Original Article

Current understanding of children's head shape and its impact on health: a cross-sectional study among pediatric medical staff in China

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Background: Head shape problems are common in infancy and early childhood, and thus their early identification and management can benefit the health of children. This study aimed to investigate pediatric healthcare professionals' existing knowledge of children's head shape abnormalities and their associated effects in China, providing guidelines for future clinical interventions, training, and interdisciplinary collaboration.

Methods: We conducted a survey among pediatric medical staff, encompassing various age groups, genders, hospitals, and professional levels. The electronic questionnaire queried respondents' basic information, knowledge pertaining to head shape issues, diagnosis and treatment approaches, and the clinical development status of head shape problems. All surveys and data collection were conducted anonymously.

Results: A total of 214 valid questionnaires were collected. Differences in the level of understanding among medical staff regarding head shape issues were observed. Medical staff in tertiary care facilities showed the highest proficiency in diagnosing and treating positional plagiocephaly and cranial asymmetry ($P<0.05$), while those in primary care facilities exhibited the lowest competency in diagnosing head shape abnormalities ($P<0.05$). Most medical staff had a partial understanding of specific aspects of head shape issues, such as identifying high-risk individuals (n=144, 67.29%), making diagnoses (n=176, 82.24%), and understanding the consequences (n=151, 70.56%), with no significant differences across medical facilities of various levels. Additionally, 99.07% (n=212) of the medical staff believed that head shape measurements should be included as a routine component of pediatric physical examinations, and 75.23% (n=161) incorporate head shape assessment as part of their routine physical examination. Furthermore, 91.12% (n=195) of the medical staff received consultations on children's head shape issues, with a higher prevalence in secondary and tertiary care facilities. Finally, 93.97% (n=201) of the participants expressed the need for further education and knowledge on pediatric head shape, with no significant differences across medical facilities of various levels.

Conclusions: There is a limited understanding among medical personnel in China regarding children's head shape issues. Therefore, it is imperative to enhance training and educational initiatives for medical staff in China, with the goal of enhancing their awareness and knowledge regarding children's head shape problems.

Keywords: Healthcare professionals; craniofacial conditions; cranial morphology; survey research

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Introduction

Cranial morphological abnormalities in infants and young children, known as head shape problems, are prevalent and can be observed in the first few months of life. Moreover, cranial development patterns vary across different ethnicities, regions, and cultures. A systematic review conducted in Australia (1) indicated that the prevalence of oblique head at birth was approximately 8.2%, which increased to 16% at 6 weeks, 22.1% at 7 weeks, and 19.7% at 4 months of age. Data from Italy revealed an incidence of 37.8% in infants aged 8 to 12 weeks' term (2). In Finland, the prevalence of oblique heads in healthy term infants was reported to be as high as 46.6% (3). Our study conducted in China involved sampling 3,406 term infants aged 0 to 6 months, and we found that the incidence of head shape problems in this population was 56.5% (4). Head shape problems can stem from various causes, including genetic mutations, certain adverse embryonic environmental factors, certain drugs, craniosynostosis, and postural factors (5-9). Severe cephalic issues can have detrimental consequences that affect appearance, cognition, vision, hearing, and chewing ability (10,11). Following the American Academy of Pediatrics' recommendation in 1992 to position infants to sleep on their backs, the prevalence of head malformations has increased. Consequently, there has been extensive research on head shape, spanning 40 years in Europe and the United States (12).

In recent years, China has experienced rapid economic development, which has led to an improvement in the quality of life of the population. As a developing country, China's research on infant head shape began relatively late. However, with the increased focus on the health of infants, there has been a growing awareness of the importance of head shape. Despite a decade of research (4,13-16) on infant head shape in China, there is still a need for further improvement in medical staff's understanding of children's head shape and its impact on health. Projects related to children's growth, development, vision, and hearing screening are being widely implemented (17-21). However, the examination of head shape has not yet been fully integrated into these programs. Therefore, the purpose of this survey study was to assess the current understanding of Chinese pediatric medical staff regarding children's head shape and its associated impacts. This study aims to contribute to our understanding of the current state and future development trends in the field of children's head health in China. Moreover, it is important to emphasize the need to raise public awareness of children's head problems and foster increased parental attention to these issues in order to facilitate better outcomes for these children. We present this article in accordance with the STROBE reporting checklist (available at https://tp.amegroups.com/article/view/10.21037/tp-23-396/rc).

Highlight box

Key findings

- Disparities in understanding children's head shape exist across healthcare tiers, with tertiary centers outperforming primary centers.
- Medical staff show partial comprehension of the essential facets of pediatric cranial morphology, which is consistent across tiers.
- Nearly all the pediatric medical staff (94%) emphasize the need for better education on pediatric head shape.

What is known and what is new?

- Head shape problems are common among infants and young children and require early detection and intervention.
- Our survey revealed deficits among Chinese medical staff in regarding head shape problems.

What is the implication, and what should change now?

- Targeted interventions, training, and interdisciplinary collaboration are urgently needed enhance pediatric medical staff's understanding of head shape problems in children.
- Initiatives should be implemented to prioritize and support children's cranial health and thus improve the outcomes of those with head shape problems in China.

Methods

Participants

To ensure early detection of head problems, it is crucial for pediatric medical staff to possess a solid understanding of these issues, particularly as it relates to infancy and early childhood. To assess this level of understanding, our survey targeted a diverse group of healthcare professionals, including doctors, nurses, therapists, etc., from a variety of hospitals across China. These hospitals encompassed children's hospitals, maternal and child health hospitals, and general hospitals, among others. By conducting this survey among healthcare providers responsible for delivering medical services to children, we sought to obtain comprehensively characterize the current practices and perspectives pertaining to head problems in China's pediatric healthcare sector.

Procedure

Based on previous clinical experience, we developed a concise, logical, and scientific questionnaire on head shape issues. To enhance the relevance and reliability of our survey, we conducted a focus group discussion with a panel of experts prior to developing our survey questions. The panel consisted of five professionals from three different hospitals, each with more than 5 years of experience in the field of child care. Their feedback was crucial in refining our survey questions, ensuring that they were both scientifically rigorous and relevant to our research objectives. The questionnaire, administered online, consisted of three themes: (I) participant's basic information, including age, years of clinical practice, hospital grade, hospital type, and specialization; (II) participant's knowledge of head shape problems, including on topics related to flat head syndrome, oblique cephalometry, craniosynostosis, high-risk groups, diagnosis, consequences, and treatment; and (III) participant's current clinical work and attitude toward continued learning of head shape problems.

The online questionnaire network collected feedback information, ensuring a 100% collection of valid questionnaires. The results were exported and the data analyzed. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Ethics Committee of the Second Affiliated Hospital of the Army Medical University (approval No. 2021-044-01). Written consents were obtained from the medical staff before participation in this study.

Statistical analysis

Descriptive statistical analysis was conducted to summarize the demographic data of the participants and responses to the questions related to head shape problems. To compare the differences in the understanding of the head shape problem across different variables, the Pearson chi-squared or Fisher exact test was employed. A significance level of $P<0.05$ was used to determine statistical significance.

When evaluating the comprehension of a problem among hospital staff using a weighted average method, scores were allocated as follows: no understanding (f1), 0 points; partial understanding (f2), 1 point; and complete understanding (f3), 2 points. The qualitative data were then converted into quantitative data using the weighted average method as follows: $Mean=\frac{f_1*x_1+f_2*x_2+f_3*x_3}{\sum_1^i f_i}, i=1,2,3,T$. Following this, the data were analyzed using one-way analysis of variance (ANOVA).

Results

Demographic characteristics of medical personnel

A total of 215 questionnaires were collected from medical staff in 14 provinces across China between January 1, 2022, and March 1, 2022. One questionnaire, which was completed by a customer service staff member of a medical institution, was excluded from the analysis. *Table 1* presents a summary of the demographic data of the participating medical personnel, including age, length of service, nature and grade of work unit, and field of specialization.

Regarding clinical experience, the majority of respondents had extensive work experience, with 162 (75.7%) reporting more than 5 years of service. The largest proportion of respondents (n=68, 31.78%) fell into the 10–20 years of working experience category. The respondents represented various hospital levels, with 17 (7.94%) from primary hospitals, 96 (44.86%) from district and county hospitals, and 101 (47.2%) from hospitals at the provincial level or above.

The respondents also worked in different types of hospitals, including 17 (7.94%) from community hospitals, 116 (54.21%) from general hospitals, 65 (30.37%) from maternity and children's hospitals, 11 (5.14%) from children's specialist hospitals, and 5 (2.34%) from rehabilitation hospitals. In terms of specialization, the medical staff covered various areas of pediatrics, with 82 (38.32%) engaged in child healthcare, 81 (37.85%) in pediatric medicine, 22 (10.28%) in neonatal medicine, 16 (7.48%) in pediatric rehabilitation, 2 (0.93%) in pediatric surgery, and 11 (5.14%) in general medicine.

Understanding of head shape problems among medical personnel

Our study explored medical personnels' comprehension of issues related to the occurrence, diagnosis, consequences (*Table 2*), and treatment (*Table 3*) of cranial morphological abnormalities. Our findings revealed that the overall understanding of cephalic abnormalities among medical personnel was moderate, as evidenced in *Table 2*. Notably, staff's grasp of craniosynostosis (22.90%, n=49) exceeded that of flat head syndrome (10.75%, n=23) and oblique cephalometry (12.62%, n=27). Furthermore, the knowledge of medical staff regarding craniosynostosis closure, flat

Table 1 Characteristics of the 214 medical staff in our survey

Characteristic	Participants, n (%)
Age	
<25 years	10 (4.67)
25–34 years	88 (41.12)
35–45 years	78 (36.45)
>45 years	38 (17.76)
Years of clinical practice	
<3 years	25 (11.68)
3–4 years	27 (12.62)
5–9 years	47 (21.96)
10–20 years	68 (31.78)
>20 years	47 (21.96)
Hospital grade	
Primary hospital (community hospital)	17 (7.94)
Intermediate hospital (districts/counties)	96 (44.86)
Senior hospital (provincial/national)	101 (47.20)
Hospital type	
Community hospital	17 (7.94)
General hospital	116 (54.21)
Health center for women and children	65 (30.37)
Children's hospital	11 (5.14)
Other	5 (2.34)
Specialization	
Neonatology	22 (10.28)
Children's health	82 (38.32)
Pediatric internal medicine	81 (37.85)
Pediatric surgery	2 (0.93)
General medicine	11 (5.14)
Other: child rehabilitation	16 (7.48)

head syndrome, and plagiocephaly was associated with the rank of the hospital. Those from higher-grade hospitals demonstrated a better understanding of flat head syndrome and oblique cephalometry (*Table 4*, Table S1), while there was no significant difference in the understanding of craniosynostosis closure. Around 8.88% (n=19) of medical staff claimed to have a comprehensive awareness of the high-risk group associated with head shape problems, and 13.55% (n=29) possessed a thorough understanding of the diagnosis of these problems. Notably, medical staff in first-level hospitals exhibited a weaker understanding (*Table 4*, Table S1). Approximately 20.09% (n=43) of the medical staff had knowledge about the possible consequences of premature craniosynostosis closure, with no significant difference observed between staff at different levels (Table S1).

Current status of and attitudes toward head shape problems in clinical work

Table 3 provides an overview of the current status of head shape problems in clinical practice. The findings indicate that 99.07% (n=212) of respondents believed that head shape measurement should be incorporated as a routine component of child healthcare assessment. Among these respondents, 75.23% (n=161) had integrated head shape measurement into their regular physical examinations. Although there was no significant difference observed between hospitals at different levels, secondary and tertiary hospitals demonstrated a higher adoption rate (*Table 4*, Table S1).

Furthermore, 75.70% (n=162) of medical staff were familiar with the intervention methods for head shape abnormalities, and 53.27% (n=114) of them knew the optimal intervention timing. There were no noticeable differences observed between hospitals of various levels (Table S1). In their clinical practice, 78.5% (n=168) of medical staff provided advice regarding head shape problems, with a higher proportion found in tertiary hospitals (*Table 4*, Table S1).

Regardless of their hospital's level, the majority of medical staff (n=201, 93.97%) expressed a need for further education and learning of head shape abnormalities. Cephalic problems were prevalent, with 91.12% (n=195) of medical staff having received consultations related to head shape problems. The proportion of consultations was higher in secondary and tertiary hospitals (Table S1). However, concerning the referral of children with head shape problems to appropriate medical institutions, 44.39% (n=95) of respondents were unfamiliar with the available referral options, and no significant difference was observed between hospitals across different levels (Table S1).

Discussion

Early diagnosis and correction of head shape problems: significance and benefits

Head shape problems are characterized by abnormal skull growth, resulting in the atypical shaping of the head. This condition can be attributed to abnormal closure of cranial

Table 2 Medical staff's understanding of head shape problems and related impacts

Have you mastered the following knowledge points?	Not at all, n (%)	Partly, n (%)	Completely, n (%)
Flat head syndrome	36 (16.82)	155 (72.43)	23 (10.75)
Plagiocephaly	36 (16.82)	151 (70.56)	27 (12.62)
Craniosynostosis	15 (7.01)	150 (70.09)	49 (22.90)
High-risks for head shape problems	51 (23.83)	144 (67.29)	19 (8.88)
Types of head shape problems	9 (4.21)	176 (82.24)	29 (13.55)
Consequences of craniosynostosis	20 (9.35)	151 (70.56)	43 (20.09)

Table 3 Current status of head shape problems in clinical work

Question	Yes, n (%)	No, n (%)
Have you used head shape as a routine physical examination item?	161 (75.23)	53 (24.77)
Is it necessary to make cephalometric measurements a routine item in child care?	212 (99.07)	2 (0.93)
Should advice be given or intervention performed for patients concerning abnormal head shape?	168 (78.50)	46 (21.50)
Do you know the best time for intervention of problematic head shape?	114 (53.27)	100 (46.73)
Do you know what the interventions are for problematic head shape?	162 (75.70)	52 (24.30)
For patients who require referral, is there an established medical facility to refer them to?	119 (55.61)	95 (44.39)
Is it necessary to learn more about head shape abnormalities?	201 (93.97)	13 (6.07)
Have you ever received any enquiries about head shape?	195 (91.12)	19 (8.88)

Table 4 Association between respondent characteristics and perceptions of head shape problems

Question and response	Hospital grade, mean			P value
	Primary hospital (n=17)	Intermediate hospital (n=96)	Senior hospital (n=101)	
Do you have knowledge of flat head syndrome?	0.53	0.92	1.03	0.01
Do you have knowledge of plagiocephaly?	0.65	0.91	1.06	0.02
Do you have knowledge of craniosynostosis?	1.06	1.04	1.18	0.16
Do you have knowledge of the high-risk groups for abnormal head shape?	0.65	0.85	0.88	0.53
Do you know which head shapes are problematic?	0.82	1.11	1.12	0.02
Do you know the consequences of craniosynostosis?	1.06	1.04	1.18	0.19
Is head shape routinely measured in your practice?	0.53	0.76	0.78	0.08
Is the measurement of children's head shape necessary?	1	0.98	1	0.35
Should advice be given or intervention be performed for abnormal head shape?	0.59	0.77	0.83	0.07
Do you know the best time for the intervention of problematic head shape?	0.41	0.53	0.55	0.55
Do you know the interventions for problematic head shapes?	0.71	0.69	0.83	0.05
For patients who require referral, is there an established medical facility that one could refer them to?	0.41	0.57	0.56	0.49
Is it necessary to learn more about head shape anomalies?	0.94	0.95	0.93	0.87
Have you ever received an inquiry about head shape?	0.71	0.94	0.92	0.01

The qualitative data were converted into quantitative data using the weighted average method and then analyzed via one-way analysis of variance. $P<0.05$ indicates a significant difference.

sutures or postural factors during early life (22). Typically, most cranial sutures close by the age of 2 to 4 years—with a few exceptions that may persist into middle age—coinciding with the rapid morphological development of the brain after birth. Head shape changes minimally from preschool age onwards. Alterations in head shape can affect the structure of the cranial cavity, orbit, and the brain tissue and soft tissues within the orbit. Posture correction and some special types of minimally invasive surgery are best performed before 6 months, while head correction in conventional surgery generally occurs before the age of 1.5 years (23). Therefore, monitoring and evaluating head shape before the age of 1 year are of great significance. Head problems are clinically prevalent in children, with multifactorial and complex underlying causes that can lead to serious consequences. Prompt identification of head problems, determination of the cause, and implementation of effective treatment measures or referral instructions are essential for pediatric medical staff to ensure the well-being of the affected children (24,25). Presently, the measurement of head shape in the early physical development monitoring of infants and young children is not widely conducted in China. However, in this survey study, 99.07% of respondents expressed the belief that head shape measurement should be included as a routine component of children's healthcare assessments. This practice can facilitate the early identification of infants with head shape problems, thus avoiding missing the critical period for corrective interventions.

Moreover, it promotes healthy head shape development, shortens treatment durations, and provides potential cost savings. A retrospective analysis conducted by Watt *et al.* (26), consisting of 29 peer-reviewed studies, revealed a significant cost difference between early and late diagnosis of cephalic problems. Their findings indicated that diagnosing and correcting cephalic problems before 4 months of age cost only USD $1,495, whereas the cost increased to USD $5,195 when diagnosis occurred after 6 months. This emphasizes the economic benefits associated with early diagnosis and treatment of infant cephalic problems.

In mainland China, the most commonly used methods for measuring the head shape of infants and young children in the early diagnosis of head shape abnormalities include spreading calipers and structured light 3D scanning. The spreading caliper is preferred in junior units and serves as the primary choice for head shape screening due to its affordability, simplicity, time efficiency, adaptability, and nondependency on the child's state. For units requiring more precise measurements, 3D scanning is preferred, as it provides detailed parameters for diagnosing abnormal head shape and facilitates personalized helmet customization. The combined approach aligns with China's national standards for children's head measurement (16). Of course, other diagnostic methods may be chosen based on clinical needs (27,28).

Furthermore, in addition to the early diagnosis and prevention of head problems, it is crucial to enhance scientific education on infant head shape among caregivers. Improving caregivers' health literacy enables the prevention of early infant head shape problems and significantly reduces the long-term impact of such issues, thereby reducing future healthcare costs. Therefore, prioritizing prevention is of paramount importance.

Survey findings and recommendations

This questionnaire represents the first survey conducted among Chinese medical staff regarding children's head shape. Its objective was to gain insight into Chinese medical staff's understanding of and attitude towards infant head shape problems, as well as the integration of head shape monitoring into their clinical practice. A significant majority of respondents (195/214, 91.12%) reported having received consultations on head shape problems. This indicates a noteworthy frequency of head shape problem consultations in clinics, suggesting that Chinese parents are increasingly concerned about infant head shape issues and their long-term impact on children's health and quality of life. Consequently, this places higher demands on healthcare providers. The overwhelming majority of medical staff from hospitals at all levels (n=201, 93.97%) expressed the necessity of conducting an in-depth study on head shape problems. This highlights the need for further clarification on various issues pertaining to head shape problems.

During the early stages of rapid cranial development, various factors may influence cranial suture growth and position, leading to head shape problems (5-9). These problems encompass high-risk groups, perceptions regarding diagnosis, and treatment options. In this study, only 8.88% (n=19) of the medical staff were aware of the high-risk group for cephalic problems, and none of these respondents belonged to primary hospitals (Table S1). This lack of awareness hinders early community screening for cephalic problems. Therefore, improving the awareness of medical staff of high-risk populations for cephalic problems is crucial. Only 13.55% (n=29) of the surveyed medical staff had successfully diagnosed head shape abnormalities, and

none of these respondents belonged to primary hospitals (n=0) (Table S1), implying that screening for head problems in primary hospitals may prove to be highly inefficient. Moreover, only 53.27% (n=114) of the medical staff were aware of the optimal intervention time for cephalic abnormalities, while 75.70% (n=162) of the medical staff were familiar with intervention methods for cephalic abnormalities (*Table 3*). The proficiency of medical staff did not differ substantially across different hospital levels (Table S1), and this may indicate that missed intervention opportunities for children have occurred. Early diagnosis allows for more opportune clinical interventions and yields better aesthetic outcomes (29-31). Thus, it is crucial to identify high-risk groups, identify the optimal intervention time, and promptly diagnose and intervene in clinical treatments for head shape problems.

In this study, only 20.09% (n=43) of the medical staff were fully aware of the consequences of cephalic problems. No significant difference was observed across hospitals of different levels (*Table 2*, Table S1). Previous studies have indicated that postural flathead syndrome primarily results in cosmetic issues. However, it is essential to consider the potential psychological impact on children who may face ridicule or discrimination due to abnormal head shape (11,32). Severe plagiocephaly (DP) can affect the child's appearance, cognition, vision, and hearing (10,11). For instance, in a longitudinal study conducted by Collett *et al.* in 2013 (33), 224 children with DP and 231 children without DP were assessed through 3D skull imaging, skull ratings, and the Bailey Infant and Toddler Development Scale Third Edition (BSID-III) at an average age of 7 months. The results revealed that children with DP scored lower than did those without DP in all BSID-III scales, particularly in the cognitive, language, and adaptive behavior domains (adjusted differences =−2.9 to −4.4 standard score points), whereas minimal differences were observed in motor development (adjusted difference =−2.7). Although this does not establish a causative relationship between DP and developmental problems, it suggests that DP may serve as an indicator of developmental risk, underscoring the importance of screening children with DP for developmental issues to enable early recognition and intervention. This is in line with another study, in which children with moderate-to-severe orthostatic plagiocephaly exhibited lower neurological scores compared to a control group (34). Although it remains unclear if moderate-to-severe orthostatic malformation directly causes deficits in cognition and lower academic scores, vigilant cephalic monitoring during infancy and early childhood is clinically significant (35). Therefore, it is crucial to enhance the awareness of cephalic problems among medical staff at all hospital levels.

Limitations

Several limitations to this study should be considered in the interpretation of the results. The number of participants in our questionnaire was limited, which may narrow the generalizability of our findings. Additionally, there was an uneven distribution among medical staff from hospitals of various levels. Notably, respondents from primary hospitals were underrepresented, constituting only 7.94% of all participants. Future research should aim to achieve a more balanced representation of hospital levels and expand the sample size to enhance the generalizability of the findings. Furthermore, our study did not delve into specific treatments for cephalic problems in children. This is a significant area that warrants dedicated research. We recommend that future research engage with cephalotherapy professionals to gain deeper insights into treatment modalities and best practices for pediatric cephalic issues. Despite these limitations, we believe that our findings provide a foundational understanding of this issue and can serve as a platform from which more comprehensive research can be conducted.

Conclusions

The findings of this questionnaire survey suggest that Chinese parents are gradually becoming more concerned about infants' head shape issues, specifically as they relate to children's long-term health and quality of life. However, medical staff participating in the survey exhibited limited awareness of children's head problems, potentially hindering early recognition and treatment. Thus, it is imperative for hospitals at all levels to enhance the screening, diagnosis, and treatment of head shape problems and to adopt multidisciplinary collaboration to address related issues. Moreover, the study highlights a high incidence of cephalic problems and the complex and diverse underlying causes that can lead to severe consequences. Medical staff should thus engage in comprehensive research on cephalic abnormalities, which is conducive to early identification, determination of causation, effective treatment, and rational referral. This underscores the significance of routine head monitoring and implementing effective educational

programs for pediatric health professionals in enhancing the management of children's head shape issues. In conclusion, the survey results indicate a limited awareness of children's head shape among Chinese pediatric medical staff and can serve as a reminder to medical professionals and parents to prioritize children's head shape in safeguarding their health and quality of life.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Ethics Committee of the Second Affiliated Hospital of the Army Medical University (approval No. 2021-044-01). Written consents were obtained from the medical staff before participation in this study.

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Supplementary

Table S1 Association between respondent characteristics and perceptions of head shape questions.

Question and response	Hospital grade		
	Primary hospital (n=17), n (%)	Intermediate hospital (n=96), n (%)	Senior hospital (n=101), n (%)
Do you have knowledge of flat head syndrome?			
Not at all	8 (47.1)	16 (16.7)	12 (11.9)
Somewhat familiar	9 (52.9)	72 (75.0)	74 (73.3)
Very familiar	0 (0)	8 (8.3)	15 (14.8)
Do you have knowledge of plagiocephaly?			
Not at all	7 (41.1)	17 (17.7)	12 (11.9)
Somewhat familiar	9 (52.9)	71 (74.0)	71 (70.3)
Very familiar	1 (5.8)	8 (8.3)	18 (17.8)
Do you have knowledge of craniosynostosis?			
Not at all	2 (11.7)	8 (8.3)	5 (4.9)
Somewhat familiar	12 (70.7)	72 (75.0)	66 (65.4)
Very familiar	3 (17.6)	16 (16.7)	30 (29.7)
Do you have knowledge of the high-risk groups for abnormal head shape?			
Not at all	6 (35.3)	24 (25.0)	21 (20.8)
Somewhat familiar	11 (64.7)	62 (64.6)	71 (70.3)
Very familiar	0 (0)	10 (10.4)	9 (8.9)
Do you know which head shapes are problematic?			
Not at all	3 (17.6)	1 (1.0)	5 (4.9)
Somewhat familiar	14 (82.4)	83 (86.5)	79 (78.2)
Very familiar	0 (0)	12 (12.5)	17 (16.8)
Do you know the consequences of craniosynostosis?			
Not at all	2 (11.8)	9 (9.4)	9 (8.9)
Somewhat familiar	12 (70.6)	74 (77.1)	65 (64.4)
Very familiar	3 (17.6)	13 (13.5)	27 (26.7)
Do you know the best time for the intervention of problematic head shape?			
Yes	7 (41.2)	51 (53.1)	56 (55.4)
No	10 (58.8)	45 (46.9)	45 (44.6)
Do you know the interventions for problematic head shapes?			
Yes	12 (70.6)	66 (68.8)	84 (83.2)
No	5 (29.4)	30 (31.2)	17 (16.8)
Is head shape routinely measured in your practice?			
Yes	9 (52.9)	73 (76.0)	79 (78.2)
No	8 (47.1)	23 (24.0)	22 (21.8)

Table S1 *(continued)*

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Table S1 *(continued)*

Question and response	Hospital grade		
	Primary hospital (n=17), n (%)	Intermediate hospital (n=96), n (%)	Senior hospital (n=101), n (%)
Is the measurement of children's head shape necessary?			
Yes	17 (100.0)	94 (97.9)	101 (100.0)
No	0 (0)	2 (2.1)	0 (0)
Mean	1	0.98	1
Should advice be given or intervention be performed for abnormal head shape?			
Yes	10 (58.8)	74 (77.1)	84 (83.2)
No	7 (41.2)	22 (22.9)	17 (16.8)
For patients who require referral, is there an established medical facility that one could refer them to?			
Yes	7 (41.2)	55 (57.3)	57 (56.4)
No	10 (58.8)	41 (42.7)	44 (43.6)
Is it necessary to learn more about head shape abnormalities?			
Yes	16 (94.1)	91 (94.8)	94 (93.1)
No	1 (5.9)	5 (5.2)	7 (6.9)
Have you ever received an inquiry about head shape?			
Yes	12 (70.6)	90 (93.8)	93 (92.1)
No	5 (29.4)	6 (6.2)	8 (7.9)

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