

Associated Risk Factors for Predicting Pediatric Abusive Head Trauma (AHT)

S. Misra, D.M. Notrica MD, L. Kirsch, MD, K. Lofberg, MD, C. Kelly, PhD, J.B. Ortiz, PhD, T.R. Green, R.K. Rowe, J. Greenberg MA, J. Lifshitz, PhD, B. Sussman PhD, L.W. Sayrs PhD†



Phoenix Children's Hospital, Phoenix, AZ, USA

INTRODUCTION

- Inflicted or abusive head trauma (AHT) is a leading cause of traumatic death and disability in infants.¹ It accounts for:
 - 25% of pediatric hospital admissions for head injury¹
 - Almost 70% of infant homicides¹
 - 33% of all child maltreatment deaths²
- Intracranial injuries increase the risk of death substantially: 25% of all infants who undergo AHT die^{3,5}
- Survivors have life-long physical, developmental, and emotional sequelae.^{1,2,3}
- Some risk factors have been uncovered to help identify victims of AHT: infancy, male gender, and lower socioeconomic status.⁴
- At Phoenix Children's Hospital, analysis of potential risk factors in a cohort of patients with suspected AHT was conducted to develop a comprehensive pre-admission screening algorithm.

OBJECTIVES

- To examine patient, caregiver, and injury characteristics associated with AHT.
- To identify risk factors for inclusion in a pre-admission AHT screening algorithm at an ACS verified Level 1 pediatric trauma center.

METHODS

Study Design

- Design: Retrospective analysis of AHT patients evaluated by the Child Protection Team (CPT)
- Setting: Level 1 pediatric trauma center
- Time frame: January 2010 – December 2016
- Inclusion criteria:
 - AHT
 - CPT evaluation

Data Collection

- AHT cohort: demographics, injury characteristics, birth history, social history, and abuse classification
- Abuse classified by CPT as probable abuse (PA) or probable not abuse (PNA)

Data Analysis

- χ^2 statistics used to compare group proportions
- Univariate logistic regression to estimate odds ratios (OR) for covariates of interest
- Multivariate logistic regression to estimate adjusted OR for main effect while controlling potential confounders (a priori or from univariate)
- ROC curve estimated from multivariate logistic regression predicted values based on adjusted OR

RESULTS

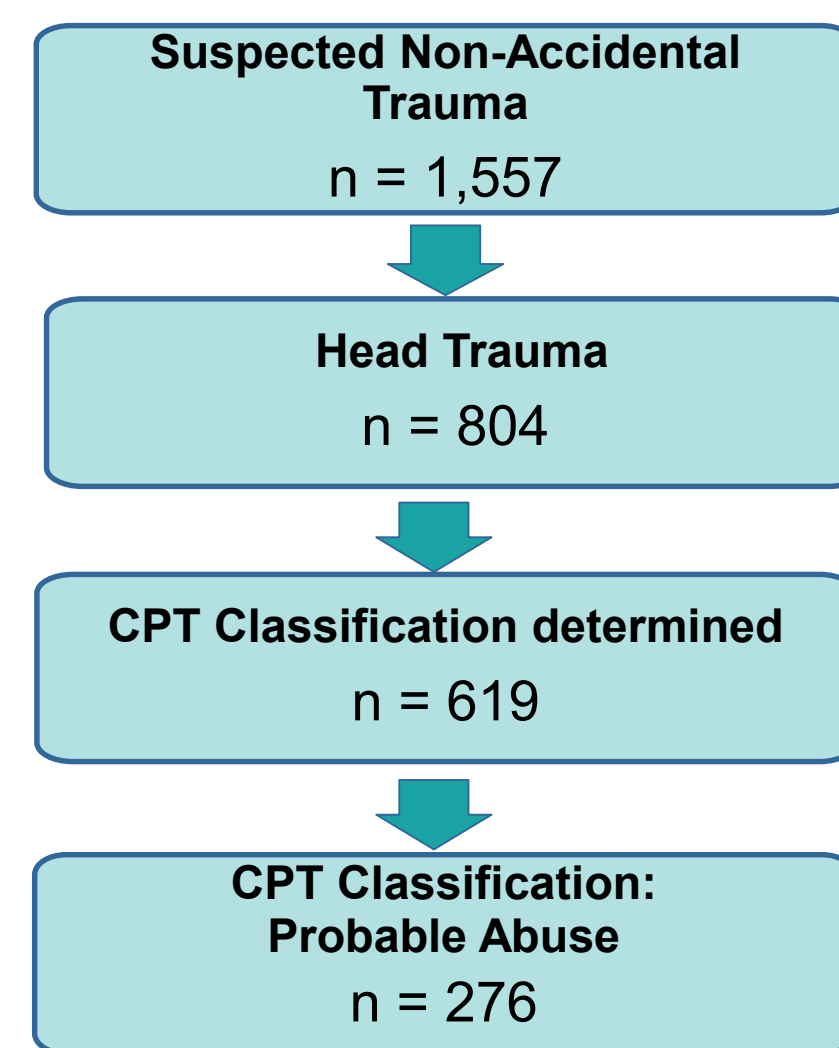


Table 1. AHT Injury Characteristics

	Probable Abuse n = 276 (%)	Probable Not Abuse n = 343 (%)
Transfer		
Yes*	134 (61.2)	91 (26.5)
No	85 (38.8)	72 (21.0)
Length of Stay (Hrs)		
1-12	9 (3.4)	36 (11.0)
13-24*	37 (14.1)	163 (49.8)
25-36	14 (5.3)	34 (10.4)
37-48	43 (16.4)	49 (15.0)
49-60	6 (2.3)	2 (0.6)
61-72	26 (9.9)	13 (4.0)
73+*	127 (48.5)	30 (9.2)
Glasgow Coma Score		
Severe (<8)*	42 (19.5)	9 (3.1)
Moderate (8-12)	18 (8.4)	3 (1.0)
Minor (≥13)	155 (72.1)	276 (95.8)
Altered/ Loss Consciousness		
Yes*	63 (34.6)	22 (7.3)
No	36 (19.8)	213 (70.5)
Unknown	83 (45.6)	67 (22.2)

* indicates significant differences between groups; p-value < 0.05

Table 2. Adjusted odds ratios for pre-admission characteristics associated with suspected AHT

Variables	AOR	95% C.I.		P-value
		Lower	Upper	
Multiple fractures	8.9	3.7	21.2	0.000
Bruise	6.4	6.5	11.5	0.000
Substance abuse	4.4	1.3	15.5	0.019
MOI Unknown	4.3	2.3	8.2	0.000
Prior Police	3.5	1.7	7.3	0.001
GCS <15	3.0	1.7	5.4	0.000
Domestic Violence	2.8	1.3	6.1	0.008
Prior CPS	2.3	1.0	4.3	0.008
Constant	0.1	---	---	0.000

Table 3. AHT Demographics

	Probable Abuse n = 276 (%)	Probable Not Abuse n = 343 (%)
Age		
Median (IQR) Months	7 (3-10)	7 (3-16)
Gender		
Male	151 (54.7)	209 (60.9)
Female	125 (45.3)	134 (39.1)
Race/Ethnicity		
Caucasian	103 (37.3)	114 (33.2)
Hispanic*	95 (34.4)	165 (48.1)
African American	22 (8.0)	16 (4.7)
Native American	44 (15.9)	27 (7.9)
Asian	1 (0.4)	2 (0.6)
Other	11 (4.0)	18 (5.2)
Insurance		
Private	215 (78.2)	244 (71.1)
Public	53 (19.3)	89 (25.9)
None	7 (2.5)	9 (2.6)
Caregiver Marital Status		
Married	64 (23.2)	94 (27.4)
Divorced	5 (1.8)	0 (0.0)
Single	67 (24.3)	37 (10.8)
Live-In Partner	57 (20.7)	24 (7.0)
Other/Unreported	83 (30.1)	188 (54.8)

* indicates significant differences between groups; p-value < 0.05

Chart 1. AHT Age Ranges

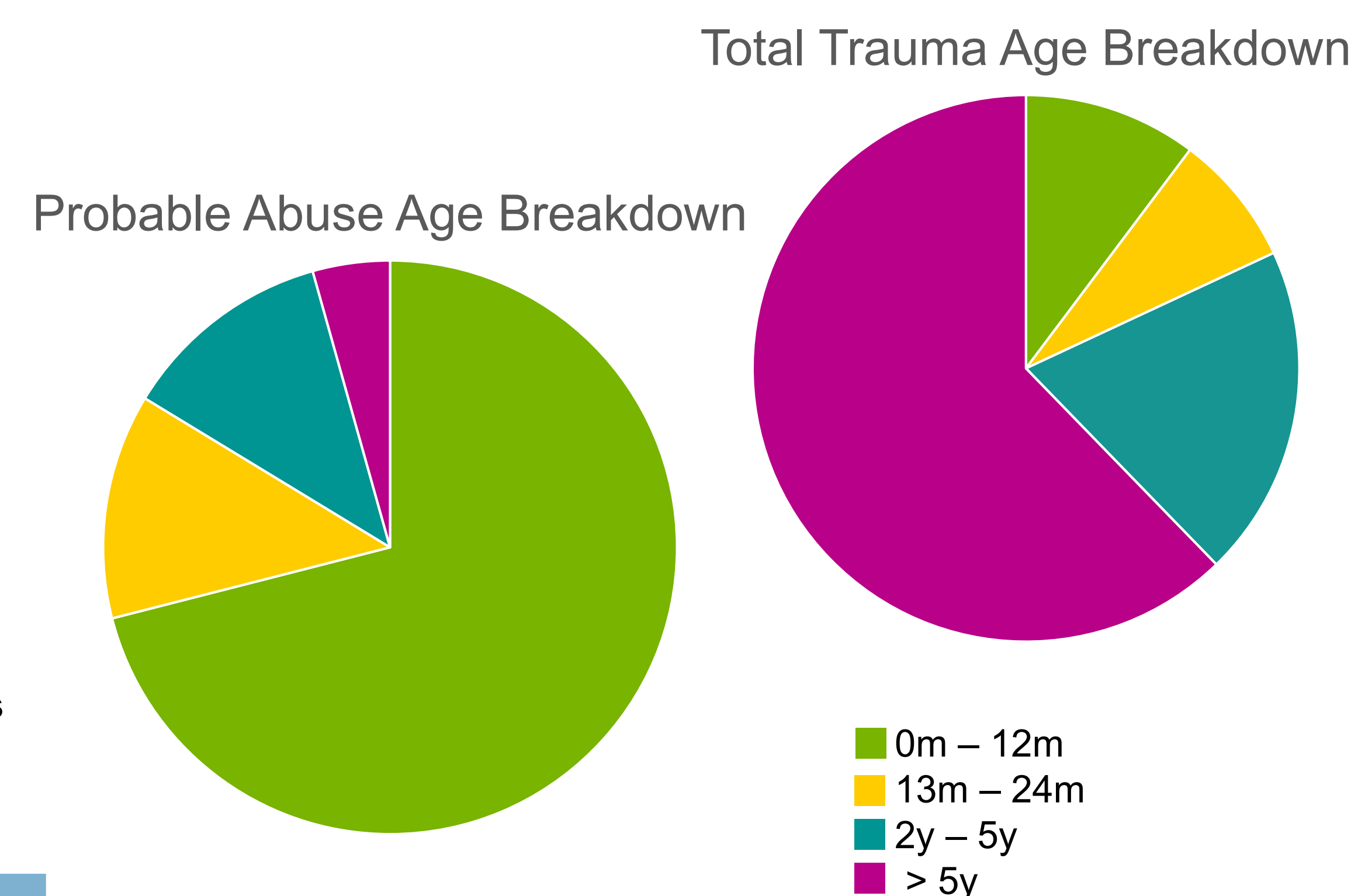
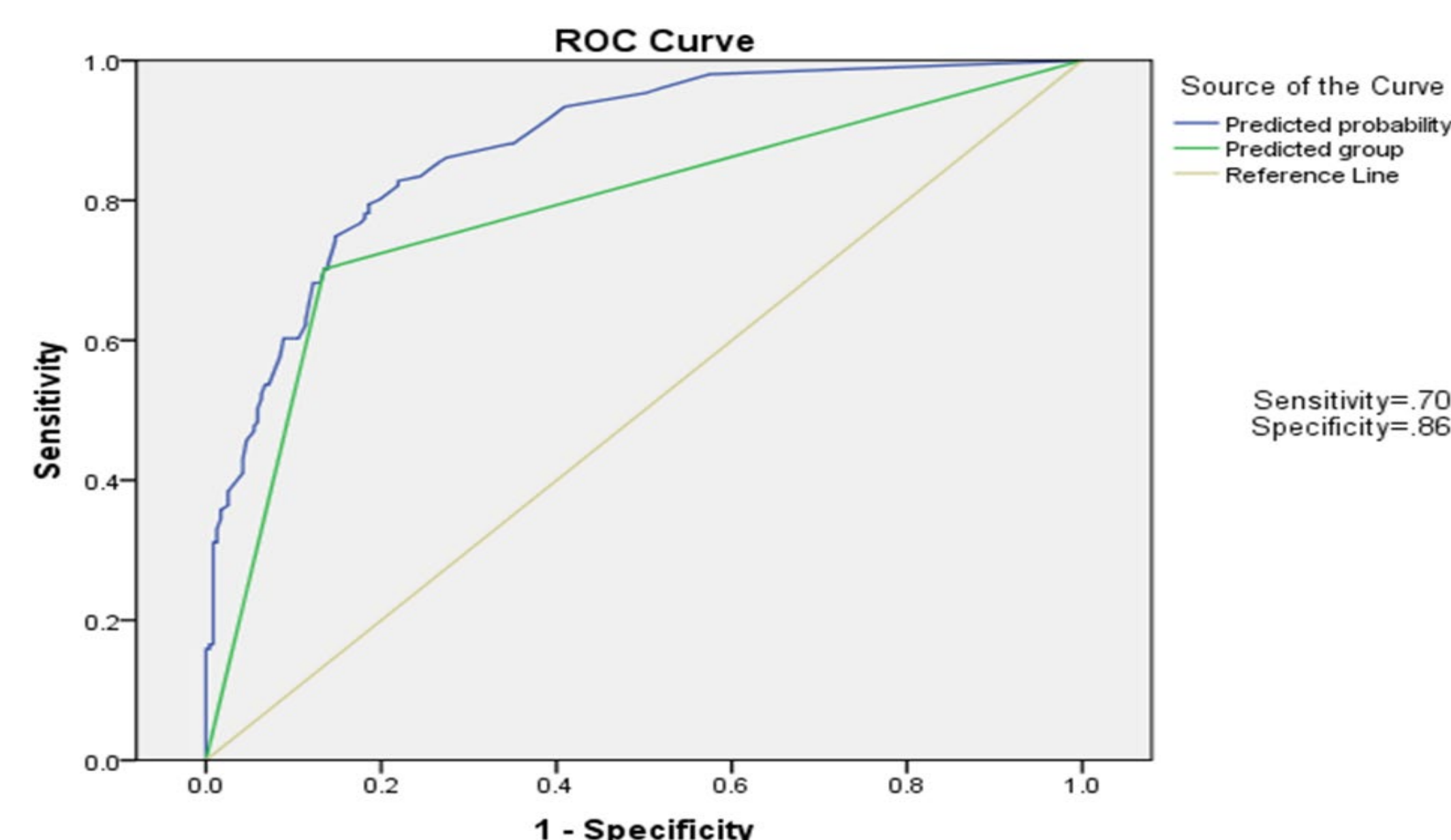


Figure 1. ROC curve for probable abuse in the AHT Population



FINDINGS

- Few demographic differences between PA and PNA patients.
- Key injury risk characteristics are transfer, LOS > 72 hours and GCS <8.
- 71% of probable AHT patients are < 12 months; 84% are < 2 years; 95% are < 5 years.
- Of 1,557 patients who had a sNAT determination, 804 were classified with head trauma. From the 804, 276 were classified as probable abuse; 343 were classified as probable not abuse and 185 were undetermined.
- Few risk factors demonstrated discriminating power for probable abuse based on adjusted odds ratios.
- Screening requires a skeletal survey, complete social history and a disrobed exam.
- The most predictive factors included multiple fractures (AOR=8.9; p<.001), bruising (AOR= 6.4; p<.001), an unknown method of injury (AOR=4.3; p<.001), and a GCS <15 (AOR=3.0; p<.001).
- Other significant predictive factors included caregiver substance abuse (AOR=1.492; p=0.019), prior police involvement (AOR=1.249; p=0.001), history of domestic violence (AOR=1.041; p=0.008), and prior CPS involvement (AOR=0.837; p=0.008).
- The logistic regression model of associated risk factors demonstrated sensitivity of .70 and specificity .86 for probable abuse based on ROC curves .

CONCLUSIONS

- Most abusive head trauma occurs prior to 2 years of age.
- Screening factors for AHT should include an unreported mechanism of injury, prior bruising, multiple fractures, and a GCS of less than 15 as injury characteristics; prior police and/or CPS involvement, substance abuse, and domestic violence as familial demographic information.
- When assessing children with head injuries, bruising, multiple fractures, an unknown MOI, and caregiver substance abuse are all independently associated with a 2-8 fold increase in the likelihood of non-accidental trauma.
- The predicted probability from the logistic regression model has an 70% sensitivity, i.e., will correctly identify AHT 70% of the time, with specificity of 86%, i.e. will correctly exclude AHT 86% of the time.

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