# Traumatic and non-traumatic coma in children in the referral hospital, Al-Hasa, Saudi Arabia

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## الغيبوبة الرضحية وغير الرضحية لدى الأطفال في مستشفى الإحالة، في منطقة الإحساء، بالمملكة العربية السعودية

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**الخلاصة:** قام الباحثون بتحديد معدل حدوث الغيبوبة، وأسبابها، ونتيجتها، بين الأطفال المرضى في مستشفى الملك فهد، وهو مركز الإحالة الوحيد لمنطقة الإحساء، في المملكة العربية السعودية. وبلغ عدد الأطفال الذين أدخلوا المستشفى لإصابتهم بالغيبوبة (في المجال العمري من 28 يوماً إلى 12 عاماً) 91 طفلاً، وذلك خلال المدة من نيسان/إبريل 1999 إلى آذار/مارس 2002. وباستخدام مقياس جلاسجو الرقمي للغيبوبة لتقييم وعي الأطفال، تم تصنيف النتائج العصبية إلى ثلاث فئات: سلامة، واختلال، ووفاة. وبلغ معدل حدوث الغيبوبة 4.77 لكل 100 000 من السكان في السنة. وكانت الرضوح (رضوح الرأس أو الرضوح المتعدِّدة) هي المسبِّب الأكثر شيوعاً للغيبوبة (52.8%)، تليها العدوى (25.3%). وبلغ معدل الوفيات 47.2% (35.4% بين المصابين بالرضوح و60.5% بين الحالات غير الرضحية). ولوحظت نتائج تدل على حدوث اختلال لدى 19.8% من المرضى (22.9% بين المصابين بالغيبوبة الرضحية، و16.3% بين المصابين بالغيبوبة غير الرضحية).

ABSTRACT We determined the incidence, etiology and outcome of paediatric coma patients in King Fahad Hospital, which is the only referral centre for Al-Hasa region, Saudi Arabia. From April 1999 to March 2002, 91 children with coma (age range 28 days to 12 years) were admitted. The Glasgow Coma Scale for children was used for assessment. Neurological outcomes were categorized as intact, impairment or death. Incidence of coma was 4.77 per 100 000 population per year. Trauma (head trauma or polytrauma) was the commonest cause of coma (52.8%), followed by infection (25.3%). Mortality was 47.2% (35.4% among traumatic cases and 60.5% among non-traumatic cases). There was impaired outcome in 19.8% of patients (22.9% with traumatic coma and 16.3% with non-traumatic coma).

**Coma post-traumatique et non post-traumatique chez l'enfant à l'hôpital de recours d'Al-Hasa en Arabie saoudite**

RÉSUMÉ Nous avons évalué l'incidence, l'étiologie et l'issue du coma en pédiatrie à l'Hôpital King Fahad, seul centre hospitalier de recours pour la région d'Al-Hasa en Arabie saoudite. Entre avril 1999 et mars 2002, 91 enfants en coma (âgés de 28 jours à 12 ans) y ont été admis. L'évaluation a reposé sur le score de Glasgow pédiatrique. Il a été défini trois catégories de pronostic neurologique : bon (récupération complète), incertain (récupération incomplète) ou fatal (décès). L'incidence annuelle du coma pour l'ensemble de la population était de 4,77 cas pour 100 000. Les traumatismes (traumatisme crânien ou polytraumatisme) étaient la cause la plus fréquente de coma (52,8 %), suivis par les infections (25,3 %). La mortalité s'élevait à 47,2 % (35,4 % des cas post-traumatiques et 60,5 % des cas non post-traumatiques). La récupération s'est avérée incomplète chez 19,8 % des patients (22,9 % des comas post-traumatiques et 16,3 % des comas non post-traumatiques).

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## Introduction

The assessment of patients in coma is a medical emergency. The cause should be identified and, where possible, corrected and the brain provided with appropriate protection to reduce further damage. It then becomes important to identify those patients for whom the prognosis is hopeless and in whom the institution or persistence of resuscitative measures is inappropriate [*1*]. Most epidemiological studies of coma in children have focused on traumatic coma [*2–4*]. In the past few years, there have been an increasing number of studies that have looked at non-traumatic coma of different etiologies [*5,6*].

The aim of this study was to determine the incidence, etiology and outcome of coma, both traumatic and non-traumatic, in paediatric patients in Al-Hassa region, eastern province, Saudi Arabia, a highly populated region, to determine the commonest causes of coma and death in these patients.

## Methods

This was a retrospective study of medical records conducted in King Fahad Hospital, Hofuf in Saudi Arabia. This hospital is the only referral centre for the whole of Al-Hassa region, which represents almost one-quarter of the area of Saudi Arabia and is the largest oasis in the world [*7*]. All children, aged 28 days to 12 years, admitted to the paediatric intensive care unit (PICU) with acute alteration of consciousness, between April 1999 and March 2002, were the subjects of the study. Depression of consciousness was assessed by the modified Glasgow Coma Scale for children (GCS) [*8,9*] as shown in Table 1.

Investigations performed for patients of the study were guided by the clinical presentation of the patients and were determined by the consultant in charge of every child. Neurological outcomes [*6*] were determined as: intact (normal or no change from premorbid functioning; seizures, if recorded, are 100% controlled), impaired (alteration of tone, power or reflexes; cranial nerve dysfunction; ataxia; seizures; persistent vegetative states) or death.

Data were collected, computed and statistically analysed using *Epi-Info*, version 6. The chi-squared test was used for comparison between traumatic and non-traumatic coma. The *F*-test was used to assess the significance of the relation between GCS and outcome. Differences were considered significant at $P \leq 0.05$.

## Results

During the study period, a total of 91 (10.5%) children out of 870 admissions to PICU were admitted with a diagnosis of coma, an average rate of 2.6 patients per month. There were 59 males and 32 females giving a male to female ratio of 1.8:1. Population census of the region showed that the number of children aged 28 days to 12 years was therefore 635 603 during the study period. The incidence of coma was therefore 4.77 per 100 000 population per year.

Table 2 shows that preschool aged children constituted the greatest proportion of the cases (43.9%) and two-thirds of all the cases had a GCS of 8 or less. Figure 1 indicates that the commonest causes of coma were head trauma (42.9%), followed by infections (25.3%) and polytrauma (9.9%). Figure 2 shows the frequency of different types of infections; gastroenteritis was the commonest cause of sepsis-related coma. *Pseudomonas aeruginosa*, streptococcal pneumonia and *Haemophilus influenzae* were the most frequently isolated microor-

Table 1 **Modified Glasgow coma score**

| Score | Response | Response | Response |
|---|---|---|---|
| *Eye opening* | > 1 year | 0–1 year | |
| 4 | Opens spontaneously | Opens spontaneously | |
| 3 | Opens to a verbal command | Opens to a shout | |
| 2 | Opens in response to pain | Opens in response to pain | |
| 1 | No response | No response | |
| *Best motor response* | > 5 years | 2–5 years | 0–23 months |
| 5 | Oriented and able to converse | Uses appropriate words | Cries appropriately |
| 4 | Disoriented and able to converse | Uses inappropriate words | Cries |
| 3 | Uses inappropriate words | Cries and/or screams | Cries and/or screams inappropriately |
| 2 | Makes incomprehensible sounds | Grunts | Grunts |
| 1 | No response | No response | No response |
| *Best verbal response* | > 1 year | 0–1 year | |
| 6 | Obeys command | Spontaneous | |
| 5 | Localizes pain | Localizes pain | |
| 4 | Flexion withdrawal | Flexion withdrawal | |
| 3 | Flexion abnormal (decorticate) | Flexion abnormal (decorticate) | |
| 2 | Extension (decerebrate) | Extension (decerebrate) | |
| 1 | No response | No response | |

Table 2 **Age, type of coma and Glasgow coma score of comatose infants and children**

| Variable | No. (*n* = 91) | % |
|---|---|---|
| *Age group*[a] | | |
| Infants (28 days–<1 year) | 17 | 18.7 |
| Preschoolers (1–5 years) | 40 | 43.9 |
| School-aged (6–12 years) | 34 | 37.4 |
| *Type of coma* | | |
| Traumatic | 48 | 52.7 |
| Non-traumatic | 43 | 47.3 |
| *Glasgow coma score* | | |
| 3–8 | 61 | 67.0 |
| 9–12 | 30 | 33.0 |

[a]*Mean (standard deviation) = 4.6 (3.5) years, median = 4 years.*

ganism from blood, cerebrospinal fluid or tracheal aspirate.

Tables 3 and 4 show different outcomes (intact, impairment or death) in relation to the cause of coma and GCS score.

## Discussion

Most studies on childhood coma have been done in developed countries and there are few comprehensive data from developing countries where 80% of the world's children live [*5*].

Unsupervised activity is a major risk factor for traumatic coma and its age-specific

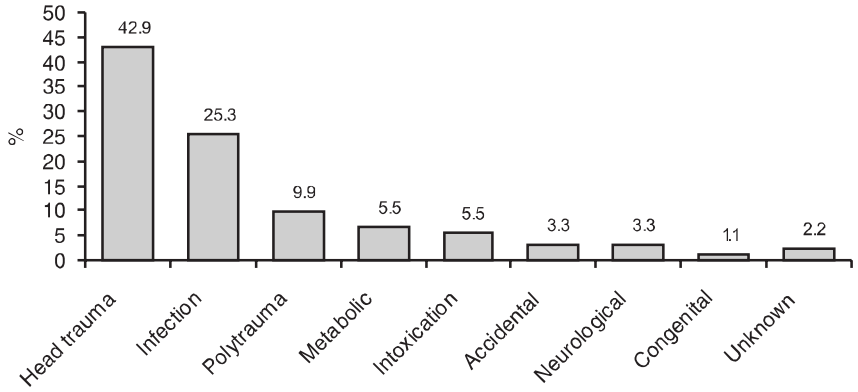


Figure 1 **Etiology of coma in the study patients (*n* = 91)**

incidence rises throughout early childhood with the highest rates in the preschool age group [*10,11*]. In our study, 10.4% of the patients with traumatic coma were in the infant age group compared to 27.9% with non-traumatic coma. Other studies report varying rates for traumatic coma. In an Indian study only 3.2% of the patients were below 2 years [*12*], in a Japanese study 12.5% of patients were infants [*13*] and in a Malaysian study 50% were infants [*5*].

In our study, trauma was the commonest cause of coma during the preschool and school ages and was accompanied by poor outcome (death or impairment) in more than half of the cases. These findings agree with earlier reports on traumatic coma [*3,4,10*]. Acute brain injury has been reported to be the cause of approximately 100 000 paediatric hospital admissions per year in the United States of America [*14*] and it is the leading cause of death in children older than 1 year [*9*]. In a Spanish 1-year study on children, 70% of deaths from traumatic brain injuries occurred within the first 48 hours and mortality ranged between 20% and 35% [*15*]. In another report on head trauma in children, 38% died and the average length of coma in survivors was 15.5 days; 29% of the survivors were unimpaired at follow up, 9% of had motor deficits but normal intellect and 9% had severe intellectual and motor problems [*16*].

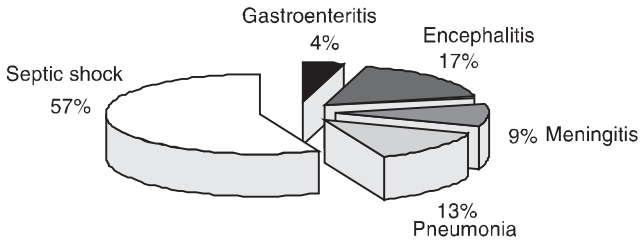


Figure 2 **Infectious causes of coma in the study patients (*n* = 23)**

Table 3 **Etiology of coma by clinical outcome**

| Etiology | Total | Intact | | Impairment | | Death | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % |
| Head trauma | 39 | 16 | 41.0 | 11 | 28.2 | 12 | 30.8 |
| Polytrauma | 9 | 4 | 44.4 | 0 | 0.0 | 5 | 55.6 |
| Infection | 23 | 2 | 8.7 | 3 | 13.0 | 18 | 78.3 |
| Poisoning | 5 | 5 | 100 | 0 | 0.0 | 0 | 0.0 |
| Other (accidental)[a] | 3 | 0 | 0.0 | 0 | 0.0 | 3 | 100 |
| Metabolic | 6 | 2 | 33.3 | 3 | 50.0 | 1 | 16.7 |
| Neurological | 3 | 0 | 0.0 | 1 | 33.3 | 2 | 66.7 |
| Congenital | 1 | 0 | 0.0 | 0 | 0.0 | 1 | 100 |
| Unknown | 2 | 1 | 50.0 | 0 | 0.0 | 1 | 50.0 |
| Total | 91 | 30 | 33.0 | 18 | 19.8 | 43 | 47.2 |

[a] *2 cases of drowning and 1 of electric shock.*

Table 4 **Outcome of cases in relation to mean Glasgow coma score and type of coma**

| Outcome | Traumatic (*n* = 48) | | Non-traumatic (*n* = 43) | | Total (*n* = 91) | |
|---|---|---|---|---|---|---|
| | No. | Mean (SD) | No. | Mean (SD) | No. | Mean (SD) |
| Intact | 20 | 8.1 (2.5) | 10 | 9.3 (2.2) | 30 | 8.5 (2.1) |
| Impairment | 11 | 6.6 (2.3) | 7 | 7.0 (2.8) | 18 | 6.7 (2.5) |
| Death | 17 | 4.2 (1.6) | 26 | 5.8 (3.3) | 43 | 5.1 (2.9) |
| *F*-test | 14.55 | | 4.90 | | 13.92 | |
| *P* | < 0.001 | | < 0.05 | | < 0.001 | |

*SD = standard deviation.*

Infection was the commonest cause of non-traumatic coma in our study and the commonest cause of coma in infants. Our results about infection-induced coma are in agreement with an English study on non-traumatic coma where infections caused 50.5% of coma in infancy, compared to 33.7% and 31.5% in preschool and school-aged children respectively [*6*]. In a Malaysian study, about two-thirds of the total coma cases were due to infection [*5*]. The same study considered infection as the most important cause of childhood coma throughout the world. In a Japanese study, 74% of cases of coma were also due to infection, mostly viral [*13*]. In an Indian study the etiology of coma in 60% of cases with non-traumatic coma was central nervous system (CNS) infection including tubercular meningitis, encephalitis, bacterial meningitis, and others [*17*]. This contradicts some reports from developed counties which stressed the importance of hypoxic ischaemic encephalopathy and toxic/metabolic causes [*11,18,19*].

The pattern of infection varies in different regions. In our study, the commonest infection was septicaemia complicated by septic shock (56.5%) followed by CNS infections (26.1%). The organisms isolated were diverse but the commonest were *Pseudomona*s spp. and *H. influenza*e. Different infective agents predominate in other parts of the world, for example cerebral malaria in Africa [*20*] and dengue haemorrhagic fever in South-east Asia [*21*]. In Japan, measles virus, herpes simplex and rubella are important [*13*]. In Malaysia, *H. influenzae* has been commonly implicated in CNS infection [*22,23*]. In an English study, *Neisseria meningitides* was recovered in 47% of cases where a pathogen was identified [*6*].

Other causes of coma apart from trauma and infection were found in only 21.9% of our patients. They are heterogenous causes but metabolic disorders, poisoning and accidental causes were the commonest. Accidental and neurological causes had the worst outcome in comparison with intoxication, which was followed by complete recovery. Although these findings are similar to previous studies [*5,6*], the small number of cases did not allow for statistical analysis.

In our study the overall mortality rate was 47.2%. The mortality rate was not statistically different in patients with GCS $\leq 8$ (47.7%) versus those with GCS $> 8$ (42.3%). However, patients with lower GCS who survived had less favourable outcomes. Although GCS was lower if coma was due to a traumatic cause, the mortality rate in the non-traumatic group was nearly double that of the traumatic group (60.5% versus 35.4%). The reverse was true regarding the proportion with impaired outcome (16.3% versus 22.9%). This was supported by the finding of a mildly significant relationship between GCS and outcome in the non-traumatic group compared to a highly significant relationship in the traumatic group (Table 4). In non-traumatic coma, etiology rather than GCS was more significantly related to the outcome. Nayana et al. stated that in long-term prediction of outcome in acute non-traumatic coma, GCS is not useful [*24*]. However, verbal response, a component of GCS, correlates well with long-term functional outcome and intelligence quotient. In the Malaysian study, the overall outcome was poor and one-third made a full recovery, one-third recovered with neurological deficit and one-third succumbed to the acute illness [*5*]. In a recent Indian study, 11% achieved full recovery, 54% showed neurological impairment and 35% died [*24*]. Survival was significantly better in patients with CNS infection. In the English study, the mortality rate was 45.7% [*6*].

We conclude that head trauma and infections are the commonest causes of coma. The common reasons for poor outcome included septic shock, severe head trauma, accidental causes and metabolic disorders. GCS in traumatic coma and the specific etiology in non-traumatic coma were the most important prognostic factors for the outcome.

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