in the AGE children.

In the present study, the sensitivity, specificity, LR + was higher for Gorelick 10-point scale in identifying the severe dehydration compared to moderate dehydration, whereas Pringle K *et al.*^[8] reported based on their study findings that by Gorelick 10-point scale, sensitivity was higher for moderate dehydration 82% vs 21%, respectively, whereas, specificity, LR+, LR- was higher for severe dehydration (89%, 2.04, 0.88) compared to moderate dehydration (35%, 1.25, 0.53), which was parallel to the present study findings.

Conclusion

Though the diagnostic accuracy of IMCI was little higher than Gorelick 10-point scale in identifying significant dehydration, having obtained κ value of 0.9 indicates posing an excellent agreement that Gorelick 10-point scale can be used in place of IMCI to identify significant dehydration.

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Conflicts of interest

There are no conflicts of interest.

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