Validity And Reliability of A Chinese-translated Perceived Exertion Scale for Children: The Children's Effort Rating Table (CERT)

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The objective of the study was to examine the validity and reliability of the Chinese-translated Children's Effort Rating Table (CERT) during continuous incremental cycle ergometry in Hong Kong school children aged 10 to 11 years. Children (N = 41) performed two trials of identical incremental cycling exercise (trial 1 and 2) one week apart. The objective measures of exercise intensity (heart rate, absolute power output, and relative oxygen consumption) and the subjective measure of effort (CERT scores) were obtained during incremental bicycle ergometric exercise. Regarding the validity of the CERT, significant (p < .01) positive Pearson's interclass correlations were found when the CERT scores were correlated with heart rate (rs .86), absolute power output (rs >= .89), and relative oxygen consumption (rs >= .85). Regarding the reliability of the CERT, high test-retest intraclass correlations were found (Rs >= .90) suggesting that the consistency between trials was high. To conclude, the Chinese-translated version of the CERT appears to be a valid and reliable measure of exercise intensity during controlled exercise in preadolescent children. Future studies are recommended to examine integratively the validity and reliability of both the CERT and the Borg's rating of perceived exertion (RPE) scale in their respective Chinese-translated versions.

The rating of perceived exertion is a measure of exercise intensity, which corresponds to the overall perception of effort during physical exertion (Borg, 1985). The best known and most commonly-used instrument for measuring perceived effort is the Borg 6-20 Rating of Perceived Exertion (RPE) scale (Borg, 1970, 1985). The RPE scale is based on the principle that an individual can monitor the sensations of strains in joints, muscle, and cardiopulmonary system during physical exertion, and can interpret these subjective feelings in numerical forms (Borg, 1985). For instance, a numerical rating of 8 is “extremely light”, 13 is “somewhat hard”, and 20 is “maximal exertion”. Based on the conceptual model of the RPE scale (Borg, 1980), multiplying a rating by 10 provides an estimation of heart rate at a particular level of physical exertion (i.e. heart rate = 10 \times \text{RPE}).

Over the past 30 years, research on the applicability of the RPE scale for measuring exercise intensity in adults has been abundant. Recent RPE-related research has extended into addressing the ability of children to perceive accurately the actual and changing levels of exercise intensity. Williams, Furlong, Hockley, and Mackintosh (1993) suggested that children might not have the cognitive ability to use the RPE scale. Other researchers claimed that children tend to underrate exercise intensity using the RPE scale (Bar-Or, 1977; Bar-Or & Ward, 1989; Lamb, 1995). Miyashita, Onodera, and Tabata (1986) further suggested that there might be a critical age under which children could not use the scale effectively and correctly. Correlations (Pearson's r) between RPE and objective measures of exercise intensity (heart rate, power output, and oxygen consumption) were found to be in the range of .45 to .88 among children aged seven years and above during continuous incremental exercise tests (Alekseev, 1989; Bar-Or, 1977; Bar-Or & Reed, 1986; Eakin, Finta, Serwer, & Beekman, 1992; Eston & Williams, 1986; Gillach, Sallis, Buono, Patterson, & Nader, 1989; Lamb, 1995; Miyashita et al., 1986; Ward, Blimkie, & Bar-Or, 1986). Such inconsistencies in using the RPE scale have prompted the suggestion that a child-specific effort rating scale be proposed to provide more meaningful expressions of effort than the RPE scale (Bar-Or & Ward, 1989; Lamb, 1995; Ward, Jackman, & Galiano, 1991; Williams, Eston, & Stretch, 1991).

A recently devised Children's Effort Rating Table (CERT) has emerged to provide an alternative of the RPE scale for children (Eston, Lamb, Bain, Williams, & Williams, 1994; Williams, Eston, & Furlong, 1994). The CERT is a 1-10 effort perception scale with verbal...
expressions accompanying all 10 numbers. The CERT was derived with developmentally appropriate verbal language and the numerical scale was thought to be better for use by children (Eston et al., 1994; Williams et al., 1994). Compared with the RPE scale, the CERT has 5 fewer possible responses and a shorter scale (1-10) as opposed to the 6-20 scale in RPE. Several studies have indicated that the CERT was a valid and reliable indicator of exercise effort in children (Eston et al., 1994; Lamb, 1995; Williams et al., 1993, 1994). Significant positive relationships between CERT and objective measures of exercise intensity were found with rs ranging from .69 to .99 in children aged five to nine years during incremental stepping exercise (Williams et al., 1993, 1994), and in children aged eight to eleven years during incremental cycle ergometry (Eston et al., 1994; Lamb, 1995).

Research on the rating of perceived exertion was quite extensive; however, to the knowledge of the present investigators, no research has yet been conducted to examine the validity and reliability of the CERT in the Chinese translated version. Therefore, there exists considerable scope to examine whether the concept and usefulness of perceived exertion are appropriate when the CERT is translated into another language. Cultural differences may influence the effort perception of an individual. The present study was therefore designed to examine the validity and reliability of the Chinese-translated CERT during controlled exercise among Hong Kong preadolescent children.

**Key Words:** Perception, workload, intensity, testing.