Original Article

Human Touch to Detect Hypothermia in Neonates in Indian Slum Dwellings

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ABSTRACT

Objective. To assess the validity of human touch (HT) method to measure hypothermia compared against axillary digital thermometry (ADT) and study association of hypothermia with poor suckle and underweight status in newborns and environmental temperature in 11 slums of Indore city, India.

Methods. Field supervisors of slum-based health volunteers measured body temperature of 152 newborns by HT and ADT, observed suckling and weighed newborns. Underweight status was determined using WHO growth standards.

Results. Hypothermia prevalence (axillary temperature <36.5°C) was 30.9%. Prevalence varied by season but insignificantly. Hypothermia was insignificantly associated with poor suckle (31% *vs* 19.7%, p=0.21) and undernutrition (33.3% *vs* 25.3%, p=0.4). HT had moderate diagnostic accuracy when compared with ADT (kappa: 0.38, sensitivity: 74.5%, specificity: 68.5%).

Conclusions. HT emerged simpler and programmatically feasible. There is a need to examine whether trained and supervised community-based health workers and mothers can use HT accurately to identify and manage hypothermia and other simple signs of newborn illness using minimal algorithm at home and more confidently refer such newborns to proximal facilities linked to the program to ensure prompt management of illness. **[Indian J Pediatr 2010; 77 (7) : 759-762]** *E-mail: siddharth@uhrc.in, sids62@yahoo.com*

Key words: Urban poor; Newborn; Hypothermia

Urban poor constitute one-third of India's urban population.[1] Despite a plethora of health facilities in cities, 56% urban poor newborns are born at home.[2] Among home births, 87% are attended by an unskilled provider resulting in poor intra and postpartum care.[2] These factors contribute to high rates of hypothermia. Hypothermia is an important contributor of neonatal deaths. Hence, its early recognition and prompt management is crucial. Human touch (HT) is one simple programmatically feasible method to detect neonatal hypothermia.[3] However, there is no study that validated HT in Indian slum settings. This study estimated the prevalence of neonatal hypothermia through trained slum-level field workers using HT and axillary digital thermometry (ADT) and assessed diagnostic accuracy of HT.

MATERIAL AND METHODS

The study was conducted in 11 slums of Indore between December 2004 and February 2006. These slums were among the 79 slums where a health intervention of a non-government organization was operational, through a network of slum-based women groups, health volunteers (1/3,000 population) and field extension workers (1/15,000 population).

A trained Field Extension Worker (FEW) measured body temperature of 152 newborns in day time during field visits, first using HT and then ADT. She used dorsum of her right hand to assess newborn's skin temperature at abdomen (just below the umbilicus) and soles of feet. She classified the newborn as warm, mildly hypothermic and moderately hypothermic if both abdomen and soles were warm, abdomen warm and soles cold, both abdomen and soles were cold, respectively. Based on the condition, FEW counselled the mother on home-based warming measures[3] and danger signs for referral.

TABLE 1. Diagnostic Accuracy of Human Touch Method in Identifying Hypothermia

	Axillary Method (Gold Standard)				
	Hypothermia (<36.5°C)	No Hypothermia (>=36.5°C)	Total	Prevalence	= 30.9%
				Sensitivity	= 74.5%
Human Touch Method Result Positive	35 *(True +ve)*	33 *(False +ve)*	68	Specificity PV+	= 68.5% = 51.4%
Negative	12 *(False −ve)*	72 *(True −ve)*	84	PV-	= 85.7%
Total	47	105	152	LR+ LR-	= 2.36 = 0.38

PV= predictive value; LR = likelihood ratio

TABLE 2. Association Between Prevalence of Hypothermia and Selected Characteristics

	N	n (%)					
		By HT method			By ADT method		
		Warm (N=84)	Hypothermia		Warm (N=105)	Hypothermia	
			Mild (N=59)	Moderate (N=9)		Mild (N=33)	Moderate (N=14)
Season (mean environment temperature at the time of assessment)							
- Dry summer(26-33°C)	46	30 (65.2)	15 (32.6)	1 (2.2)	38 (82.6)	7 (15.2)	1 (2.2)
- Wet summer (22-28°C)	51	25 (49.0)	21 (41.2)	5 (9.8)	32 (62.7)	13 (25.5)	6 (11.8)
- Winter (14-23°C)	55	29 (52.7)	23 (41.8)	3 (5.5)	35 (63.6)	13 (23.6)	7 (12.7)
Age of newborn (days)							
- 0-7	44	23 (52.3)	18 (40.9)	3 (6.8)	28 (63.6)	9 (20.4)	7 (16.0)
- 8-28	108	61 (56.5)	41 (38.0)	6 (5.5)	77 (71.3)	24 (22.2)	7 (6.5)
Gender of newborn							
- Male	80	47 (58.8)	28 (35.0)	5 (6.3)	55 (68.8)	19 (23.8)	6 (7.5)
- Female	72	37 (51.4)	31 (43.1)	4 (5.6)	50 (69.4)	14 (19.4)	8 (11.1)
N	110	58	46	6	81	22	7
Underweight#							
- Mild (WAZ <-1 to -2 SD)	35	23 (65.7)	10 (28.6)	2 (5.7)	29 (82.9)	4 (11.4)	2 (5.7)
- Moderate (WAZ <-2 to 3 SD)	20	8 (40.0)	10 (50.0)	2 (10.0)	13 (65.0)	5 (25.0)	2 (10.0)
- Severe (WAZ <-3SD)	10	7 (70.0)	3 (30.0)	0 (0.0)	7 (70.0)	3 (30.0)	0 (0.0)
- Not underweight (WAZ>=-1SD)	45	20 (44.4)	23 (51.1)	2 (4.4)	32 (71.1)	10 (22.2)	3 (6.7)
Poor suckling							
- Yes	25	11 (44.0)	12 (48.0)	2 (8.0)	16 (64.0)	7 (28.0)	2 (8.0)
- No	85	47 (55.3)	34 (40.0)	4 (4.7)	65 (76.5)	15 (17.6)	5 (5.9)

Based on Z score for weight-for-age (WAZ) calculated as per WHO standards 2006
The percentage values given in parentheses indicates the row %

FEW measured axillary temperature using digital thermometer with soft flexible tip (Becton and Dickinson, New-Jersey; accuracy of 0.1°C; measuring range 32-43.9°C). She first placed the thermometer's tip high in the apex of baby's axilla, ensured it was free from moisture using a cotton ball and then folded the baby's arm over the chest for 4 minutes. Mother was requested to hold baby close to her chest for better positioning.[4] Newborns were classified warm, mildly hypothermic and moderately hypothermic if their axillary temperatures were 36.5-37.5°C, 36-36.4°C and <36°C respectively. [3]

On a sub-sample of 110 newborns, undernutrition status and suckling, was also examined by FEW. Weighing was done using a portable hanging Salter's spring balance (range: 0-25 kg; accuracy: 100 gm) using WHO guided procedures.[5] Z scores for weight-for-age were calculated compared to WHO standards 2006.[6] For assessing suckling, a 4 min breastfeeding observation was conducted. If the newborn took slow deep sucks with pauses, suckling was regarded as effective; else it was considered poor.[7]

Data was entered and analyzed using SPSS version 9. Hypothermia rates were calculated according to season and newborn's age, sex, underweight status and poor suckle. Chi-square test was used, to detect statistically significant association of hypothermia with these variables. To compare agreement between the two methods, kappa statistic was calculated.[8] To assess the

diagnostic accuracy of HT method, ADT was considered as gold standard and sensitivity, specificity, positive and negative predictive values and likelihood ratios were calculated.

DISCUSSION

The percentage of newborns categorized as warm and mildly hypothermic by ADT were 69.1% and 21.7% respectively. Significantly higher percentage of newborns were assessed mildly hypothermic and fewer as warm by HT (p<0.05). Overestimation by HT prompted FEW to counsel for extra warmth/ care, which was not disadvantageous, since in slum households thermal care practices are sub-optimal.

Hypothermia assessed by HT was in agreement, with hypothermia assessed by ADT (<36.5°C), in 107 out of 152 observations. Kappa value of 0.38 (95% C.I. 0.33-0.43) showed a moderate agreement between the two tests. Taking ADT as gold standard, sensitivity and specificity of HT method to correctly identify hypothermic (true positive) and non-hypothermic babies (true negative) was 74.5% and 68.5% respectively (Table 1). Other studies comparing accuracy of HT method against axillary thermometry, showed that its accuracy to correctly identify hypothermic babies varies, depending on the investigator carrying out the assessment being 96%, 74%, 34.4% and 23.4% sensitive when assessed by paediatricians[4], non-medical post-graduate field supervisor[9], community-based workers[10] and mothers [10] respectively.

Hypothermia rates differed significantly by season. Hypothermia rates were 17.4%, 37.2% and 36.3% in dry summer, wet summer and winter season respectively (Table 2). High neonatal hypothermia even during wet and dry summer, could possibly be contributed to – a) poor thermal care practices in slum households; b) thermal care was possibly neglected assuming that thermal protection is not relevant in warm season; and c) physiological vulnerability of newborns to hypothermia owing to[3] – i) incompletely developed thermo-regulatory capacity, ii) relative to body-weight, the body surface of the newborn being approximately 3 times, iii) the rate of heat loss being approximately 4 times that of the adult and iv) insulating layer of subcutaneous fat that produces and conserves heat being thinner. Hence, health programs should continue to emphasize on thermal protection at birth and hypothermia identification, even during summer or in areas with sufficiently warm climate.

By HT, 88.4% of all hypothermia was mild hypothermia, 26% and 61% newborns having mild hypothermia also had a poor suckle and were underweight (WAZ < -1SD) respectively (Table 2). This indicates that mild hypothermia is a simple and easy to detect early sign of neonatal sickness, just as is poor suckle.

As reported by FEW, HT method was simpler to use and enabled FEW to focus on counseling and prompt appropriate management/referral. ADT provided an exact measurement of body temperature, which is an advantage over HT. However, use of ADT adds cost to a program; considering initial cost of thermometer and replacements of non-functioning, damaged or lost thermometers. Further, using ADT took more time than HT, FEW's focus got singly directed to the instrument, to ensure accurate positioning and accurate measurement rather than providing counselling on management of hypothermia.

CONCLUSIONS

Overall, HT with a moderate diagnostic accuracy, may be programmatically more feasible for field settings and the two criteria (mild hypothermia and poor suckle) emerge as a promising minimal algorithm, for early neonatal sickness identification at community level.

REFERENCES

1. Ministry of Health and Family Welfare (MOHFW). National Population Policy (NPP), 2000. New Delhi, India: Ministry of Health and Family Welfare, Government of India; 2000. Available from: URL: *http//www.populationcommission. nic.in/ npp_intro.htm. Accessed October 21, 2008.*
2. Urban Health Resource Centre. Health of the Urban Poor in India. Key Results from the re-analysis of NFHS-3, 2005-06 data by wealth index quartiles (Wall chart). New Delhi, India: Urban Health Resource Centre; 2008. Available from: *http:// www.uhrc.in/downloads/wall-chart.pdf. Accessed June 20, 2008.*
3. WHO. Hypothermia in the newborn. In *Thermal protection of the newborn: a practical guide.* Geneva: World Health Organization; 1997.
4. Singh M, Rao G, Malhotra AK, Deorari AK. Assessment of

newborn baby's temperature by human touch: a potentially useful primary care strategy. *Indian Pediatr* 1992; 29: 449-452.

5. WHO. Measuring changes in nutritional status. *Guidelines for assessing the nutritional impact of supplementary feeding programs for vulnerable groups*. Geneva: World Health Organization; 1983.

6. WHO. Anthro 2005, Beta version Feb 17th, 2006: *Software for assessing growth and development of the world's children [computer program]*. Geneva: World Health Organization; 2006.

7. WHO/UNICEF. *Integrated management of neonatal and childhood illness. Assess and classify the sick young infant age up to 2 months*. New Delhi: Ministry of Health and Family Welfare, Government of India; 2003.

8. Landis RJ, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977; 33: 159-174.

9. Agarwal S, Sethi V, Pandey RM, Kondal D. Human touch *vs* axillary digital thermometry for detection of neonatal hypothermia at community level. *J Trop Pediatr* 2008; 34:200-201.

10. Kumar R, Agarwal AK. Accuracy of maternal perception of neonatal hypothermia. *Indian Pediatr* 1996; 33: 583-585.

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