Published in final edited form as:

Pediatr Phys Ther. 2008 ; 20(3): 247–253. doi:10.1097/PEP.0b013e318181a959.

The Relationship of Physical Activity to Health Status and Quality of Life in Cerebral Palsy

Kristie F. Bjornson, PhD, PT, Basia Belza, PhD, RN, Deborah Kartin, PhD, PT, Rebecca Logsdon, PhD, John McLaughlin, MD, and Elaine Adams Thompson, PhD, RN

Pediatrics/Genetics and Developmental Medicine (K.F.B., J.M.), Biobehavioral Nursing and Health Systems, School of Nursing (B.B.), Physical Therapy/Rehabilitation Medicine (D.K.), and Psychosocial & Community Health, School of Nursing (R.L., E.A.T.), University of Washington, Seattle, Washington; and Children's Hospital and Regional Medical Center, Seattle, Washington (K.F.B., J.M.)

Abstract

Purpose—To compare the influence of functional level, ambulatory, and physical activity performance on self-reported health status and quality of life (QOL) of youth with cerebral palsy (CP) and with typical development.

Methods—A cross-sectional comparison cohort design was used in 81 youth with CP, ages 10 to 13 years and 30 youth with typical development. Participants wore the StepWatch™ monitor for 7 days and completed the Activity Scale for Kids, Child Health Questionnaire-Child Form, and Youth Quality of Life Questionnaire. Multiple regression analysis was used.

Results—Self-reported activity performance influenced self-reported physical ($\beta = 0.36$), behavioral ($\beta = 0.32$), and emotional ($\beta = 0.29$) health. Functional level and performance did not influence QOL.

Conclusions—Measures of ambulatory and physical activity and youth-reported health status separated from the measure of QOL seem helpful in defining the specific health issues of ambulatory youth with CP and have implications for physical activity intervention.

Keywords

activities of daily living; adolescent; cerebral palsy/rehabilitation; child; cross-sectional studies; health status; human movement system; motor activity/physiology; motor skills disorders/physiopathology; walking/physiology; quality of life; questionnaires; self-concept

INTRODUCTION

Clinical and research outcome measures for walking activity include 3 dimensional gait analysis, energy cost measures, physical activity, and functional gross motor skill assessment. These are truly only measures of a youth's "capacity" to complete a task in a structured environment and do not sample what the youth actually do (performance) in their day-to-day lives. Rehabilitation therapies tend to address the impairments in body structure and function (ie, spasticity, decreased strength, and range of motion) associated with

Copyright © 2008 Section on Pediatrics of the American Physical Therapy Association.

Address correspondence to: Kristie F. Bjornson, Children's Hospital and Regional Medical Center, 4800 Sand Point Way NE, MPW8-1, Seattle, WA 98105. kristie.bjornson@seattlechildrens.org.

This work was completed by Dr. Bjornson as part of her doctoral program.

cerebral palsy (CP). Interventions for these impairments, such as physical therapy or injections, and orthopedic and neurological surgeries, may have the desired goal of improving walking activity and, as a result, overall health status, and quality of life (QOL). Such interventions are intended to improve a child's performance in their everyday lives. Before we can assess the efficacy or effectiveness of our current interventions to improve walking activity performance and potentially general health status and QOL of youth with CP, we must first determine the relationships of functional level and activity level (performance) to health status and QOL.

“Activities and participation” are 2 components of the International Classification of Functioning, Disability, and Health (ICF).¹ Activity is further defined within the ICF context as the execution of a task or action by an individual. The constructs of “capacity” and “performance” are proposed to measure the general component of activity. The completion of a task in a controlled environment such as the standardized functional motor tests administered by clinicians is considered “capacity.” The resultant data indicate what a child is capable of doing in a structured clinical setting. The completion of a task in the natural environment or what a person “really does” at home, school, or in the community is “performance.” A limited number of activity “performance” measures for youth with physical limitations exist. Evidence of significant differences between the parental perception of the functional level and performance of gross motor skills (ie, crawling and walking) in children with CP has been reported.² This discrepancy has significant implications for goal setting, documentation of intervention outcome, and subsequent decision making.

Cerebral palsy is a common, chronic disabling condition of childhood, occurring in 1.5/1000 to 3/1000 live births with a similar prevalence rate into adolescence and adulthood.³ A nonprogressive chronic condition, CP affects body movement and muscle coordination. The resulting impairments are thought to be due to faulty development and/or damage to the motor areas in the brain, which disrupt the brain's ability to control movement and posture. Often CP has a significant impact on a person's ability to carry out everyday life activities such as walking and self-care. Walking activity for youth with or without CP has traditionally been documented via activity capacity-based measures such as computerized 3 dimensional gait analysis, gross motor function tests, energy cost, and clinical gait analysis. A recent study using the StepWatch™ monitor to document daily walking activity in youth with mobility impairment because of CP compared with youth with typical development (TD) confirmed that daily ambulatory activity performance decreased as functional level decreased.⁴

The impact of mobility restrictions on daily life in children with CP is unclear, but it is generally believed that activity limitations are associated with less than optimal QOL. The World Health Organization (WHO) defines QOL as a “person's perceptions of their position in life in the context of the culture and value system in which they live, and in relation to their goals, expectations, standards, and concerns.”^{5,6} The major policy goals of Healthy People 2010 support improving QOL for youth with CP and this is reflected in a recent NIH program announcement for the study of QOL issues in persons with mobility limitations.⁷

Historically, health and/or QOL in youth with CP has been assessed by parental report combining the constructs of “health” with “QOL” with the nomenclature of health-related quality of life (HRQL). Often referred to as “QOL” or “HRQL,” the Child Health Questionnaire (CHQ) actually focuses on perceptions of functional-based health status.⁸ In one study of children with moderate to severe CP using the CHQ, Liptak et al⁹ showed that caregivers reported their children's general and physical health lower than a normative sample. Four CHQ dimensions—pain, physical functioning, physical summary scores, and

impact on parents—were significantly lower than the norms. These results suggest that the caregiver-reported health status is influenced by the child's medical condition and that lower CHQ scores are associated with increased severity of motor function among children with CP. A strong association between caregiver-reported functional ambulatory health status and motor impairment has also been observed. Caregivers of 408 school-aged children tended to decrease their ratings of child health status as walking impairment increased.¹⁰ Although parental report provides valuable information regarding QOL of children and youth with CP, little is known about how the youth themselves perceive and report their own QOL. Because QOL is a subjective construct, it is also important to have youth with CP rate their QOL for themselves and to self-report issues that are important to their QOL.⁸ A recent geographically defined population study documented family assessment activities and participation of youth with CP in the United Kingdom.¹¹ Using the Lifestyle Assessment Questionnaire for CP, the authors suggest that physical independence and mobility strongly predict the functional movement level [Gross Motor Function Classification System (GMFCS)] for 129 youth/families, ages 6 to 12 years.

Healthcare providers have a vested interest in the relationship between clinical indicators of disability and the care recipient's QOL. Indeed, the primary purpose of treatment is to improve QOL by identifying and implementing interventions that maximize QOL while minimizing “costs” such as pain, adverse side effects, monetary costs, and time. This study explored the influence of ambulatory functional level and performance on self-reported health status and QOL of youth with CP compared with a comparison cohort of youth with TD. To control for the social and environmental factors that influence the WHO definition of QOL, a matched cohort was selected for comparison rather than a “normative” sample.^{5,6} The conceptual model (developed from the ICF) for this project (Fig. 1) suggests that activity performance and functional level will have direct effects on self-reported health status and on general QOL. How a child feels about life on the day he/she self-reports is proposed to have a direct influence as well. It was hypothesized that activity performance would be positively associated with health status and QOL in youth with and without CP. A second hypothesis was that the strength of associations of activity performance and health status would be ordered by functional level as measured by the GMFCS such that youth with TD > Level I > Level II > Level III.¹² That is, it was anticipated that the strength of the relationship between activity performance and health status would be linked to the level of function. In contrast, a third hypothesis was that QOL would not be ordered by functional level.

METHOD

Participants

The study sample included 111 children and their parents, including 81 youth with CP and a comparison group of 30 youth with TD. Inclusion criteria for the youth with CP included age 10 to 13 years, GMFCS Levels I-III, and ability to read and understand at the 10-year age level as confirmed by the Wide Range Achievement Test-3 reading subtest.^{12,13} The inclusion criteria for youth with TD were age 10 to 13 years, matched gender of a participant with CP, and a minimum of a 10-year-old reading ability. Participants were excluded if they had a history of (a) fracture/sprain/strain injury of the lower extremities in the past 6 months; (b) neurological or orthopedic surgery in the last 12 months; (c) exercise-induced asthma; (d) a congenital heart defect with cardiac compromise; and/or (e) an uncontrolled seizure disorder. Demographic data are summarized in Table 1. Of the 30 youth with TD, 15 were siblings of the participants with CP.

Measurement

The instruments used in this study are described briefly below. Their psychometric properties and protocols for scale calibration have been published elsewhere^{4,14} along with details of the data collection procedures. Participants with CP were categorized by GMFCS Levels I to III for functional level.¹² Functional sitting, walking abilities, and need for assistance were used to classify functional level per GMFCS protocol. For ambulatory activity performance the variety of step activity (walking) within the context of daily life was measured with the StepWatch accelerometer.¹⁵ StepWatch data were collected over a 7-day period and average daily step counts were calculated. The Activities Scale for Kids (ASK), a self-report measure of childhood physical performance (ASKp38-performance version) for youth aged 5 to 15 years,¹⁶ was used to query what the youth “usually does” taking into account the environment in which the child functioned in the past 7 days. The Child Health Questionnaire child form (CHQ-CF87) was administered to ascertain self-reported health status. The CHQ is a generic norm-referenced child health status instrument. The CHQ-CF87 consists of the following 11 subscales: role/social emotional, role/social behavioral, role/social physical, bodily pain, family activities, family cohesion, physical function, behavior, general health, self-esteem, and mental health.¹⁷ The Youth Quality of Life Instrument-Research Version (YQOL-R) was administered to assess the youth's self-reported QOL. The YQOL-R assesses the 4 perceptual domains of total QOL, sense of self, social relationships, culture/community environment, and general QOL.⁸

Gender, age, socioeconomic status (SES), and Current Day Outlook were collected. An SES proxy was scaled using the consenting parent's education level. Current Day Outlook, which was used to evaluate the participant's life perception on the day the questionnaires were completed, was measured by the global single question “How do you feel about your life today?” and was scored on a 7-point Likert scale from (1) “terrible” to (7) “delighted.”¹⁸

Procedures

Detailed study procedures have been described elsewhere.^{4,14} Potential participants were approached using a focused mailing to youth with CP seen in the last 5 years at 3 regional specialty children's hospitals in the Pacific Northwest. Participants and their parent/legal guardian completed written informed assent/consent per approval of the Institutional Review Board of the recruitment agencies. Reading level ability was confirmed by the Wide Range Achievement Test-3 reading subtest during the informed assent/consent process. Participants completed the Current Day Outlook measure, the CHQ-CF87, and the YQOL-R at a home-based research visit. Step data from the StepWatches were downloaded at a second visit or when the monitor was returned to the investigator by mail. The participants completed the ASKp38 on the last day the StepWatch was worn to obtain an overall assessment of the child's physical activity during the past week. For consistency, data collection occurred only during months when school was in session. Three dimensions of health status were constructed as measures of physical health, behavioral health, and emotional health based on the 3 major constructs measured by the CHQ. As there are no summary scales validated and/or published for the CHQ-87, for this analysis, physical health was defined as the mean of 4 CHQ subscales: physical function, role/social physical, general health, and bodily pain. Behavior health was defined as the mean of 2 subscales: role/social behavioral and the behavioral subscales. Emotional health was the mean of 3 CHQ subscales: role/social emotional, self-esteem, and mental health.

Analysis Plan

Descriptive statistics were used to summarize demographic data; between group differences were analyzed using a one-way analysis of variance for continuous variables and chi-square for categorical variables. The relationship between the StepWatch data and the 11 CHQ

subscales were explored using Spearman correlation coefficients. Subsequently, multiple regression techniques were used to explore the effects of functional level and activity performance on self-reported health status and general QOL.

Initial correlational analysis revealed that activity performance measured by average step/day (StepWatch) was positively associated with only 2 of 11 CHQ subscales [Physical Functioning ($b = 0.002$, $\beta = 0.20$, $p < 0.05$), and Role/Social Behavior ($b = 0.002$, $\beta = 0.25$, $p < 0.01$)]. StepWatch activity performance was not associated with YQOL-R scores. Because the ASKp38 variable was significantly correlated with more health dimensions than Step-Watch, the ASKp38 (but not the StepWatch) was used as the measure of activity performance in the regression analyses.

Multiple regression techniques were used to explore the effects of functional level and activity performance on self-reported health status and general QOL. Regression analyses were initially conducted with age, gender, and SES as control variables, but none of these variables influenced either of the health status dimensions or QOL, and thus were removed from subsequent analyses. The results reported describe the direct effects of Current Day Outlook, activity performance, and functional level (GMFCS Levels I-III compared with youth with TD) on physical, behavioral, and emotional health and on general QOL. General QOL was defined by the YQOL domain. Thus, 4 separate regression analyses were conducted to test the hypothesized predictors of each of the 4 dependent variables: physical, behavioral and emotional health, and QOL.

RESULTS

Description of the Sample

Study participants with CP were also categorized by GMFCS Level ($n = 31$ for Level I, $n = 30$ for Level II, and $n = 20$ for Level III). The mean age was 11.8 years for youth with CP ($n = 81$) and 11.9 years for youth with TD ($n = 30$, Table 1). Forty-eight percent of the youth with CP were female compared with 50% of the youth with TD. The youth with TD group was 83.3% white compared with 77.8% of the group with CP. Educational level of the parents or a legal guardian was slightly greater for the youth with CP (39.5% vs 26.7%). The average Current Day Outlook for the 2 groups was 5.6 (CP) and 5.8 (youth with TD). No significant differences were found between the youth with CP compared with the youth with TD on any demographic variable.

Regression Analysis

The results of the regression of Current Day Outlook, activity performance (ASKp38), and level (GMFCS Levels I-III compared with youth with TD) on self-reported QOL and physical, behavioral, and emotional health status are summarized in Table 2. Each represents 4 independent regression analyses (1 for each health status dimension and 1 for QOL). Regression results for each of the functional levels (GMFCS Levels I-III) represent a comparison of one GMFCS functional level with youth with TD as the comparison referent group. Across all analyses, self-reported activity performance was positively correlated with self-reported physical ($\beta = 0.36$), behavioral ($\beta = 0.32$), and emotional ($\beta = 0.29$) health supporting the primary hypothesis. Compared with youth with TD, functional Levels I and II (GMFCS) were associated with significantly lower self-reported physical health $\beta = -0.22$ and $\beta = -0.25$, respectively. Youth in Level I (GMFCS), compared with the youth with TD sample, reported lower levels of emotional health ($\beta = -0.22$). None of the functional levels compared with youth with TD were associated with reported behavioral health, thus the secondary hypothesis was not consistently supported for health status.

Current Day Outlook was positively associated with physical health ($\beta = 0.25$), behavioral health ($\beta = 0.33$), and emotional health ($\beta = 0.42$) and was the only significant predictor of general QOL ($\beta = 0.54$) in the regression analysis. None of the functional levels (GMFCS Levels I-III) or activity performance (ASKp38) influenced self-reported general QOL. Thus, none of the hypotheses were supported for QOL. The functional level and activity performance variables explained approximately 24% of the variance in physical health, 20% of behavioral health, 28% of emotional health, and 34% of QOL in this regression model (Table 2).

DISCUSSION

How the participants felt about their life on the day they completed the questionnaires (Current Day Outlook) seems to have had a greater positive influence on their self-reported general QOL than any of the health status dimensions. Current Day Outlook also appears to have had a greater positive influence on emotional health than activity performance or functional level. Activity performance had a positive influence on physical, behavioral and emotional health as defined for this model development. The effects of functional level (GMFCS) compared with youth with TD suggest lower self-reported physical and emotional health for some GMFCS levels. Functional level (GMFCS levels) did not seem to influence behavioral health as defined for these models.

This study investigated the influence of functional level and ambulatory and physical activity performance on self-reported health status and QOL of youth with CP compared with youth with TD. This is the first published study to examine the association between ambulatory activity performance, self-reported physical activity performance, functional level, and self-reported health status separated from QOL in youth with CP compared with a comparison cohort. Actual walking activity (StepWatch data), as hypothesized and clinically expected, was positively associated with self-reported physical function and behavior in social situations. Walking activity (StepWatch data) was not associated with self-reported QOL. Previous studies describing function and well-being in ambulatory children with CP have used parental report and functional measures that were capacity based.¹⁹ Pirpiris et al¹⁹ reported no relationship between a child's motor function and their psychosocial well-being per parental report. This study documents the direct positive influences of self-reported activity performance on behavioral and emotional health. In addition, functional level (GMFCS Level I) was associated with negative influences on emotional health compared with a youth with TD sample. These contrasting outcomes may be due to the use of an assessment that relied on a performance-based functional measure (ASKp38), self-report versus parental report and/or the comparability of the comparison sample.

The results of this comparison cohort study are consistent with a population-based study of QOL and HRQL conducted in Ontario, Canada.²⁰ Using the self-report QOL instrument for People with Developmental Disabilities, the authors found inconsistent ordered effects of functional level for the domains of being, belonging, becoming, or overall QOL. In comparison, the mean scores for the domains of ambulation and overall HRQL (as measured by the Health Utilities Index, Mark 3, or HUI3) decreased as functional skill level decreased. A recent cross-sectional European study also reported that QOL was not associated with severity of impairment in the domains of psychological well-being, self-perception, social support, school environment, financial resources, and social acceptance.²¹ This European study documented lower self-reported QOL for youth with the most walking impairment. Lower QOL was also associated with poorer physical well-being, intellectual impairment, lower mood levels, decreased autonomy, speech difficulty, and with poorer relationships with parents.

Varni et al²² documented self-reported HRQL in 69 children and adolescents with CP ages 5 to 18 years across functional levels using the Pediatric Quality of Life Inventory Version 4.0 (PedsQL 4.0). In their sample, the authors demonstrated significantly lower HRQL levels in physical function, self-reported emotional, social, and school function compared with the normative sample. The data presented in this article suggest positive associations between self-reported activity performance and physical, behavioral, and emotional health (Table 2). Also, the analysis suggests that only the youth at GMFCS Level I perceive negative influences on their emotional health compared with an age-matched and gender-matched sample of youth with TD. No reported difference in behavioral health was noted compared with the youth with TD, whereas Levels I and II perceive negative influences on physical health.

The measurement of health status separate from QOL may be clinically helpful in discerning the physical, behavioral, and emotional health issues of ambulatory youth with CP. These findings, in contrast to recently published parental and self-reported HRQL, suggest that the construct of health status alone as opposed to one compounded with QOL (as in the HRQL) may be more sensitive to the specific health issues (ie, physical, behavioral, and emotional) influenced by the youths' activity limitations.

It is not surprising to find that the Current Day Outlook strongly correlated with self-reported health status and QOL. As general QOL was measured with the YQOL, these results are thus consistent within the context of the WHO definition of QOL based on a person's perceptions of their position in life in the context of the culture and value system in which they live, and in relation to their goals, expectations, standards, and concerns.^{5,6} How a person feels about his or her life on the day he/she completes a QOL questionnaire should be highly associated with general QOL.

The limitations in physical activity noted in youth with CP are intuitively thought to be related to decreased function and psychosocial well-being by clinicians. This was recently confirmed in a population-based study of adolescent health and reported satisfaction with life.²³ Physical health was positively and highly associated with reported life satisfaction for over 4000 adolescents, 13 to 18 years of age on the Centers for Disease Control and Prevention health survey. The influence of activity performance (ASKp38) on self-reported health status reported here supports the above clinical premise and Centers for Disease Control and Prevention life satisfaction results, whereas the QOL results do not. In contrast to the positive association of physical health to life satisfaction noted earlier, functional level for the highest functioning youth with CP (GMFCS Levels I and II) compared with youth with TD was negatively associated with physical health. Youth at GMFCS Level I, when compared with youth with TD, self-reported poorer emotional health. This relationship is consistent with the population-based study of Witt et al,²⁴ which documented functional activity limitations as a significant correlate of psychosocial adjustment among children with broad disabilities. Children with mild limitations in physical activity and participation may have a greater awareness of what may seem to others as relatively small difference between themselves and the youth with TD.

This study has a number of important implications for clinical practice. First, self-report of health status and QOL is feasible in youth with CP with a reading comprehension of 10 years of age. Second, results about specific health status (physical, behavioral, and emotional) issues suggest that they might influence mobility interventions and/or outcomes. Third, the results suggest that measuring health status alone versus HRQL may be more sensitive to some health issues reported by ambulatory youth with CP. Fourth, interventions aimed at specific functional levels (GMFCS) in youth with CP may not consistently affect self-reported health status issues given the negative influences found by regression analysis.

The findings also suggest that activity/mobility interventions may not affect or influence self-reported general QOL at all. Interventions to enhance activity performance and mobility should be evaluated using performance-based outcomes to have the greatest potential to capture intervention effects on health status. Performance-based outcome measures require sampling during an individual's daily life experiences and thus have the greatest potential for association with health experiences.

The lack of activity performance influence on general QOL suggests that there are other factors influencing perceptions of QOL. The Theory of Subjective Well-being Homeostasis may provide a framework for interpreting these observations.^{25,26} This theory proposes that self-reported QOL is actively maintained and controlled by the cognitive factors of self-esteem, reported control, and optimism. These factors influenced by personality are typically held in a relatively positive state and allow interpretation of life experiences that are self-serving to the individual. This interaction of factors allows people to maintain a positive sense of their well-being despite living with significant challenges such as limitations in walking skills. The lack of ordered strength of association between the GMFCS Level and the health status documented in these results and other projects using generic measures of "QOL" supports the Theory of Subjective Well-being Homeostasis as the individual factors noted above interact for greater influence than the functional level.²¹

The lack of relationship between self-reported activity performance and general QOL supports the WHO definition that QOL is a global construct relative to health status.^{5,6,27} The WHO general definition of QOL is a person's perceptions of their position in life in the context of the culture and value system in which they live, and in relation to their goals, expectations, standards, and concerns. As Patrick and Chang²⁷ have proposed, these results support the view that QOL is a broader construct than health status and may not be an appropriate outcome measure for specific health interventions such as physical therapy for mobility impairments or limitations.

Noted limitations of this study and future research needs warrant discussion. The relatively small sample size is likely to produce unstable estimates of association. The cross-sectional design precludes testing for causality of effects. The data only describe associations of the activity variables on self-reported health status and QOL. All measures were collected at the same time, except for the Step-Watch and the ASKp38. A longitudinal study would be needed for "prediction" of health status and QOL from activity performance.

To examine constructs such as activity, participation (ICF components), health status, or HRQOL, future researchers need to explore the factors and/or interventions that contribute to activity performance in youth growing up with CP. Such information will be of benefit to youth with CP, their families, and clinicians in treatment decision making throughout the lifespan.²⁸ Replication of this study with a population-based sample is needed to confirm and expand the above findings. A longitudinal follow-up of this study sample into adulthood would be helpful in confirming and interpreting the results relative to the stability of the documented perceptions of health, Current Day Outlook, and QOL as it relates to physical functioning on a daily basis. The inclusion of "participation" measures (ICF) would clarify the influences of physical activity on participation in daily life, health status, HRQL, and/or QOL.

CONCLUSIONS

This study supports the use of self-reported health status, physical activity, and QOL measures in youth with ambulatory CP. The findings provide preliminary development of a conceptual framework for testing the efficacy of current interventions for mobility

impairments associated with CP. The results and similar population-based studies^{20,21} lay the foundation for a longitudinal study of functional level and performance, health status, and QOL of persons with CP as they develop from childhood and into adulthood.

Acknowledgments

Recruitment and technological support was provided by Children's Hospital & Regional Medical Center, Seattle, WA; Madigan Army Medical Center, Tacoma, WA; and the Shiner's Hospital for Children, Portland, OR and Spokane, WA. Major Robert Miller supported data collection and provided consultation support.

Grant support: Supported by partial funding from the Rehabilitation Science Training Grant T32 HD07424, National Research Scientist Award (NRSA) and NINDS F31-NS048740, Hester McLaws Nursing Scholarship at School of Nursing, University of Washington, Seattle, WA.

REFERENCE

1. World Health Organization. International Classification of Functioning, Disability and Health (ICF). World Health Organization; Geneva: 2002.
2. Tieman B, Palisano R, Gracely E, et al. Gross motor capability and performance of mobility in children with cerebral palsy: a comparison across home, school and outdoors/community settings. *Phys Ther.* 2004; 84:419–429. [PubMed: 15113275]
3. Stanley, F.; Blair, E.; Alberman, E. How common are the cerebral palsies?. In: Stanley, F.; Blair, E.; Alberman, E., editors. *Cerebral Palsies: Epidemiology and Causal Pathways*. MacKeith Press; London: 2000. p. 22-39.
4. Bjornson KF, Belza B, Kartin D, et al. Ambulatory physical activity performance in youth with cerebral palsy and youth who are developing typically. *Phys Ther.* 2007; 87:248–257. [PubMed: 17244693]
5. World Health Organization Quality of Life Group. The development of the World Health Organization Quality of Life assessment instrument (WHOQOL).. In: Orley, J.; Kuyken, W., editors. *Quality of Life Assessment: International Perspectives*. Springer-Verlag; Berlin: 1994. p. 41-57.
6. Bonomi A, Patrick DL, Bushnell DM, et al. Validation of the United States' version of the World Health Organization Quality of Life (WHOQOL) instrument. *J Clin Epidemiol.* 2000; 53:19–23. [PubMed: 10693899]
7. U.S. Department of Health and Human Services. *Healthy People 2010*. Government Printing Office; Washington, DC: 2000. With understanding and improving health and objectives for improving health..
8. Edwards TC, Heubner CE, Connell FA, et al. Adolescent quality of life, Part I: Conceptual and measurement model. *J Adolesc.* 2002; 25:275–286. [PubMed: 12128038]
9. Liptak G, O'Donnell M, Conaway M, et al. The health status of children with moderate to severe cerebral palsy. *Dev Med Child Neurol.* 2001; 43:364–370. [PubMed: 11409824]
10. Kennes J, Rosenbaum P, Hanna SE, et al. Health status of school-aged children with cerebral palsy: information from a population-based sample. *Dev Med Child Neurol.* 2002; 44:240–247. [PubMed: 11995892]
11. Morris C, Kurinczuk J, Fitzpatrick R, et al. Do the abilities of children with cerebral palsy explain their activities and participation? *Dev Med Child Neurol.* 2006; 48:954–961. [PubMed: 17109782]
12. Palisano, R.; Rosenbaum, P.; Walter, S., et al. *Gross Motor Function Classification System* [pamphlet].. Neurodevelopmental Clinical Research Unit at McMaster University; Ontario, Canada: 1995.
13. Wilkinson, GS. [October 15, 2007] *Wide Range Achievement Test (WRAT-3)*. [online] 2005 January 1.. Available at: <http://www3.parinc.com/products/product.aspx?Productid=WRAT3>.
14. Bjornson KF, Belza B, Kartin D, et al. Self-reported health status and quality of life in youth with cerebral palsy and typically developing youth. *Arch Phys Med Rehabil.* 2008; 89:121–127. [PubMed: 18164341]

15. Cyma Inc.. Make every step count StepWatch3TM. Cyma Inc; Jan 5. 2006 Available at: <http://www.cymatech.com>.
16. Young N, Williams JI, Yoshida KK, et al. Measurement properties of the Activities Scale for Kids. *J Clin Epidemiol*. 2000; 53:125–137. [PubMed: 10729684]
17. Landgraf, J.; Abetz, L.; Ware, JE. The CHQ User's Manual. The Health Institute, New England Medical Center; Boston: 1996.
18. Lehman AF. A quality of life interview for the chronically mentally ill. *Eval Program Plann*. 1988; 11:51–62.
19. Pirpiris M, Gates PE, McCarthy JJ, et al. Function and well-being in ambulatory children with cerebral palsy. *J Pediatr Orthop*. 2006; 26:119–124. [PubMed: 16439915]
20. Rosenbaum P, Livingston M, Palisano R, et al. Quality of life and health-related quality of life of adolescents with cerebral palsy. *Dev Med Child Neurol*. 2007; 49:519–521.
21. Dickenson H, Parkinson K, Ravens-Sieberer U, et al. Self-reported quality of life of 8–12 year-old children with cerebral palsy: a cross-sectional European study. *Lancet*. 2007; 369:2171–2178. [PubMed: 17604799]
22. Varni JW, Burwinkle T, Sherman S, et al. Health-related quality of life of children and adolescents with cerebral palsy: hearing the voices of children. *Dev Med Child Neurol*. 2005; 47:592–597. [PubMed: 16138665]
23. Zullig KJ, Valois RF, Heubner ES, et al. Adolescent health-related quality of life and perceived satisfaction with life. *Qual Life Res*. 2005; 14:1573–1584. [PubMed: 16110937]
24. Witt WP, Riley AW, Coiro MJ. Childhood functional status, family stressors, and psychosocial adjustment among school-aged children with disabilities in the United States. *Arch Pediatr Adolesc Med*. 2003; 157:687–695. [PubMed: 12860792]
25. Cummins, RA.; Gullone, E.; Lau, ALD. A model of subjective wellbeing homeostasis: the role of personality.. In: Gullone, E.; Cummins, RA., editors. *The Universality of Subjective Wellbeing Indicators: A Multi-Disciplinary and Multi-National Perspective*. Kluwer Academic Publishers; Boston: 2002. p. 7-46.
26. Cummins RA, Nistico H. Maintaining life satisfaction: the role of positive cognitive bias. *J Happiness Stud*. 2002; 3:37–69.
27. Patrick DL, Chiang Y. Measurement of health outcomes in treatment effectiveness evaluations. *Med Care*. 2000; 38(Suppl 9):II14–25. [PubMed: 10982087]
28. Campbell SK. Therapy programs for children that last a lifetime. *Phys Occup Ther Pediatr*. 1997; 17:1–15.

Fig. 1.
Conceptual model for regression analysis of the influence of activity performance and functional level on self-reported health status and quality of life.

TABLE 1

Characteristics of the Sample (N = 111)

Youth Characteristics	Youth With Cerebral Palsy	Youth With Typical Development	<i>p</i> [*]
N	81	30	
Age, mean (SD)	11.8 (1.3)	11.9 (1.2)	0.98
Male, n (%)	42 (52)	15 (50)	0.86
Gross Motor Function Classification, n			
Level I	31	N/A	N/A
Level II	30	N/A	N/A
Level III	20	N/A	N/A
Race, n (%)			
White	63 (77.8)	25 (83.3)	0.78
Hispanic	8 (9.9)	1 (3)	
Asian	5 (6.2)	3 (10)	
Black	3 (3.7)	1 (3)	
Other	2 (2.4)	01	
Socioeconomic status of parents/guardians			
Vocational school/college, n (%)	32 (39.5)	8 (26.7)	0.18
Current Day Outlook, mean (SD)	5.6 (1.4)	5.8 (1.2)	0.53

* Level of significance was determined by one-way analysis of variance for continuous variables and chi-square for categorical variables.

TABLE 2

Regression Analysis of Activity Performance, Functional Levels, and Current Day Outlook on Self-reported Quality of Life and Physical, Behavioral, and Emotional Health Status

Predictor Variables	Dependent Variables							
	General Quality of Life		Physical Health		Behavioral Health		Emotional Health	
	<i>b</i>	β	<i>b</i>	β	<i>b</i>	β	<i>b</i>	β
Activity performance	0.21	0.17	0.29 *	0.39 *	0.38 *	0.38 *	0.22 †	0.29 †
Functional level								
GMFCS level I	-6.7	-0.15	-5.9 †	-0.22 †	-6.5	-0.18	-6.5 †	-0.22 †
GMFCS level II	-0.22	-0.005	-7.0 †	-0.25 †	-3.5	-0.10	-3.3	-0.11
GMFCS level III	5.4	0.10	-0.33	-0.01	8.7	0.20	5.1	0.14
Current Day Outlook	8.1 †	0.54 †	2.4 *	0.25 *	4.1 †	0.33 †	4.4 †	0.42 †
<i>R</i> ² (variance)	0.34		0.24		0.20		0.28	

Activity performance was measured with the Activities Scale for Kids (ASKp38). Functional level regression was coded by Gross Motor Function Classification System (GMFCS) levels for the youth with cerebral palsy, with youth with typical development as the referent group (dummy variable). General quality of life was measured with the Youth Quality of Life Instrument. Physical, behavioral, and emotional health status were measured with the Child Health Questionnaire.

* $p < 0.01$

† $p < 0.05$

‡ $p < 0.001$; *b*, unstandardized; β , standardized.