

# Factors that interfere in the recognition of the neonatal facial expression of pain by adults

*Fatores que interferem no reconhecimento por adultos da expressão facial de dor no recém-nascido*

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## ABSTRACT

**Objective:** To evaluate the factors related to adult observers that interfere on their recognition of facial expression of pain in term newborn infants.

**Methods:** 405 adults were interviewed: 191 health professionals and 214 parents. Adults' demographic and socio-economical characteristics were surveyed. At the end of the interview, each adult looked at three series of pictures of three different newborns, each series with eight pictures of the face of each newborn, in eight different moments (M1, M3, M6 e M8: resting; M2: light stimulus; M4 and M5: heel rubbing; M7: heel stick) and answered to the following question: In which picture of these do you think the newborn is feeling pain? The 405 adults were analyzed according to the number of right answers for the three series of pictures by multiple linear regression analysis.

**Results:** A smaller number of right answers in the three series of pictures was noticed to adults without a partner, with more children, higher family income and, if health professionals, with less years in school or, if parents, with more years in school. Adults with these characteristics, therefore, presented more difficulty to recognize the expression of pain in the newborn's face.

**Conclusions:** The heterogeneity of factors that interfere in the recognition of neonatal pain by adults emphasizes the need of using validated pain assessment tools in the care of critically ill neonates.

**Key-words:** infant, newborn; pain; facial expression.

## RESUMO

**Objetivo:** Avaliar quais fatores relacionados ao observador adulto interferem no reconhecimento da expressão facial de dor do recém-nascido a termo.

**Métodos:** Foram entrevistados 405 indivíduos (191 profissionais da área da saúde da criança e 214 pais/mães de recém-nascidos), pesquisando-se características pessoais, profissionais e socioeconômicas. Ao término da entrevista, cada indivíduo observou três séries de fotos de três bebês diferentes, cada série com oito fotos da face de cada neonato em oito tempos diferentes (T1, T3, T6 e T8: repouso; T2: estímulo luminoso; T4 e T5: fricção do calcâneo; T7: punção) e respondeu à seguinte pergunta: em qual foto desta prancha o senhor acha que o bebê está sentindo dor? Os 405 entrevistados foram analisados de acordo com número de acertos para as três séries de fotos por regressão linear múltipla.

**Resultados:** Constatou-se um menor número de acertos para os entrevistados sem parceiro fixo, com maior número de filhos, renda *per capita* elevada, atuação profissional na área da saúde e escolaridade inferior a 16 anos ou com atuação profissional em outras áreas que não a da saúde e escolaridade superior a 16 anos. Ou seja, os entrevistados detentores dessas características tiveram maior dificuldade para reconhecer a expressão facial de dor do recém-nascido.

**Conclusões:** Diante da heterogeneidade dos fatores que interferem no reconhecimento da expressão facial de dor no recém-nascido por observadores adultos aqui encontrada, faz-se necessária a utilização rotineira de instrumentos objetivos para a avaliação sistemática da dor no período neonatal.

**Palavras-chave:** recém-nascido; dor; expressão facial.

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## Introduction

Over the last three decades, the great diffusion of research into the physiology, evaluation and treatment of pain in the neonatal period has led to the discovery and confirmation that neonates feel and respond to pain and that their painful experiences can be objectively diagnosed and effectively treated<sup>(1-4)</sup>.

Effective treatment of pain during the neonatal period is dependent on accurate evaluation of that pain<sup>(4)</sup>. In response to nociceptive stimulus, newborn infants exhibit a wide repertoire of physiological, hormonal and behavioral changes<sup>(4)</sup>. Among these, changes in facial expression constitute one of the main responses to painful stimulus, in terms of both specificity and sensitivity<sup>(2,4)</sup>, with emphasis on four actions: contraction of the forehead with lowering of the eyebrows, tightening of eyelids and/or closing of eyes, deepening of the nasolabial furrow and/or raising of the cheeks and half-open mouth and/or stretched lips<sup>(5)</sup>.

Nevertheless, any attempt to evaluate a painful event must consider that recognition of pain in infants is a subjective phenomenon and thus subject to many factors that could influence perception and evaluation<sup>(6)</sup>. The recognition of these factors, which are capable of interfering with the evaluation of pain in neonates and, as a result, with therapeutic decision-making, is important to understand the difficulties related to the communication of pain between newborns and the healthcare professionals caring for them<sup>(7,8)</sup>.

Among the factors that have been cited in the literature, there are characteristics related to the patient, such as gestational age, sex, skin color, religion/ethnicity/culture, physical appearance, type and degree of difficulty of the procedure carried out, presence of tissue damage and severity of clinical and surgical diagnosis<sup>(9-19)</sup>, and characteristics related to the observer, such as age, sex, race, religion, marital status, prior personal or family experience, professional knowledge and experience, professional role and socioeconomic level<sup>(7,9,11,12,15-18,20-30)</sup>.

Among the characteristics related to the observer, some studies have stated that the judgment of health professionals with regard to the presence of pain in children reduces as age advances<sup>(11,25)</sup>; other studies have reported the opposite, i.e., that the judgment increases with age<sup>(17,24,29,30)</sup>. However, the majority of studies have not detected any influence of observer's age on the accuracy of pain assessment in adult or pediatric patients<sup>(7,10,18)</sup>. With relation to observer's gender,

it has been suggested that women's observations of painful phenomena in children and adults are more precise than those made by men<sup>(15,25,26)</sup>. Studies analyzing the influence of observer's race<sup>(9,16,30)</sup> and religion<sup>(22,28)</sup> on the diagnosis of pain in the patients they treat are based more on their cultural characteristics than on skin color or religious beliefs. These studies have concluded that greater cultural and/or religious affinity between the healthcare professional and the patient may lead to improved interpretations of the patient's pain by the observer<sup>(22,28)</sup>. Several different studies have also emphasized that prior personal or family experience with pain increases the sensitivity of pain diagnosis made by adults in preverbal patients<sup>(12,21,23,24,30)</sup>. With respect to the interference of observer's level of education, theoretical knowledge and professional experience with recognition of pain in infants, some studies have shown that these variables do not have any influence whatsoever on pain interpretation in the patients they treat<sup>(11,12,18)</sup>, while others have indicated that the greater the educational level, the more precise pain assessment is and the greater the concern with correctly treating pain<sup>(17,29,30)</sup> and yet other studies have indicated exactly the opposite<sup>(10,30,31)</sup>.

In general, it is clear that assessment and relief of pain in the neonatal period are affected by beliefs, attitudes and factors related to the patient and to the observer, whether parent or healthcare professional, and that these influences are variable and controversial and thus require further study. In this context, the objective of this study was to determine which factors related to the adult observer interfere with their recognition of facial expressions of pain in full term newborn infants.

## Methods

After approval of the research protocol by the Research Ethics Committee at Unifesp-EPM, a cross-sectional study was carried out from December 1997 to August 1998 at Hospital São Paulo, Universidade Federal de São Paulo, which treats patients on the Brazilian National Health System (SUS, *Sistema Único de Saúde*), and at Santa Joana Hospital and Maternity Unit, which cares for women on private healthcare systems. The decision to study two hospitals with distinct characteristics was made with the aim of assessing a population as heterogeneous as possible, thereby increasing the external validity of the study.

The adults studied were selected on the basis of possible personal and/or professional contact with neonatal

pain and were subdivided into two categories: health professionals (physicians, nurses, pediatrics residents and nursing aids) and parents (parents of healthy newborn infants, parents of newborn infants with illnesses and parents of older newborn infants, all professionals working in areas other than health). Written consent from the adults was not necessary since their consent to reply to the questionnaire after being informed of the research objectives and the guarantee of anonymity were themselves indications of the parents and health professionals' agreement to participate in the project. These observers were selected as follows:

- Physicians and nurses: all physicians, residents, nurses and nursing technicians who were working during the study period in the neonatal intensive and/or in the nursery or in the mother-and-baby rooming-in wards at Hospital São Paulo (Unifesp-EPM), and all physicians, nurses and nursing technicians who were working in the neonatal intensive at Santa Joana Hospital and Maternity Unit, on interview days chosen at random by the investigator.
- Parents of newborns: fathers and/or mothers of healthy newborn infants or of newborn infants admitted to intensive units, who were either visiting or staying with their children at the mother-and-baby rooming-in wards at Hospital São Paulo (Unifesp-EPM) or at the conventional maternity ward at Santa Joana Hospital and Maternity Unit during the study period. Participants in this subset were chosen by lots from among all those present on the days the investigator had chosen at random for data collection.
- Other parents: the fathers and/or mothers of children in other age groups who were accompanying their children for routine consultations at the general pediatrics clinic at Hospital São Paulo (Unifesp-EPM), or who were visiting the families of healthy newborn infants at Santa Joana Hospital and Maternity Unit, during the study period. Participants in this subset were chosen by lots from among all those present at the study locations on the days the investigator had chosen at random for interviews.

The newborn infants enrolled in the study and photographed were chosen according to the following criteria: written consent provided by the mother; healthy newborn infants in the mother-and-baby rooming-in wards; gestational age from 37 weeks to 41 weeks and 6 days;

postnatal age between 6 and 24 hours of life; at least one risk factor for hypoglycemia; and need to perform a heel stick to collect blood for screening using test strips. The interval between the last time the infants were fed or handled and the time the photographs were taken was set at 30 to 60 minutes. The infants were in an awake state immediately before taking the photographs, according to the modified Grunau and Craig behavioral state assessment<sup>(5)</sup>. One further inclusion criterion was a five-minute Apgar score >7, and infants were excluded if their mothers had been given opioids or general anesthetics during labor or delivery.

All photographs were taken by the same physician, in a room with natural light, during the afternoon, with the newborn in a standard cot and in the following sequence: Photo 1 (resting: no handling whatsoever of the newborn); Photo 2 (stimulus with light: the newborn was exposed to the sunlight admitted into the room by opening one of the curtains, and the photograph was taken five seconds after opening the curtain); Photo 3 (resting); Photo 4 (rubbing: the external lateral surface of the patient's heel was rubbed with cotton soaked with alcohol, for ten to 15 seconds, and the photograph was taken during this period); Photo 5 (rubbing); Photo 6 (resting); Photo 7 (heel stick: the external lateral surface of the patient's heel was punctured with a 25 x 8 needle to collect blood for the hypoglycemia screening test, and the photograph was taken after insertion of the needle); and Photo 8 (resting).

Each set of eight photographs, all focused on the newborn's face, were defined as a "series." Three photographic series were chosen and shown to each of the adults interviewed, always in the same sequence. Figure 1 shows an example, namely Series 1.

Each adult answered a questionnaire designed to collect personal, professional and socioeconomic details and was then given 1 minute to observe and analyze each of the three series. At the end of the minute, the interviewee provided an answer to the following question: "In which of these photos do you think the newborn is feeling pain?"

The preliminary statistical calculations defined the ideal minimum sample size as 250 to 375 cases, since ten to 15 interviewees would be necessary for each individual variable to be analyzed by logistic regression with relation to the dependent variable "number of correct answers" for the three photographic series<sup>(32)</sup>. After 405 interviews, the investigators classified the replies as "Correct" or "Incorrect." The

photograph corresponding to the heel stick procedure was defined as “Correct,” while all other possibilities (rubbing, light stimulus, resting or no photo chosen) were defined as “Incorrect.” The number of correct replies was calculated for each interviewee, with the following results being possible: zero, one, two, or three correct answers.

Descriptive analysis was carried out using the Statistical Package for the Social Sciences (SPSS®) version 8.0 and consisted of Pearson’s chi-square test, partitioned chi-square, analysis of variance (ANOVA), and the Bonferroni test to locate the differences detected by ANOVA<sup>(33)</sup>. Inferential analysis was carried out by multivariate linear regression for the dependent variable “number of correct answers”<sup>(32)</sup>.

### Results

Of the total of 405 interviewees, 12 (3%) did not identify any of the photos showing neonatal facial pain in any of the three series, 74 (18%) adults correctly identified one photo out of the three series, 164 (41%) identified two photos correctly, and 155 (38%) individuals correctly identified the photograph of the newborn’s face expressing pain in all three series.

With relation to the main demographic characteristics of the adults interviewed (Table 1), irrespective of whether they provided zero, one, two or three correct answers, the majority were women, Catholic and had a mean age of around 30 years. The race and marital status categories revealed a heterogeneous distribution of white ( $p=0.019$ ) and married interviewees ( $p=0.007$ ) across the four study groups. Interviewees who scored zero showed: a higher mean number of hospitalizations compared with



**Figure 1** – Series of eight photographs of the same newborn, four taken while resting, one with facial response to light stimulus, two with facial response to heel rubbing and one with facial response to pain caused by heel stick (arrow).

**Table 1** – General characteristics of the 405 interviewees, grouped by number of correct answers after analyzing three series of photos

	Number of correct answers				p
	0 (n=12)	1 (n=74)	2 (n=164)	3 (n=155)	
Age (years)	34±11	29±7	30±7	29±7	0.139 *
Female	10 (83%)	68 (68%)	147 (90%)	130 (84%)	0.253 †
White race	5 (42%)	60 (82%)	119 (73%)	121 (78%)	0.019 †
Stable partner	7 (58%)	45 (61%)	98 (60%)	119 (77%)	0.007 †
Catholic	10 (83%)	54 (73%)	127 (77%)	115 (74%)	0.770 †
Number of hospitalizations	3±5	1±2	2±1	2±2	0.003 *
Number of children	2±2	1±1	1±1	1±1	0.036 *
Years of education	10±6	14±5	13±6	12±6	0.032 *
Health professional	4 (33%)	47 (63%)	88 (53%)	57 (37%)	<0.001 †
Income (R\$)	558±631	1215±1195	1099±1131	814±820	0.014 *
Social class A or B	5 (42%)	45 (61%)	93 (57%)	69 (45%)	0.052 †

\*Analysis of variance (ANOVA)

†Pearson’s chi-square test



those scoring one, two or three (Bonferroni:  $p=0.001$ ); a greater mean number of children than those scoring one (Bonferroni:  $p=0.048$ ) and those scoring two (Bonferroni:  $p=0.035$ ); a lower mean educational level (ANOVA:  $p=0.032$ ); and a lower mean per capita income (ANOVA:  $p=0.014$ ). There was a higher proportion of healthcare professionals among the interviewees scoring zero or three ( $\chi^2$ :  $p=0.0005$ ). Low socioeconomic status (not in classes A or B) was more frequent among adults scoring three than among those scoring less than three (partitioned  $\chi^2$ :  $p=0.014$ ).

The final multivariate linear regression model allowed the number of correct answers to be estimated according to the following formula: number of correct answers =  $1.52 + (0.28 \text{ marital status}) + (-0.08761 \text{ number of children}) + (0.0382 \text{ educational level}) + (0.819 \text{ profession}) + (-0.0001246 \text{ per capita income}) + (-0.04928 \text{ educational level versus profession})$ . Analysis of each  $\beta$  coefficient adjusted for the remaining independent variables in the model (Table 2) yielded the following findings:

- Adults with a stable partner correctly identified, on average, 0.28 more photographic series showing the neonatal facial expression of pain than did adults without a stable partner.
- The greater the number of children, the lower the number of correct answers, i.e., for each extra child, the interviewee's score reduced by an average of 0.09 correct answers.
- Among healthcare professionals, the higher the degree of education, the greater the number of correct answers. In contrast, among adults whose professions were not healthcare-related, the higher the degree of education, the lower the number of correct answers.

- Among individuals with 16 years or less of education, parents scored a greater number of correct answers than healthcare professionals. Furthermore, the greater the number of years parents had spent in education, the lower the increase in the number of correct answers. Among interviewees with 17 years or more of education, it was found that the parents scored a lower number of correct answers than the healthcare professionals and that the greater the parents' educational level, the lower the estimated number of correct answers.
- The greater the monthly per capita income of the interviewee, the lower the number of correct answers.

Therefore, in general, we found a lower number of correct answers among interviewees without a stable partner, with a higher number of children, with higher per capita incomes, with healthcare-related professions and less than 16 years in education or with non-healthcare-related professions and more than 16 years in education.

## Discussion

Since immediately after birth, neonates express their physical and emotional needs through behaviors such as crying, facial expressions, and body movements<sup>(3,4)</sup>. It is up to adults to recognize and interpret these signals of pain and discomfort, establishing a mechanism for codification, decodification and decision-making. Such a mechanism is not a linear process and is influenced by a series of factors, including those related to the adult's being open to recognizing the pain of patients incapable of verbally expressing their suffering<sup>(7,21)</sup>. In this context, our study observed that the presence or absence of a stable partner, the number of

**Table 2** – Final multivariate linear regression model for the dependent variable “number of correct answers” for 374\* adult interviewees

Independent variables	Coefficient ( $\beta$ )	95% confidence interval	Partial t test
Constant ( $\beta_0$ )	1.5200	1.019 to 2.021	<0.001
Marital status	0.2800	0.074 to 0.486	0.008
Number of children	-0.0876	-0.158 to -0.017	0.015
Educational level	0.0382	0.007 to 0.069	0.016
Profession	0.8190	0.315 to 1.324	0.002
Income	-0.0001	0.000 to 0.000	0.026
Educational level versus profession	-0.0493	-0.089 to -0.010	0.014

Statistical significance of the model: ANOVA;  $p<0.001$ ;

\*31 interviewees did not provide their per capita income and were excluded from the inferential analysis.

children, family income, educational level and profession of the observer have, to a greater or lesser extent, a negative impact on the recognition of neonatal facial expressions of pain.

There was a greater frequency of interviewees who were either married or in a consenting partnership among the group of adults who scored three correct answers (Table 1) and that having a stable partner contributed to a greater number of correct answers for the three series of photographs (Table 2). Nevertheless, some studies in the literature have indicated that accurate patient pain assessment, whether by parents or health professionals, is independent of the marital status of the assessor<sup>(27,28)</sup>. Our finding, contrasting with the literature, is possibly an indication that an intense relationship may make a person more sensitive in terms of inferring and interpreting the “other’s” specific behavior and, as a consequence, becoming more open to the non-verbal communication of children in a range of situations, including those in which the presence of pain predominates.

Furthermore, having children and witnessing their painful experiences may improve the observer’s ability to receive and interpret the expressions of pain made by preverbal infants<sup>(12,23,30)</sup>. Notwithstanding, our study actually found that a higher number of children was associated with lower numbers of correct answers for the three photographic series (Table 2). In line with our results, some authors have reported that the painful experiences of children may not affect or may even reduce their parents’ accuracy when assessing the pain of their children, since repeated painful episodes would desensitize the parents to these situations<sup>(14,20)</sup>.

Among the socioeconomic characteristics that were investigated, it was found that family income was capable of interfering with the identification of neonatal facial expressions of pain: adults with higher family incomes scored lower numbers of correct answers (Table 2). In parallel, Jacox<sup>(6)</sup> reported that the higher the socioeconomic level of the nurses she investigated, the lower their ability to infer and interpret the expressions of pain of the people they were observing. In Brazil, family income and socioeconomic status are both cause and consequence of educational level and profession, and these factors may have a stronger relationship with the capacity to decode neonatal pain than income itself.

Previous studies have reported that, in general, observers’ level of education, theoretical knowledge about pain, type of profession and professional experience have

variable and sometimes paradoxical effects on the adults’ ability to decode the patient’s pain<sup>(7,10-12,17,18,21,29-31)</sup>. In an earlier report<sup>(7)</sup>, it was found that healthcare professionals recognized neonatal facial expressions of pain less often than adults who did not work in healthcare. However, the results of this study demonstrate that the adults’ capacity to understand nonverbal pain behavior in newborns suffers a combined influence from their profession and level of education. Among our healthcare professionals, the higher the educational level, the more accurate was their recognition of facial expression of pain, whereas among parents, the inverse was observed (Table 2). These results suggest that, for healthcare professionals, greater theoretical and practical exposure to information about pain and to methods for diagnosing and treating it during the neonatal period facilitate recognition of patients’ non-verbal pain behavior. Notwithstanding, this increased accumulation of knowledge should not only be of a practical nature, i.e., should not be restricted to day-to-day experience of caring for newborns. Among health professionals, there is also a need to improve the theoretical knowledge about pain; it was found that health professionals with less education (represented by nursing aids) recognized neonatal pain less often (Table 2). Therefore, it may be inferred, based on this and on other studies<sup>(6,10,21,31)</sup>, that daily contact with routine intensive care and with frequent patient pain, i.e., greater practical professional experience, does not *per se* increase the capacity of healthcare professionals to recognize neonatal pain.

In the case of the parents, the greater the number of years spent in education, the greater the chances that they would not recognize facial expressions of pain in the three photographic series (Table 2). This finding may possibly be the result of mechanisms that have been described by some authors, by which the increased education of the observer increases their chance of not recognizing the pain of the patient being observed<sup>(10,21,31)</sup>. The increased or reduced capacity of parents to identify their children’s and other individuals’ non-verbal pain behavior is not exclusively related to their profession or degree of education, but to maternal or paternal intuition of the existence of discomfort, pain and suffering in their children. It is possible that the higher socioeconomic status associated with a higher degree of education may make these individuals more critical and skeptical in relation to valuing their intuition.

Noteworthy among the limitations of our study is its relatively static character, in that photographs taken at

specific moments were offered for assessment isolated from the overall behavior of the baby itself and from the environment. In real life situations, facial changes are transitory, and recognizing them at the bedside is a challenge, especially in the stressful environment of the intensive care unit, inhabited by babies suffering from diverse problems and at different gestational ages<sup>(35)</sup>. The other limitation of the study is related to the possibility of generalizing the results, which we have attempted to mitigate by interviewing a very heterogeneous group of adults. Nevertheless, as mentioned above, extrapolation of the results presented here to another cultural context demands careful and critical attention.

Despite these limitations, it can be concluded that several associated and interrelated factors (marital status, number of

children, profession associated with educational level, and family income of the adult interviewee) can interfere with the recognition of neonatal facial expressions of pain and explain a small part of the process of decoding the pain of others, which is an extremely difficult task given the complex and subjective character of pain. The fact that personal, professional and socioeconomic characteristics, combined with individual, emotional and psychological features of the adult responsible for neonatal care, interfere with their capacity to observe and interpret neonatal nonverbal communication of pain emphasizes the need for a systematic use of objective methods of pain assessment, founded on routine bedside use pain scales designed for this specific target population, namely, patients who are not yet able to verbalize the pain they are feeling.

## References

- Anand KJ, Carr DB. The neuroanatomy, neurophysiology, and neurochemistry of pain, stress, and analgesia in newborns and children. *Pediatr Clin North Am* 1989;36:795-822.
- Guinsburg R, Balda RC, Berenguel RC, Almeida MF, Tonello J, Santos AM *et al*. Aplicação das escalas comportamentais para avaliação da dor em recém-nascidos. *J Pediatr (Rio J)* 1997;73:411-8.
- Anand KJ, International Evidence-Based Group for Neonatal Pain. Consensus statement for the prevention and management of pain in the newborn. *Arch Pediatr Adolesc Med* 2001;155:173-80.
- American Academy of Pediatrics Committee on Fetus and Newborn; American Academy of Pediatrics Section on Surgery; Canadian Paediatric Society Fetus and Newborn Committee, Batton DG, Barrington KJ, Wallman C. Prevention and management of pain in the neonate: an update. *Pediatrics* 2006;118:2231-41.
- Grunau RV, Craig KD. Pain expression in neonates: facial action and cry. *Pain* 1987;28:395-410.
- Jacox AK. Assessing pain. *Am J Nurs* 1979;79:895-900.
- Xavier Balda R, Guinsburg R, de Almeida MF, Peres C, Miyoshi MH, Kopelman BI. The recognition of facial expression of pain in full-term newborns by parents and health professionals. *Arch Pediatr Adolesc Med* 2000;154:1009-16.
- Balda RC, Guinsburg R. Perceptions of Neonatal Pain. *NeoReviews* 2007; 8:e533-42.
- Davitz LJ, Sameshima Y, Davitz J. Suffering as viewed in six different cultures. *Am J Nurs* 1976;76:1296-7.
- Mason DJ. An investigation of the influences of selected factors on nurses' inferences of patient suffering. *Int J Nurs Stud* 1981;18:251-9.
- Dudley SR, Holm K. Assessment of the pain experience in relation to selected nurse characteristics. *Pain* 1984;18:179-86.
- Burokas L. Factors affecting nurses' decisions to medicate pediatric patients after surgery. *Heart Lung* 1985;14:373-9.
- Karraker KH. Adult attention to infants in a newborn nursery. *Nurs Res* 1986;35:358-63.
- Manne SL, Jacobsen PB, Redd WH. Assessment of acute pediatric pain: do child self-report, parent ratings, and nurse ratings measure the same phenomenon? *Pain* 1992;48:45-52.
- Carr E. Factors influencing the experience of pain. *Nurs Times* 1997;93:53-4.
- Sheiner EK, Sheiner E, Shoham-Vardi I, Mazor M, Katz M. Ethnic differences influence care giver's estimates of pain during labour. *Pain* 1999;81: 299-305.
- Salantera S, Lauri S. Nursing students' knowledge of and views about children in pain. *Nurse Educ Today* 2000;20:537-47.
- Breaux LM, McGrath PJ, Stevens B, Beyene J, Camfield C, Finley GA *et al*. Judgments of pain in the neonatal intensive care setting: a survey of direct care staffs' perceptions of pain in infants at risk for neurological impairment. *Clin J Pain* 2006;22:122-9.
- Reyes-Gibby CC, Aday LA, Todd KH, Cleeland CS, Anderson KO. Pain in aging community-dwelling adults in the United States: non-Hispanic whites, non-Hispanic blacks, and Hispanics. *J Pain* 2007;8:75-84.
- Fradet C, McGrath PJ, Kay J, Adams S, Luke B. A prospective survey of reactions to blood tests by children and adolescents. *Pain* 1990;40:53-60.
- Prkachin KM, Craig KD. Expressing pain: the communication and interpretation of facial pain signals. *J Nonverbal Behav* 1995;19:191-205.
- Todd KH. Pain assessment and ethnicity. *Ann Emerg Med* 1996;27:421-3.
- Woodgate R, Kristjanson LJ. A young child's pain: how parents and nurses 'take care'. *Int J Nurs Stud* 1996;33:271-84.
- Porter FL, Wolf CM, Gold J, Lotsoff D, Miller JP. Pain and pain management in newborn infants: a survey of physicians and nurses. *Pediatrics* 1997;100: 626-32.
- Riaño Galán I, Mayoral González B, Solís Sánchez G, Orejas Rodríguez-Arango G, Málaga Guerrero S. Pediatricians' opinion on sedation in children. *An Esp Pediatr* 1999;51:230-4.
- Hall CW, Gaul L, Kent M. College students' perception of facial expressions. *Percept Mot Skills* 1999;89:763-70.
- Saigal S, Stoskopf BL, Feeny D, Furlong W, Burrows E, Rosenbaum PL *et al*. Differences in preferences for neonatal outcomes among health care professionals, parents and adolescents. *JAMA* 1999;281:1991-7.
- Sheiner E, Sheiner EK, Hershkovitz R, Mazor M, Katz M, Shoham-Vardi I. Overestimation and underestimation of labor pain. *Eur J Obstet Gynecol Reprod Biol* 2000;91:37-40.
- Pölkki T, Laukkala H, Vehviläinen-Julkunen K, Pietilä AM. Factors influencing nurses' use of nonpharmacological pain alleviation methods in paediatric patients. *Scand J Caring Sci* 2003;17:373-83.

30. He HG, Pölkki T, Pietilä AM, Vehviläinen-Julkunen K. Chinese parent's use of nonpharmacological methods in children's postoperative pain relief. *Scand J Caring Sci* 2006;20:2-9.
31. Wilson B, McSherry W. A study of nurses' inferences of patients' physical pain. *J Clin Nurs* 2006;15:459-68.
32. Kleinbaum DG, Kupper LL. *Applied regression analysis and other multivariable methods*. Boston: Duxbury Press; 1978.
33. Berquó ES, Souza JM, Gottlieb SL, editores. *Bioestatística*. 2ª ed. São Paulo: Editora Pedagógica e Universitária; 1981.
34. McGrath PA. An assessment of children's pain: a review of behavioral, physiological and direct scaling techniques. *Pain* 1987;31:147-76.
35. Elias LS, Guinsburg R, Peres CA, Balda RC, Santos AM. **Disagreement between parents and health professionals regarding pain intensity in critically ill neonates**. *J Pediatr (Rio J)* 2008;84:35-40