Clinicians often rely on parents for guidance regarding their child’s health-related quality of life (HRQOL) as they play an important role in medical decision making. Even when a child’s responses are available, the perspective of parent has an important bearing on health care decision with respect to the child. Although parents don’t always concur on all aspects of the child’s HRQOL, they are more reliable than other proxies such as teachers and health professionals. For these reasons, parallel reporting is increasingly recommended in studies involving the assessment of health outcomes in child populations with analogous questionnaires for children and their parents being developed.

In case of child brain tumor (BT) patients, many health outcome studies in pediatric psycho-oncology have excluded child BT patients from study participation, as their experiences were not included in the study.

INTRODUCTION

Parents are recognized as one of the main sources of emotional support for children with cancer. Many children with cancer currently receive a large proportion of their treatment at home, placing an added burden of care on family members. Unlike adult measures of quality of life (QOL) in the patients, which rely on self-reporting, measures of QOL in children may use self-reporting, proxy reporting, or both. Clinicians often rely on parents for guidance regarding their child's health-related quality of life (HRQOL) as they play an important role in medical decision making. Even when a child's responses are available, the perspective of parent has an important bearing on health care decision with respect to the child. Although parents don't always concur on all aspects of the child's HRQOL, they are more reliable than other proxies such as teachers and health professionals. For these reasons, parallel reporting is increasingly recommended in studies involving the assessment of health outcomes in child populations with analogous questionnaires for children and their parents being developed.
considered atypical to that of the majority of pediatric survivors\(^3\,13\,18\), and because none were designed specifically for survivors of childhood brain tumors\(^19\). In 2007, Palmer and co-workers\(^27\) presented the 24-item PedsQLTM BT module, and Lai and colleagues\(^11\) also developed the 34-item Patient and Parent Version (ages 7-12 years; grade school) of the Pediatric Functional Assessment of Cancer Therapy-BT Survivor (pedsFACT-BrS) for assessing HRQOL of child BT patients, and has been extended to adolescent for both patient and parent since then.

Tao and Parsons\(^22\) suggested that brevity, instrument practicality (e.g., length of questionnaire; language suitability; age-appropriateness), and ease of administration is needed particularly in busy clinical settings, when selecting a HRQOL instrument for a study, and the pedsFACT-BrS has the advantage of these criteria.

Until now, we had finished the validation studies of the brain tumor-specific tool for measurement of childhood BT survivors’ QOL, the patient’s version of both the pediatric functional assessment of cancer therapy questionnaire (version 2.0) in brain tumor survivors aged 7-12\(^26\), and aged 13 years and older\(^23\), and then we found that these tools could be reliable and valid instruments.

The value of proxy reporting is still controversial\(^29\). Before we started the validation study of pedsFACT-BrS parent form, we investigated the agreement between self-report from pediatric brain tumor patients and proxy reports from their parents whether it would be necessary to perform the validation study of both pedsFACT-BrS age 7-12 and aged 13 years and older(parent form) or not\(^26\). According to the result of Yoo et al.\(^26\), the proper use of the pedsFACT-BrS for their parent proxies had provided clinicians with valid information about the overall QOL of child and adolescent BT patients, including their general health and their brain tumor specific well-being, so we have performed the validation study of pedsFACT-BrS aged 7-12 and aged 13 and older parent proxy version individually. This study was at first to evaluate the reliability and validity of the Pediatric Functional Assessment of Cancer Therapy Questionnaire Brain Tumor Survivor (version 2.0) Aged 13 years and older (Parent Form) (pedsFACT-BrS parent of adolescent) before investigation of the long-term follow-up HRQOL study for adolescent BT patients.

### Table 1. Demographic and clinical characteristics of 170 adolescent brain tumor patients and their parent

| Variables                                          | Mean (SD, %) |
|----------------------------------------------------|--------------|
| Parents of adolescent brain tumor patients         |              |
| Mean age of parent                                 | 43.98 (3.54) |
| Mean age of education                              | 12.97 (2.08) |
| Marital status                                     |              |
| Married                                            | 168 (98.8)   |
| Divorced                                           | 2 (1.2)      |
| Occupation status                                  |              |
| Homemaker                                          | 165 (97.1)   |
| Full time                                          | 3 (1.8)      |
| Part time                                          | 2 (1.1)      |
| Adolescent brain tumor patients                    |              |
| Sex                                                |              |
| Male                                               | 99 (58.2)    |
| Female                                             | 71 (41.8)    |
| Mean age (SD)                                      | 15.34 (2.26) |
| Mean age of education (SD)                         | 13.14 (2.32) |
| Pathology                                          |              |
| Medulloblastoma/PNET                               | 25 (14.7)    |
| Malignant glioma                                   | 22 (12.9)    |
| Low-grade glioma                                   | 33 (19.4)    |
| Other low grade neoplasm                           | 44 (25.9)    |
| Germ cell tumor                                    | 46 (27.1)    |
| Treatment received                                 |              |
| Surgery only                                       | 73 (42.91)   |
| Surgery+chemotherapy+radiotherapy                  | 48 (28.2)    |
| Surgery+radiotherapy                               | 49 (28.8)    |
| Location                                           |              |
| Supratentorial                                     | 111 (65.3)   |
| Infratentorial                                     | 59 (34.7)    |
| Shunt                                              |              |
| Yes                                                | 33 (19.4)    |
| No                                                 | 137 (80.6)   |
| Currently receiving treatment                      |              |
| Yes                                                | 38 (22.4)    |
| No                                                 | 132 (77.6)   |

**PWB:** physical well-being, **SFWB:** social/family well-being, **EWB:** emotional well-being and illness experience, **BTS:** brain tumor survivor-specific concerns, **PSF:** psychosocial function (SFWB+EWB), **pedsFACT-BrS:** pedsFACT-BrS total score

### MATERIALS AND METHODS

#### Subjects

We enrolled 170 adolescent brain tumor patients’ mothers (Table 1). The patients were recruited from Asan medical center (n=72), Severance children’s hospital (n=62), Seoul National university hospital (n=24), and National cancer center (n=12). All mothers with patients returning for routine follow-up appointments were consecutively asked to enroll between December 2006 and December 2009. Parents were excluded if they had pre-existing cognitive impairment, psychiatric disorders, or hearing loss. Informed consent was obtained from all participants. As previous childhood studies contained only small numbers of cases, we decided to perform a multicenter study. As was in Yoo et al.\(^23\) result, the patients’ frequencies of tumor pathologic subtypes in this study were similar to those reported for the American population\(^27\) and for earlier Korean populations\(^30\), except that the proportion of germ cell tumor patients (27.1%) was particularly high in our sample. We considered the incidence in the East was between 2.1-9.4%, which seemed noticeably higher than in the West, and in particular, the incidence of Korea and Japan was much higher than that of other eastern countries\(^30\).
Assessment tool

pedsFACT-BrS parent of adolescent

The pedsFACT-BrS adolescents consisted of 37 items: 25 generic concerns [7 on physical well-being (PWB), 13 on emotional well-being and illness experiences (EWB), 5 on social/family well-being (SFWB)], and 12 brain tumor survivor-specific concerns (the BTS questions) (http://www.facit.org).

Development of the Korean pedsFACT-BrS parent of adolescent

The pedsFACT-BrS parent of adolescent was translated employing standard FACIT methodology. A provisional version of the instrument was pre-tested on 30 mothers in total, 5 mothers each according to their children's age between 13 to 18 years during their follow-up clinic visits. Participants were asked to self-administer the questionnaires. Subjects were asked to write their opinions on the questions below that had made to clarify what and how many items made subjects discomfort.

1) Would you please tell me which items were difficult to understand and why they were difficult? Also, could you suggest a better way to phrase these items?
2) Would you please tell me which items were not relevant or were offensive, and why? Also, could you suggest a better way to phrase these items?
3) Is there anything else that should have been included related to your children's condition? Would you please tell me what should be added?

Reliability

Internal consistency coefficients were calculated for each subscale. We performed test-retests at intervals of 7-10 days in 30 mothers among the 170 subjects who agreed to complete the questionnaire twice.

Clinical validity

We determined discrimination of the pedsFACT-BrS parent of adolescent by comparing the pedsFACT-BrS parent of adolescent scores to Karnofsky scores, pathology, treatment type, tumor location, shunt, and treatment on/off status.

Convergent and divergent validity

Convergent and divergent validity were assessed by comparing patient responses with those on the neuroticism in EPQ and mental health (MH), self-esteem (SE), physical functioning (PF) in Child health questionnaire (FA), role/social limitation/emotional/behavioral (REB), time impact on parent (PT), emotional impact on parent (PE), self-esteem (SE), mental health (MH), behavior (BE), family cohesion (FC), and change in health (CH). We analyzed only the PF (α=0.78), MH (α=0.82), SE (α=0.74) in this study.

N, MH, and SE scores were used as measures of related concept (emotion). And PF was used as related concept (physical function), too. It was expected that correlations with N, MH, and SE should be stronger for EWB answers, moderate to low for PWB and BTS answers, because these are measures of emotion. And correlation with PF was expected to be stronger for PWB answers, moderate to low for SFWB and BTS, because PF is measure of physical function. According to Dawson et al., a coefficient correlation value of 0.60-0.79 indicated a strong correlation and 0.40-0.59 a moderate correlation.

Procedures

The pedsFACT-BrS parent of adolescent questionnaire was administered verbally by research nurses to ensure that questions were always posed in the same manner. A research assistant was available to answer questions raised by participants during completion of the self-administered instruments at the outpatient clinic.

Statistical analyses

Descriptive statistics [means, standard deviation (SD), and frequencies] were calculated for all variables, and group differences were assessed using analysis of covariance, controlling statistics for mother age, and mother's educational age. Internal consistency reliability was assessed using Cronbach’s alpha. The intraclass correlation coefficient (ICC) (Two-way random effect model absolute agreement definition) was used to assess instrument's test-retest reliability. Pearson product moment correlation was used to determine the convergent and divergent validities of pedsFACT-BrS parent of adolescent, including assessment of the overall scale, subscales. We classified patients into three groups based on Karnofsky score assessed by patient's mother; Karnofsky score of 100, 90, or 80. The independent sample t-test and one-way ANOVA were employed to determine whether the test was able to discriminate across Karnofsky score assessed by patient's mother, shunt, tu-
RESULTS

Pre-testing

All 30 mothers had reported that there were no difficult, irrelevant, or offensive items in pedsFACT-BrS parent of adolescent reported. And, they had no item that had been included related to their conditions. Cronbach’s α coefficient showed acceptable internal consistency (0.7) 4, suggesting that translated items performed well in association with other items in the same subscale.

Reliability

All Cronbach’s α coefficients were ranging from 0.76 to 0.94 that exceeded Nunally’s criterion 10 of 0.7 for modest reliability. The assessment of test-retest reliability using ICC revealed satisfactory values with ICCs ranging from 0.84 to 0.93 (Table 2). An ICC value of 0.7 or greater was considered to indicate acceptable reliability. 14,10

Validity

None of age, age of education showed significant associations with total QOL. Pathological diagnosis was not significantly associated with total QOL.

Convergent and divergent validity

We hypothesized that the EWB was strongly correlated with MH and SE scores (convergent validity), whereas SFWB and BTS were associated to a lesser degree with such assessments (divergent validity). It was hypothesized that the PWB was strongly correlated with PF scores (convergent validity), whereas SFWB and BTS were associated to a lesser degree with such assessments (divergent validity). Correlations greater than 0.40 have been considered to be satisfactory convergent validity. Conversely, for adequate divergent validity, scales measuring different constructs should show low correlations, well under 0.40.27 Correlations between EWB and N (r=0.72), between EWB and MH (r=0.60), and between EWB and SE (r=0.62) were stronger that we had expected, reflecting measurement of the same phenomenon. In contrast, correlations between SFWB and MH (r=0.32), between BTS and MH (r=0.14), between BTS and SE (r=0.29) were low, indicating that different phenomena were being addressed. Correlations between PWB and PF (r=0.78) was stronger than we had predicted, reflecting measurement of the same phenomenon. In contrast, correlations between BTS and PF (r=0.26) was low, indicating that different phenomenon was being addressed (Table 3).

Known group comparison

Overall questionnaire data (p<0.001) and subscale results (p<0.001) enabled discrimination by Karnofsky score. Analysis by treatment type revealed significant differences in PWB (p<0.001), SFWB (p<0.01), EWB (p<0.05), PSF (p<0.05), and overall scores (p<0.05) except BTS. Significant differences between tumor location (supratentorial vs. infratentorial) and between shunt-yes and shunt-no were seen in PWB (p<0.001), EWB (p<0.05), PSF (p<0.05), and overall scores (p<0.05). Finally, significant differences between treatment-on and treatment-off status were also seen in PWB (p<0.001), SFWB (p<0.05), EWB (p<0.01), BTS (p<0.05), PSF (p<0.01), overall scores (p<0.001) (Table 4).

DISCUSSION

The results presented here show the good psychometric properties of the Korean version of the pedsFACT-BrS parent of adolescent, including internal consistency, test-retest reliability, good convergent and divergent validity, and known group validity. As expected, the correlations among EWB, N, MH, and SE subscales showed that essentially the same phenomenon (emotion) was being measured. N, MH, SE scores were correlated well with EWB scores (convergent validity) and poorly with SFWB and BTS (divergent validity). The correlations between PWB and PF subscales showed that essentially the same phenomenon (physical function) was being measured. PF score was correlated well with PWB scores (conver-
gent validity) and poorly with BTS (divergent validity).

Known group validities were confirmed by Karnofsky score, type of treatment, tumor location, presence of shunt, and receiving-treatment status. The parent report in this study indicated that the surgery-only group showed the highest scores in all sub-scales and on overall pedsFACT-BrS parent of adolescent mean score except BTS, however there was no significant difference between surgery+radiotherapy group and surgery+radiotherapy+chemotherapy group.

We could not compare our results directly with any previous report because no studies on the QOL of adolescent-only BT patients have been conducted except our adolescent patient group's report\(^1\). Our results were very similar to those of adolescent BT patients\(^2\) except SFWB. And, though our results were similar to those of Bhat and colleagues\(^3\), we did not have a no-treatment group or a radiotherapy-only group in our study. Therefore, further research is needed to compare the QOL of BT patients according to their treatment type such as surgery-only, radiotherapy-only, or other treatments.

In this study, tumor location and presence of shunt affected PWB, EWB, PSF, overall scores except SFWB, and BTS. Mothers with patients with infratentorial tumor or presence of shunt indicated that their children indicated lower physical function, psychosocial function, and overall HRQOL than mothers with patients with supratentorial or non-presence of tumor group.

Our results were partially similar to those of Bhat and colleagues\(^1\) study, because parents in their study reported that patients who had a shunt also indicated lower physical (\(p<0.05\)) and psychosocial functioning (\(p<0.01\)).

But, in Bhat et al.'s\(^1\) study, parents reported that patients who had a shunt indicated decreased social functioning (\(p<0.05\)), which was different from our result. In tumor location, Bhat et al.'s\(^1\) study didn't show the significant difference between supratentorial group and infratentorial group either in self-reports or parent proxy reports, and that children with infratentorial tumor had significantly more problems communicating issues related to their illness than children with supratentorial tumors\(^1\).

The difference between Bhat et al.'s\(^1\) and our study was probably due to the difference of brain tumor patients' mean age level. Bhat et al.'s\(^1\) patient mean age was 11.82 (SD=5.39) (child group), whereas the mean age of the patients in this study was 15.37 (SD=2.23) (adolescent group). These differences indicated that children and adolescent might have different concerns with respect to their HRQOL\(^2\).

The limitation of the present study is exclusion of fathers in the parent group. Although Russell et al.'s\(^2\) also revealed that no significant difference in QOL outcomes when maternal and paternal influences were considered\(^2\), we tried to enroll fathers in this study at the start, but we concluded that caregivers of adolescent BT patients in Korea were mostly their mothers, not their fathers.

### Table 4. Differences in pedsFACT-BrS scores according to Karnofsky scores, treatment type, location, shunt, and treatment on/off status

| Variables | Karnofsky | N | PWB | SFWB | EWB | BTS | PSF | PedsFACT-BrS |
|-----------|-----------|---|-----|------|-----|-----|-----|-------------|
| Location  | Supratentorial | 111 | 18.96 (4.67) | 12.71 (3.99) | 25.64 (6.79) | 35.99 (9.46) | 38.36 (9.51) | 96.59 (21.49) |
|           | Infratentorial | 59  | 15.45 (6.32) | 11.86 (3.46) | 23.10 (7.67) | 34.71 (9.49) | 34.97 (10.36) | 88.13 (22.09) |
| Treatment | Surgery     | 73  | 23.49 (4.37) | 13.42 (3.23) | 26.17 (6.34) | 36.12 (9.14) | 57.85 (11.98) | 99.21 (19.28) |
|           | S+R        | 48  | 18.91 (6.15) | 11.75 (4.13) | 23.80 (7.34) | 36.12 (8.72) | 52.11 (14.29) | 90.58 (20.32) |
|           | S+R+C      | 49  | 19.58 (7.10) | 11.73 (3.76) | 23.76 (7.81) | 34.29 (10.75) | 51.49 (45.82) | 88.86 (25.62) |
| Treatment | On         | 38  | 18.24 (6.27) | 11.71 (2.88) | 22.96 (5.79) | 33.27 (8.24) | 50.76 (10.38) | 86.18 (16.37) |
|           | Off        | 132 | 22.38 (5.47) | 12.80 (4.04) | 25.69 (7.45) | 36.76 (9.59) | 56.16 (14.96) | 97.52 (22.57) |

\(p < 0.05, **p < 0.01, ***p < 0.001. S+R : surgery+radiotherapy, S+R+C : surgery+radiotherapy+chemotherapy\)
CONCLUSION

The present results suggest that the Korean translation of the pedsFACT-Br5 parent of adolescent is a reliable and valid instrument for measuring the QOL of Korean adolescent BT patients. Further research is needed not only to determine whether the questionnaire remains efficient and sensitive to detect longitudinal QOL changes in adolescent BT parent overall, but also whether it is suitable for detecting longitudinal QOL changes within homogeneous patient groups, such as those with medulloblastoma, or according to treatment type. It is also needed that the validation study of pedsFACT-Br5 aged 7-12 parent form also has to be performed in near future.

Acknowledgements

This study was supported by a grant from the national R&D Program for Cancer Control, Ministry of Health, Welfare and Family affairs, Republic of Korea (No.0520300). All authors have read and approved the manuscript, and informed consent was obtained from the subject(s) and/or guardian(s).

References

1. Bhat SR, Goodwin TL, Burwinkle TM, Lansdale ME, Dahl GV, Huhn SL, et al. : Profile of daily life in children with BTs : an assessment of health-related quality of life. J Clin Oncol 23 : 5493-5500, 2005
2. Cella D : Manual of the functional assessment of chronic illness therapy (FACIT scales). Evanston, IL : Center on outcomes, research and education (CORE), Evanston Northwestern Healthcare and Northwestern University, 1997
3. Cho J, Choi JU, Kim DS, Suh CO : Low-dose craniospinal irradiation as a definitive treatment for intracranial germinoma. Radiother Oncol 91 : 75-79, 2009
4. Cronbach LJ : Coefficient alpha and the internal structure of tests. Psychometrika 16 : 297-334, 1951
5. Dawson J, Doll H, Coffey J, Jenkinson C : Oxford and Birmingham foot and ankle clinical research group : Responsiveness and minimally important change for the Manchester-Oxford foot questionnaire (MOXFQ) compared with AOFAS and SF-36 assessments following surgery for hallux valgus. Osteoarthritis Cartilage 15 : 918-931, 2007
6. Eysenck HJ, Eysenck SBG : Manual of the Eysenck Personality Questionnaire. London : Hodder & Stoughton, 1975
7. Gurney JG, Smith MA, Bunin GR : CNS and miscellaneous intracranial and intraspinal neoplasms, in Ries LAG, Smith MA, Gurney JG, et al. (eds.) : Cancer incidence and survival among children and adolescents : United States SEER program 1975-1995. Bethesda, MD : National Institute of Cancer, SEER program, 1999, pp 51-63
8. Hrchiching HA, Upton P, Cheung WY, Maddocks A, Eiser C, Williams JG, et al. : Development of a parent version of the Manchester-Minneapolis quality of life survey for use by parents and carers of UK children: MMQL-UK (PF). Health Qual Life Outcomes 6 : 19, 2008
9. Klasson A, Raina P, Reineking S, Dix D, Pritchard S, O’Donnell M : Developing a literature base to understand the caregiving experience of parents of children with cancer : a systematic review of factors related to parental health and well-being. Support Care Cancer 15 : 807-818, 2007
10. Korean Central Center Registry : 2002 Annual report of the Korea central cancer registry. Ministry of Health and Welfare. Republic of Korea, 2003, p107, p112
11. Lai JS, Cella D, Tomita T, Bode RK, Newmark M, Goldman S : Developing a health-related quality of life instrument for childhood brain tumor survivors. Childs Nerv Syst 23 : 47-57, 2007
12. Landgraf J, Abetz L, Ware J : Children Health Questionnaire (CHQ) : A user’s manual. Boston, MA : Health Institute, New England Medical Center, 1996
13. Lee HS, Eysenck HJ : The manual of the Eysenck Personality Questionnaire. Seoul : Hakjisa, 1997
14. Marinozzi A, Martinelli N, Panasci M, Cancilleri F, Franceschetti E, Vincenzi B, et al. : Italian translation of the Manchester-Oxford Foot Questionnaire, with re-assessment of reliability and validity. Qual Life Res 18 : 923-927, 2009
15. Norberg AL, Romner KK : Parent distress in childhood cancer : a comparative evaluation of posttraumatic stress symptoms, depression and anxiety. Acta Oncol 47 : 267-274, 2008
16. Nunally JC, Bernstein IR : Psychometric theory. Ed 3, New York, McGraw-Hill, 1994
17. Palmier SN, Meeske KA, Katz EK, Burwinkle TM, Varni JW : The Ped-SQ, Brain Tumor Module : initial and validity. Pediatr Blood Cancer 49 : 287-293, 2007
18. Patenaude AF, Kupst MJ : Psychosocial functioning in pediatric cancer. J Pediatr Psychol 30 : 9-27, 2005
19. Rentz AM, Matza LS, Secnik K, Swensen A, Revicki DA : Psychometric validation of the child health questionnaire (CHQ) in a sample of children and adolescents with attention-deficit/hyperactivity disorder. Qual Life Res 14 : 719-734, 2005
20. Russell KM, Hudson M, Long A, Phipps S : Assessment of health-related quality of life in children with cancer : consistency and agreement between parent and child report. Cancer 106 : 2267-2274, 2006
21. Schneider JW, Gurucharri LM, Gutierrez AL, Gaebler-Spira DJ : Health-related quality of life and functional outcome measures for children with cerebral palsy. Dev Med Child Neurol 43 : 601-608, 2001
22. Tao ML, Parsons SK : Quality of life assessment in pediatric brain tumor patients and survivors : lessons learned and challenged to face. J Clin Oncol 23 : 5424-5426, 2005
23. Warschburger P, Landgraf JM, Petermann F, Freidel K, et al. : Health related quality of life in children assessed by their parents : evaluation of the psychometric properties of the CHQ-PF50 in two German clinical samples. Qual Life Res 12 : 291-301, 2003
24. Wirrell E, Blackman M, Barlow K, Mah J, Hamiwka L : Sleep disturbances in children with epilepsy compared with their nearest-aged siblings. Dev Med Child Neurol 47 : 754-759, 2005
25. Yoo H, Kim DS, Shin HY, Lai JS, Cella D, Park HJ, et al. : Validation of the Pediatric Functional Assessment of Cancer Therapy Questionnaire (version 2.0) in brain tumor survivors aged 13 years and older. J Pain Symptom Manage 40 : 559-565, 2010
26. Yoo H, Ra YS, Park HJ, Lai JS, Cella D, Shin HY, et al. : Validation of pediatric functional assessment of cancer therapy : patient version 2 of “brain tumor survivor” for grade school patients aged 7-12 years. Qual Life Res : 2010 in press