

# FOLLOW-UP STUDY OF BEHAVIORAL DEVELOPMENT AND PARENTING STRESS PROFILES IN CHILDREN WITH CONGENITAL HYPOTHYROIDISM

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Recent longitudinal experiences have emphasized that the follow-up of children with treated congenital hypothyroidism (CHT) should not be limited to the cognitive domain. This study attempted to evaluate the emotional-behavioral profiles in children with CHT together with maternal parenting stress profiles. Data for child and family characteristics were collected from 47 families with a 3–12-year-old CHT child diagnosed and treated since the newborn period. Cognitive assessments were performed. The main caregiver completed the following questionnaires: (1) Strengths and Difficulties Questionnaire, which rated behavioral symptoms in children; (2) Parenting Stress Index, which determined the quality and magnitude of parenting stress experienced by the caregiver; and (3) Symptom Checklist-90-R, which evaluated the psychopathological symptoms of the caregiver. In addition, 31 unaffected siblings were recruited as a comparative control group. The results revealed that children with treated CHT had normal intelligence quotients (mean,  $93.6 \pm 16.2$ ) at the time of the study. However, CHT children had more problems in emotional-behavioral domains than sibling controls ( $p=0.01$ ). Overall, 29.8% (14/47) of the CHT children had emotional-behavioral problems above the clinical cutoff. In addition, 13% of the caregivers of CHT children had parenting stress above the clinical cutoff. Therefore, professional intervention is warranted in these subgroups of CHT children and parents.

**Key Words:** behavioral problems, congenital hypothyroidism, emotional development, parenting stress

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Congenital hypothyroidism (CHT), detected in 1/3,500–4,000 newborns worldwide, is the most common preventable cause of mental retardation [1]. Neonatal screening programs are reported to improve prognosis by reducing the number of cases of mental retardation [2]. In Taiwan, the introduction of systematic neonatal screening in 1984 has enabled

early detection and successful treatment of affected children with CHT [3]. According to Hsiao et al [4], the follow-up mean intelligence quotients (IQ) for a sample of Taiwanese children with treated CHT was  $102 \pm 18$ , and the most important prognostic factor affecting intellectual outcome was the severity of hypothyroidism at diagnosis. Nevertheless, with more comprehensive follow-up studies reported in developed countries, it has become clear that early diagnosis and treatment of CHT does not eliminate all deficits [5–7]. Children with CHT may still have specific developmental problems such as defective motor skills, learning difficulties, language, attention, memory and behavioral concerns [8–10]. In addition,



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previous Western studies of the psychological adjustment of children affected by CHT reported that these children had more internalized problems such as anxiety, depression and worry, which tended to increase with the child's age and was related to the severity of the disease [11]. It was speculated that parental worry and anxiety consequent to the birth of a baby with CHT might be projected onto the child, producing emotional distress, poor self-confidence, and anxiety or depressed mood [11]. It was also reported that there is a high frequency of incorrect psychological attitudes in parents of children with CHT, and it was strongly recommended that the follow-up of CHT children should include an evaluation of the parent-child affective domain [12]. Therefore, it was recommended that the follow-up assessment of children with CHT should include not only cognitive assessment, but also social behavior, temperament, emotional-behavioral problems, and the affective relationship between parents and affected children [13,14].

In this study, we attempted to evaluate Taiwanese families of children with treated CHT for the children's cognitive development and emotional-behavioral problems, together with maternal psychological functioning and their relative contributions to overall and specific dimensions of parenting stress. The emotional-behavioral profiles of unaffected siblings were also evaluated for comparison.

## METHODS

### *Subjects*

Families and their children with CHT were recruited from the outpatient service of the Department of Pediatrics, Kaohsiung Medical University Hospital. The following criteria were required for entering the study: (1) the child was diagnosed with CHT during the neonatal period and had continuously received or was currently receiving thyroid replacement treatment in our hospital; (2) the child was aged between 3 and 13 years of age at the time of the study; and (3) the primary caregiver must have at least 9 years of formal education so that the designated questionnaires could be administered successfully. Between October 2005 and March 2006, CHT children with conditions fulfilling the above criteria and who visited our pediatric endocrine subspecialty clinic at

their annual follow-up were invited to participate in this study. Overall, 47 families out of 59 agreed to participate. The primary caregivers who completed the questionnaires were all mothers (80.4% of them were married, 19.6% were single parents). The CHT children included 22 boys and 25 girls with a mean age of  $78.7 \pm 35.4$  months (range, 3 years 1 month to 12 years 2 months). The duration of thyroid replacement treatment was at least 3 years, and 64% (30/47) of the children still needed thyroid medication. As a control group, 31 unaffected siblings (9 boys and 22 girls; mean age,  $106.0 \pm 45.0$  months) were recruited to compare behavior profiles. Most of the siblings were older than the child with CHT. Only one CHT-sibling match per family was considered. This study was approved by the Institutional Review Board of the Kaohsiung Medical University Hospital. Informed consent was obtained from the parents of each subject according to the guidelines of the Institutional Committee on Clinical Investigation.

### *Procedures*

Questionnaires (all in Chinese) for the mothers were completed in the outpatient department after receiving help from an assessor. The assessor was trained in adherence to a standardized protocol and was supervised by a licensed psychologist.

### *Measures*

#### *Strengths and Difficulties Questionnaire*

The Strengths and Difficulties Questionnaire (SDQ) is a brief behavioral screening questionnaire for children aged 3–16 years. It was first tested in the United Kingdom and copyrighted by Goodman in 1997 [15]. This questionnaire assesses 25 attributes, which are divided into five scales, each comprising five items, generating scores for conduct problems, hyperactivity-inattention, emotional symptoms, peer problems, and prosocial behavior. All but prosocial behavior are summed to generate a Total Difficulties score (range, 0–40) [16,17]. SDQ is currently available in 66 languages. Copies of the SDQ questionnaire in Chinese were retrieved from <http://www.sdqinfo.com/d4a.html>, after obtaining the authors' permission. The Center for Clinical Trials and Epidemiological Research at the Chinese University of Hong Kong had contributed greatly to the translation and back-translation of the Chinese version. The psychometric properties of this Chinese version were shown to be

acceptable in studies conducted in Shanghai [18,19]. In the current study, we used the parent SDQ version to assess the psychological morbidity of the CHT children and control siblings. As reported in the Chinese sample, the SDQ Total Difficulties score used a cutoff score of 13 for the normal band, 14–16 for the borderline band, and 17–40 for the abnormal band [19].

#### *Parenting Stress Index–Chinese version*

The mothers of the CHT children completed the Chinese version of the Parenting Stress Index (PSI) [20], a validated Chinese version of the original questionnaire developed by Abidin [21], which measures aspects of parental functioning. The PSI-Parent domain scale contains 54 items and comprises seven subscales: sense of competence, attachment, role restriction, depression, social isolation, spouse relationship, and health. The PSI-Child domain scale contains 47 items, and includes six subscales: adaptability, mood, demandingness, acceptability, hyperactivity/distractibility and reinforces parents, all of which evaluate the parent's perception of the impact a child's temperamental characteristics have on the parent-child system. In addition to the 13 subscales, the parent and child domains yield a total score and a derived raw-to-percentile score. As reported by the validated Chinese PSI manual, the "total stress score" uses a cutoff score of 286 for the abnormal band (equivalent to a derived raw-to-percentile score above the 85<sup>th</sup> percentile) [20].

#### *Symptoms Checklist-90-R–Chinese version*

The Symptoms Checklist-90-R (SCL-90-R) is a standardized self-report measure of psychopathological symptoms [22]. The 90 questions are clustered into the following symptom dimensions: somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychotic tendencies. Participants use this scale to rate 90 statements on the severity of symptoms they experienced during the previous week. A Global Severity Index (GSI) is generated as an indicator of total psychiatric disturbance because it combines information concerning both the intensity of the stress and number of symptoms reported from all the symptom dimensions. Possible scores on the GSI range from 0 to 4. The validity of the SCL-90-R in Taiwan has been established [23]. Because the GSI

provided the best measure of the current level and depth of a psychiatric condition, this score was used as a predictor in our analysis.

#### *Cognitive assessment of the CHT children*

Four kinds of cognitive tests were applied to the CHT children according to their chronological ages. For children aged 6–15 years ( $n=17$ ), the Wechsler Intelligence Scale for Children–III (Taiwanese version validated in 1997) [24] was used. Full-scale intelligence quotients (FIQ) were used for the final analysis. For children aged 3.5–6 years ( $n=17$ ), the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) (Taiwanese version validated in 2000) [25] was used. When the preschool children had limited time during the clinic visit to be given the WPPSI ( $n=7$ ), the Chinese Child Developmental Inventory (adapted from the Minnesota Child Development Inventory, validated in 1978) [26] was used instead. The developmental quotient was derived for final analysis. Finally, the Bayley Scales of Infant Development–II [27] was used for children aged <3.5 years ( $n=4$ ). The mental developmental quotient was used for final analysis. Overall, 45 children with CHT completed the cognitive assessment. Two mothers refused to let their children complete the intelligence test.

#### *Statistical analyses*

Descriptive statistics were calculated for the IQ, SDQ-Total, SDQ subscales, GSI and PSI-Total for our analyses. SDQ scores were compared between CHT children and control siblings using *t* tests. Correlational analyses were performed to explore the relationship between the child's behavior and the maternal condition in CHT subjects. Data from the 47 CHT subjects were combined and multiple regression analyses were conducted to investigate the associations between child characteristics and maternal psychopathology across different dimensions of parenting stress. From clinical experience, we formulated *a priori* hypotheses targeting two subscales of interest, competence (parent domain) and acceptability (child domain), as specific dimensions of stress. The competence domain may reflect the parents' confidence in their practical developmental knowledge of raising a CHT child. The acceptability domain may represent whether the child possesses characteristics (including the aftermath of being diagnosed with CHT) that match the expectations of the parents. These two subscales and the

overall parent stress total score were used as dependent variables in the regression analyses. The PSI-Child and Total domains were not included as dependent variables in the multiple regression analyses because several questions within these domains represented child behavioral problems, overlapping the constructs of the child and total domains and the SDQ. Three predictor variables were entered, including the SDQ Total Difficulties scale score, child age and SCL-90-R-GSI. We limited the number of independent variables entered into the model to optimize statistical power and avoid potential confounding effects such as colinearity. For all multiple regression analyses, the two-tailed  $\alpha$  value for statistical significance was 0.05.

## RESULTS

The descriptive statistics for IQ, SDQ-Total, SDQ subscales, GSI and PSI-Total are presented in Table 1. The mean IQ score for CHT children at the time of the study was in the normal range ( $93.6 \pm 16.2$ ). Comparison of the CHT children with siblings on the parent-completed SDQ revealed significantly higher scores for CHT children for the Total Difficulties score ( $p=0.01$ ). Subscales analysis revealed that mothers

reported that their CHT children had more concerns in domains of conduct problems ( $p=0.00$ ) and peer relationship ( $p=0.04$ ). In addition, 29.8% (14/47) of the CHT children had Total Difficulties scores above the clinical cutoff of 17. This finding suggested that about 30% of the treated CHT children might have problems in emotional-behavioral domains that need professional assessment. In addition, approximately 13% (6/47) of the mothers of CHT children had high parenting stress scores above the clinical cutoff of 286. Professional referral for this subgroup of CHT mothers is warranted for maternal mental health.

The correlations among various factors reported in the parent-completed questionnaires are presented in Table 2. In summary, there were moderate correlations between SDQ and Parental Psychopathology-GSI ( $r=0.60$ ,  $p<0.01$ ), between SDQ and PSI-Total ( $r=0.58$ ,  $p<0.01$ ) and between the GSI and PSI-Total ( $r=0.59$ ,  $p<0.01$ ). Multiple regression analyses applying the models with parental competence, acceptability and parent domain total stress scores as the dependent variables were all statistically significant (Table 3). SDQ-Total scores ( $\beta=0.763$ ,  $p=0.000$ ) and child age ( $\beta=0.297$ ,  $p=0.010$ ) were both significant predictors for a high acceptability score. The SDQ-Total score was also a significant predictor for the competence score ( $\beta=0.392$ ,  $p=0.024$ ). In addition,

**Table 1.** Characteristics of children with congenital hypothyroidism and comparison with sibling controls\*

	CHT children ( $n=47$ )	Sibling controls ( $n=31$ )	$p$
Sex			0.12
Boy	22 (46.8)	9 (29.0)	
Girl	25 (53.2)	22 (71.0)	
Age (mo)	$78.7 \pm 35.4$	$106.0 \pm 45.0$	0.00
IQ ( $n=45$ )	$93.6 \pm 16.2$		
SDQ			
Total Difficulties score	$13.0 \pm 7.0$	$8.8 \pm 6.6$	0.01
Emotional symptoms	$3.0 \pm 2.4$	$2.4 \pm 2.2$	0.23
Conduct problems	$2.6 \pm 1.8$	$1.2 \pm 1.4$	0.00
Hyperactivity/inattention	$4.3 \pm 3.0$	$3.3 \pm 2.6$	0.11
Peer relationship problems	$2.9 \pm 2.0$	$2.0 \pm 1.9$	0.04
Above clinical cutoff <sup>†</sup>	14 (29.8)	6 (19.4)	
Parenting Stress Index of mothers			
Total score	$235.2 \pm 46.0$		
Above clinical cutoff <sup>‡</sup>	6 (13.0)		
GSI of mothers	$0.5 \pm 0.5$		

\*Data presented as  $n$  (%) or mean  $\pm$  standard deviation; <sup>†</sup>clinical cutoff of "Total Difficulties score" of SDQ: 17 [17]; <sup>‡</sup>clinical cutoff of the Parenting Stress Index total score: 286 [20]. CHT=congenital hypothyroidism; IQ=intelligence quotient; SDQ=Strengths and Difficulties Questionnaire-Chinese version; GSI=Global Severity Index.

**Table 2.** Correlations among the children’s behavioral problems, parenting stress and parental psychopathology in families with children with congenital hypothyroidism (*n*=47)

	1	2	3	4	5	6	7
1. SDQ Total		-0.04	0.60*	0.59*	0.47*	0.62*	0.58*
2. Child Age	-0.04		0.10	-0.02	-0.06	0.25	-0.06
3. Global Severity Index	0.60*	0.10		0.54*	0.36*	0.26	0.59*
4. Isolation	0.59*	-0.02	0.54*		0.47*	0.32 <sup>†</sup>	0.77*
5. Competence	0.47*	-0.06	0.36*	0.47*		0.52*	0.76*
6. Acceptability	0.62*	0.25	0.26 <sup>†</sup>	0.32 <sup>†</sup>	0.52*		0.45*
7. PSI Total	0.58*	-0.06	0.59*	0.77*	0.76*	0.45*	

\*Correlation is significant at the 0.01 level (two-tailed); <sup>†</sup>correlation is significant at the 0.05 level (two-tailed). SDQ=Strengths and Difficulties Questionnaire–Chinese version; PSI=Parenting Stress Index–Chinese version.

**Table 3.** Multiple regression analyses predicting different parental domains of maternal stress (*n*=47)

Dependent variables	Independent variables	$\beta$	<i>p</i>
Competence Adj. R <sup>2</sup> =0.184 <i>p</i> =0.008	SDQ Total	0.392	0.024
	Child Age	-0.057	0.674
	GSI	0.133	0.433
Acceptability Adj. R <sup>2</sup> =0.450 <i>p</i> =0.000	SDQ Total	0.763	0.000
	Child Age	0.297	0.010
	GSI	-0.228	0.106
Parent Stress Total Adj. R <sup>2</sup> =0.395 <i>p</i> =0.000	SDQ Total	0.342	0.022
	Child Age	-0.080	0.494
	GSI	0.393	0.009

SDQ=Strengths and Difficulties Questionnaire–Chinese version; GSI=Global Severity Index.

high SDQ-Total and SCL-90-R-Global Severity scores explained a significant amount of the variance in high parenting stress ( $\beta=0.342$ , *p*=0.022;  $\beta=0.393$ , *p*=0.009), such that greater child behavioral problems and higher levels of parental psychological problems were associated with higher overall levels of parenting stress.

## DISCUSSION

Based on decades of experience with newborn screening of CHT in developed countries, an optimistic prognosis for the intellectual outcome can be expected for more than 90% of the patients. Our results of an average normal IQ at the time of the study demonstrated that the intellectual development of Taiwanese children with treated CHT was favorable, confirming the findings of a previous report in Taiwan [4]. Furthermore, our results showed that children with treated CHT had more problems in emotional-behavioral domains than their siblings, as reflected by higher scores in the Total Difficulties

scores. Our findings highlight the importance that clinicians pay attention to the developmental domains of CHT children. In contrast to the previous Western report of increased internalizing disorders [11], we noted significantly higher subscale scores for conduct and peer relationship problems in our CHT children. Nevertheless, the psychometric validity of the Chinese translation of the specific items of this instrument (SDQ) was debated in a recent Shanghai study [19]. Hence, our finding might not indicate a true increase in childhood disruptive behavioral disorders. Further evaluation is clearly needed.

CHT is a chronic disease associated with the need for continuous medical therapy and frequent monitoring. Nevertheless, few prior studies have investigated parenting stress in mothers of children affected by CHT. Our study identified a subgroup of mothers with CHT children who have high parenting stress above the clinical cutoff. In addition, the emotional-behavioral problems of the children were significantly associated with overall parental stress. Analysis indicated that the severity of the child behavioral problems and an increased child age might

influence whether a child met the parental expectation competence. These findings have implications with respect to later prognostication, family counseling and developing a programmatic approach to this subgroup, which might have potential problems in parent-child systems. For example, intervention should be arranged for potential parent-child attachment problems when mothers reported high scores in the acceptability of the PSI domain. In addition, well-designed parental support programs focusing on positive behavioral management might improve both the emotional-behavioral domains of the children and on the competence and mental health of the mothers.

The limitation of our study lies in the small number of cases with a broad age range; hence, the statistical power may be limited. "Method variance" is another major limitation of this study because the parents who completed the stress measure also completed the SDQ. The correlation between these two measures could be due to the fact that the same group answered all of these questions. Using siblings as a comparison group has the advantage of controlling for environmental factors; however, by definition, they differed in age from the child with CHT. Therefore, this age factor may skew the results in the parental concern of emotional-behavioral domains. Furthermore, in outcome studies of children with CHT, the challenge is to clarify the effects of variables at different points of time on the child's brain development. This is a question we are not able to answer here, due to the limited scope of our research design.

In summary, we believe that the behavioral development of children with CHT and their caretakers' conditions have great bearing on their outcome. The knowledge gained from the current study will help us to recognize problems that are potentially amenable to intervention and will guide future services to provide focused psychosocial treatments for children with CHT and their families.

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# 追蹤研究先天性甲狀腺功能低下症孩童之行為情緒發展及主要照顧者之親職壓力

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有鑒於近年來追蹤研究經驗結果顯示，對於治療甲狀腺功能低下的孩童的長期發展重點，不能只放在認知領域。故本研究旨在探討於新生兒階段即被診斷為甲狀腺功能低下 (CHT) 的孩童在治療後他們的行為情緒發展及主要照顧者的親職壓力特質。我們收集了 47 位 12 歲以下病童 (均是在新生兒階段得到 CHT 診斷並開始治療) 及家長資料，除智力測驗外並安排評估工具包括有：(1) SDQ 問卷：評估孩子的社會人格 / 情緒行為特質；(2) 親職壓力量表：評估主要照顧者的壓力大小及性質；(3) 精神症狀量表：評估主要照顧者的心理狀況。並同時以 CHT 小孩的手足為對照組 (共 31 人)，進行資料收集。結果顯示 CHT 的小孩治療後，於追蹤時的智力在正常範圍 (平均為  $93.6 \pm 16.2$ )，但在行為情緒發展範疇，則相較於手足對照組則有統計上有意義的較多困難 ( $p = 0.01$ )，其中並有 29.8% 的 CHT 孩童的行為情緒發展分數屬異常範圍，此外，13% 的 CHT 孩童的主要照顧者的親職壓力處於過高狀態，均達到宜轉介處理的閾值。此些發現可提供 CHT 孩童長期發展及療育照顧上的參考。

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