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ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

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Development of the Greek Manual Ability Classification System for children with cerebral palsy

OBJECTIVE **Cross-cultural adaptation and testing of the reliability of the Greek version of the Manual Ability Classification System (MACS) in children with cerebral palsy (CP).** METHOD **In the first step, the Greek translation was produced according to international guidelines. The second step included the test-retest and inter-rater reliability between therapists and parents, using the intraclass correlation coefficient (ICC). The association was then investigated, using Spearman's rank correlation coefficient (r_s), of the Greek MACS with the Gross Motor Function Classification System (GMFCS) for a pediatric population with CP in Greece. Specifically, 66 children with CP, aged 4–18 years, were recruited for the study.** RESULTS **The translation process was performed with no difficulty. The Greek version of the MACS was shown to have excellent test-retest reliability for both therapists (ICC=0.99, p<0.0001) and parents (ICC=0.97, p<0.0001). The inter-rater reliability between therapists and parents was also excellent (ICC=0.92, p<0.0001). The Greek version of the MACS showed strong correlation with the GMFCS (r_s=0.65–0.66, p<0.0001).** CONCLUSIONS **The Greek version of the MACS is highly reliable, and can now be used with confidence in everyday clinical practice by therapists and with parents, to classify and evaluate children with CP in the Greek population.**

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Ανάπτυξη του ελληνικού συστήματος ταξινόμησης ικανότητας χειρισμού αντικειμένων σε παιδιά με εγκεφαλική παράλυση

Περίληψη στο τέλος του άρθρου

Cerebral palsy (CP) is, internationally, the most frequent cause of childhood neuromotor disability.[1] The birth prevalence of CP in the Greek metropolitan area of Athens is about two per 1,000 live births, similar to that reported in the rest of Europe.[1] CP is not a specific disease entity, but rather a collective term, which describes a group of permanent disorders of movement and posture, due to non-progressive disturbances of the developing central nervous system (CNS).[2] Three in 4 children with CP have difficulties with upper limb function,[3] decreasing their potential to be independent and to perform common activities of daily living, such as eating, dressing, playing and writing.

In addition to the Gross Motor Function Classification System (GMFCS),[4] which is widely deployed internationally for classifying gross motor function, in combination with pathophysiological and topographical distribution, the Manual Ability Classification System (MACS) is also available for evaluation of CP. Based on the concept of the GMFCS, the

MACS is a simple five-level, ordinal grading system, created to classify fine motor ability of children with CP in the age range of 4–18 years, meeting European and international criteria.[2] It describes what the children actually do in their daily life, e.g., grasp and handle objects using their hands (performance), and not what children can do at their best (capacity).[5] The MACS, like the GMFCS in the domain of loco-motion, was developed to replace the obsolete, empirical and invalid terms "mild", "moderate" and "severe" impairment.[4,5] It was designed to evaluate overall manual ability, not the function of each hand separately. The MACS is administered by a physician or a therapist (occupational or physical) via direct observation[6] and or by semi-structured interview with a caregiver (parent or other person who knows the child well) or with the child him- or herself, based on the MACS brochure and level identification chart. It can also be completed by the parent, following instruction.

The MACS is an internationally reliable and valid system, which has been established globally as a key tool in the process of classifying and evaluating children with CP. Its original version has been found to have excellent inter-rater reliability among clinicians, and between parents and clinicians, and has good construct validity.[5,6] The MACS has already been translated into many languages, demonstrat-ing comparable good results.[7–11]

The MACS is extensively used in research and clinical practice,[12–14] together with GMFCS, to provide a common, valid language for enhancing communication between clinicians and caregivers when describing a child's motor function, and for setting goals and making decisions.[2] Until now, the MACS had not been officially translated and adapted into the Greek language.

The purpose of this study, therefore, was to translate and adapt the Greek version of the MACS cross-culturally, and to test its reliability in the Greek population.

MATERIAL AND METHOD

Design

The study consisted of two steps. First, the transcultural trans-lation of the English MACS into Greek, and second, evaluation of the test-retest and inter-rater reliability between therapists and parents of the final version, and correlation with Greek version of the GMFCS. The parents of the children with CP in this pilot study provided their informed consent.

Translation procedure

The cross-cultural translation and adaptation of the MACS brochure and identification chart, into the Greek language was carried out with the permission of the main developer (Ann-Christin Eliasson) of the original scale, based on the international guidelines.[15] The standard translation-back-translation procedure was followed. Two translators, who were under-graduate physio-therapy students with advanced knowledge of English, provided independent forward translations. The manager of the transla-tion (academician and experienced physiotherapist in pediatric neurorehabilitation) then performed reconciliation of the two translations, producing a common translation. This translation was independently back-translated into English by a bilingual Australian/Greek physiotherapist, with many years of experi-ence in pediatric neurorehabilitation, who was unaware of the original version. The back translation was checked and reviewed by the developer of the original version and her comments were integrated, to develop the pre-final Greek version of the MACS.

The pre-final version was tested by 5 occupational therapists (one male, four females), experienced in pediatric neurorehabilita-tion and users of the English version of the MACS, who were asked to read the translated brochure and use the MACS according to the identification chart, to evaluate verbally whether the MACS was difficult to understand and use, and to suggest final modifications.

Test-retest and inter-rater reliability of the Greek MACS

Participants

The study included 66 children, recruited from two private physiotherapy centers for children in the Athens metropolitan area. Inclusion criteria were children with CP aged 4–18 years, regardless of their CP type and GMFCS level. Exclusion criteria were orthopedic management and botulinum toxin injections in the upper limbs within the previous 6 months. The type of CP for each child was retrieved from the medical records, and the GMFCS level was provided by the physical therapist of each child.

Instruments

The MACS is a 5-level system to classify how children with CP, aged 4–18 years, use their hands to handle objects, and the degree of assistance or adaptation the child needs to complete manual activities. Level I means "handles objects easily", and level II "handles most objects but with somewhat reduced quality". The child handling objects with difficulty is classified as level III, the child handling a limited selection of easily managed objects is classified as level IV, and the child not handling objects at all is classified as level V.[5]

In the current study, the correlation was tested of the Greek MACS with the standard Greek translation of the GMFCS, which has substantial reliability ($\kappa=0.80$, 95% confidence interval [CI]=0.67–0.94).[16] The GMFCS is a valid 5-level system, which is used inter-nationally to describe the severity of gross motor disability in children with CP. Differences between GMFCS levels are based on functional performance and limitations, and primarily on the need for assistive devices (I: Independent ambulation; II: Independent

ambulation with limitations; III: Ambulation with walking aids; IV: Self-locomotion using wheeled mobility; V: Dependent locomotion and transportation by others).[17]

Procedure

Before the rating, the investigators briefly introduced the Greek MACS to the children's therapists (occupational or physical therapists who knew or were using the English MACS) and the parents (mother or father), who were given a copy of the Greek MACS brochure and level identification chart. Sufficient time was given for reading the brochure and discussing any queries, following which the therapists and parents performed the MACS rating. To examine the test-retest reliability of the MACS, the children were re-classified after 7–10 days after the first rating, to reduce the possibility of recall of previous scores and to limit the potential for alterations in the children's manual ability.[18]

Statistical analysis

For descriptive statistics, the mean (M) was used as the measure of central tendency and standard deviation (SD) as the measure of dispersion. The intraclass correlation coefficient (ICC) was calculated to assess test-retest reliability and inter-rater reliability. Spearman's rho correlation coefficient (r_s) was used to determine the association of the initial MACS levels, as classified by therapists and parents, with the GMFCS levels, as the data were found to be in an ordinal scale. The level of significance was set at p=0.05. The data were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows, version 21.0 (IBM-SPSS Inc, Chicago, USA).

RESULTS

Translation

During the translation process, no major problem was encountered, and the developer of the original MACS made no comments, believing that the translation phrasing preserved the intended meaning in the translation language. All the occupational therapists from the pilot testing sample reported that the MACS was easy to comprehend and use and, thus, no further changes were made. The pre-final version was considered as the final version. Figure 1 illustrates the Greek MACS.

Descriptive analyses

For the testing of the Greek MACS, 40 children were recruited from the Pediatric Physiotherapy Centre "E-N-A",
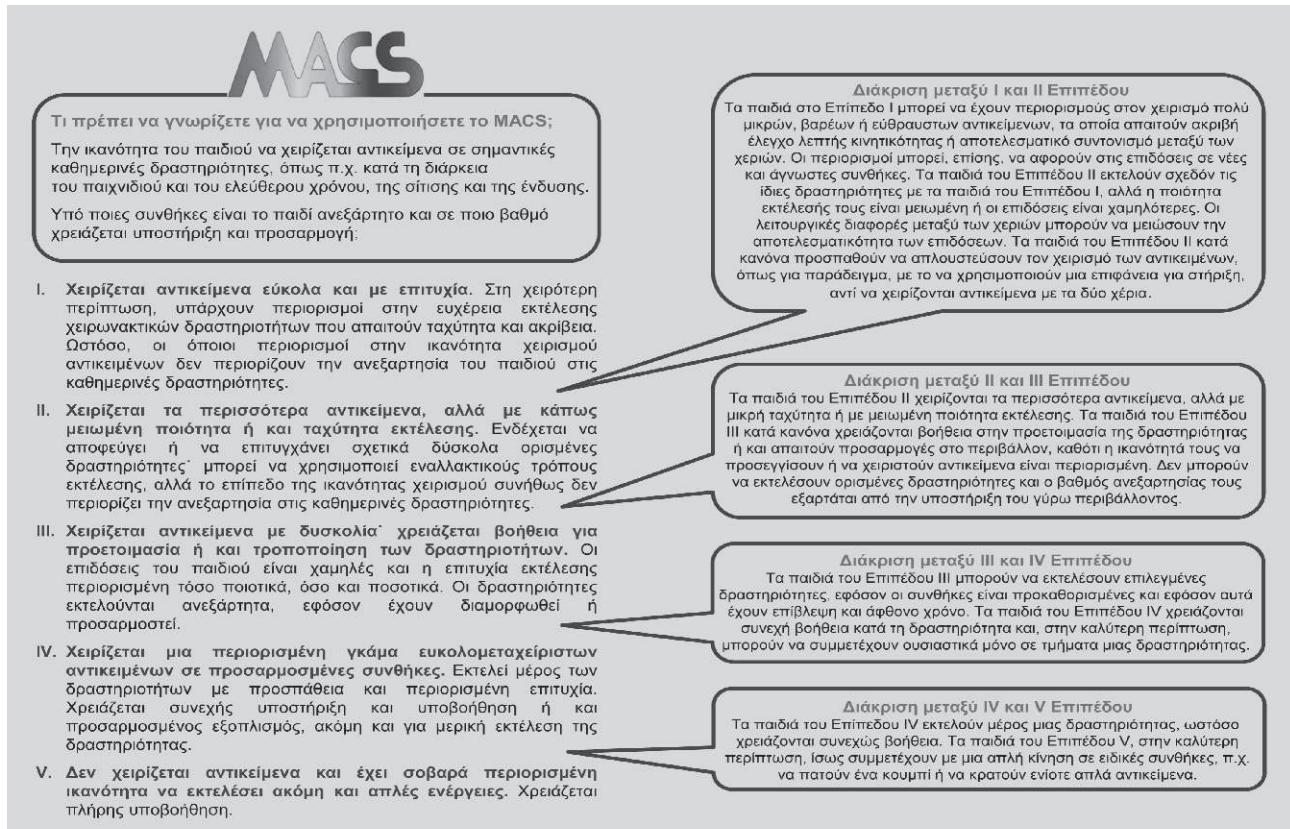
Figure 1. The Greek version of the Manual Ability Classification System (MACS).

Chalandri, Attica, Greece and 26 from the Pediatric Physiotherapy Centre "Paidokinisi", Argyroupoli, Attica, Greece. The demographic features of the children, including the distribution of their CP type and GMFCS assessment, are shown in table 1.

Reliability and correlation

The results from the test-retest reliability calculations indicate that both therapists and parents showed an excellent level of agreement, totally and by type of spastic CP, with an ICC ranging from 0.93 to 1.00 (tab. 2). The inter-rater reliability between therapists and parents was also excellent, with an ICC of 0.92 (95% CI: 0.86–0.95). The association between the initial MACS and the GMFCS levels was strong, as classified by both therapists (r_s=0.65, p<0.0001) and par-

ents (r_s=0.66, p<0.0001). The association varied according to the type of spastic CP; it was strongest for tetraplegia (r_s therapists=0.72, p=0.001; r_s parents=0.79, p<0.0001), moderate for diplegia (r_s therapists=0.47, p=0.014; r_s parents=0.56, p=0.003), and not significant for hemiplegia (r_s therapists and parents=0.49, p=0.06) (tab. 2).

DISCUSSION

The Greek version of the MACS presented excellent test-retest reliability for both therapists and parents for the total sample and each type of spastic CP – with only slight differences between them, demonstrating, also, the success of the translation process.[5] Similar positive results have been reported for the Chinese (ICC$_{therapists}$=0.94, ICC$_{parents}$=0.87),[8] Korean (ICC$_{therapists}$=0.99, ICC$_{parents}$=0.97),[9] Persian (ICC$_{therapists}$=0.974; ICC$_{parents}$=0.967)[11] and Turkish (ICC$_{therapists}$=0.96, ICC$_{parents}$=0.91)[10] versions of the MACS. To our knowledge, the test-retest of the MACS for the three CP spastic types is described for the first time. The sample for ataxic (n=2), dyskinetic (n=2) and mixed type (n=3) was too small to enable any valid conclusions to be drawn.

The Greek MACS also demonstrated excellent inter-rater reliability between therapists and parents. Similar findings were found for the Chinese (ICC=0.85–0.96),[8] Korean (ICC=0.96),[9] Persian (ICC=0.87)[11] and Turkish (ICC=0.89)[10] versions of the MACS. The agreement between the rating of therapists and parents also confirms the common understanding of the MACS.

The present study, also, showed strong correlation between the MACS and the GMFCS. These results are compatible with most of the similar studies (r_s=0.69–0.79, p<0.05)[5,10,19–23] apart from the findings in two studies that presented a weak (Cohen's kappa coefficient, κ=0.35)[24] or moderate (r_s=0.53, p<0.01)[25] relationship. The strong but not excellent correlation between two scales implies that, although they have been developed under the same philosophy, according to Eliasson and colleagues, "gross and fine motor function in children with CP do not nearly run in parallel, and can and should be independently classified".[5] For this reason, the MACS should be used in conjunction with the GMFCS to provide a comprehensive clinical picture in children with CP.

Regarding the types of spastic CP, this study illustrated that the correlation between the two scales was strong for tetraplegia and moderate for diplegia, verifying the findings of similar studies.[19,21,22,25] In contrast, in the hemiplegic group no significant correlation was found, probably due to the small sample size (n=16) and because each child had an

Table 1. Characteristics of the study population of children with cerebral palsy (n=66).

Gender (male/female)	39/27					
Age, mean±SD	8.49±3.73 years					
Type of cerebral palsy	**Gross Motor Function Classification System**					
	I	**II**	**III**	**IV**	**V**	**Total**
Spastic diplegia	10	10	5	1	0	26
Spastic tetraplegia	0	1	5	7	4	17
Spastic hemiplegia	15	1	0	0	0	16
Ataxia	0	2	0	0	0	2
Dyskinesia	0	0	1	0	1	2
Mixed	1	1	0	1	0	3
Total	26	15	11	9	5	66

SD: Standard deviation

Table 2. Test-retest reliability using intraclass correlation coefficient (ICC) of the Greek Manual Ability Classification System (MACS).

Type of spastic cerebral palsy	**n**	**Therapists ICC (95% CI, p-value)**	**Parents ICC (95% CI, p-value)**
Spastic diplegia	26	0.96 (0.92–0.98, p<0.0001)	0.96 (0.91–0.98, p<0.0001)
Spastic tetraplegia	17	1.00 (p<0.0001)	0.93 (0.83–0.98, p<0.0001)
Spastic hemiplegia	16	1.00 (p<0.0001)	0.96 (0.90–0.99, p<0.0001)
Total	66	0.99 (0.98–0.99, p<0.0001)	0.97 (0.95–0.98, p<0.0001)

CI: Confidence interval

unimpaired dominant hand that can function normally.[19] The strong correlation in children with tetraplegia appears to stem from the whole-body involvement,[19,21] while the moderate association in the diplegia may be due to the legs being much more affected.

This study has some limitations. Firstly, the number of children with ataxic, dyskinetic and mixed types of CP was small, as these types are quite rare, each representing less than 8% of the overall population with CP.[1] The appropriateness of MACS for assessment of children with ataxia, dyskinesia and mixed type should therefore be further investigated. Another limitation is that the concurrent validity was not investigated, because, to our knowledge, there is as yet no similar assessment tool of manual ability in the Greek language. A further limitation is the fact that the sample was drawn only from the private sector. Inclusion of children from the public sector could increase the generalization of the findings.

In conclusion, the MACS is a useful tool that classifies the manual ability in children with CP. The Greek version of the MACS is a practical and assessment tool and is easy for thera-pists, patients and the children themselves to understand. As the original version and translations in other languages, the Greek MACS has been shown to be highly reliable and can be used with confidence by Greek therapists in clinical practice and research. It enables the active involvement of Greek parents in the assessment process, which will give therapists a more comprehensive picture of the manual ability of the child in different settings (e.g., the home), contributing to the intervention process. Further studies on children with different types of CP may be required to explore the concurrent validity and inter-rater reliability of the Greek version of the MACS between therapists and physicians.

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ΠΕΡΙΛΗΨΗ

Ανάπτυξη του ελληνικού συστήματος ταξινόμησης ικανότητας χειρισμού αντικειμένων σε παιδιά με εγκεφαλική παράλυση

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ΣΚΟΠΟΣ Η διαπολιτισμική διασκευή και ο έλεγχος αξιοπιστίας της ελληνικής εκδοχής του συστήματος ταξινόμησης της ικανότητας χειρισμού αντικειμένων (MACS) σε παιδιά με εγκεφαλική παράλυση. **ΥΛΙΚΟ-ΜΕΘΟΔΟΣ** Σε πρώτη φάση πραγματοποιήθηκε η ελληνική μετάφραση βάσει διεθνών κατευθυντήριων γραμμών. Σε δεύτερη φάση εξετάστηκε η αξιοπιστία επαναληπτικών μετρήσεων, η αξιοπιστία μεταξύ γονέων και θεραπευτών (συντελεστής ενδοταξικής συσχέτισης [ICC]), καθώς και η συσχέτιση μεταξύ της ελληνικής εκδοχής του MACS και του συστήματος ταξινόμησης αδρής κινητικής λειτουργίας (GMFCS) (συντελεστής συσχέτισης του Spearman [r_s]) σε ένα δείγμα 66 παιδιών με εγκεφαλική παράλυση, ηλικίας 4–18 ετών. **ΑΠΟΤΕΛΕΣΜΑΤΑ** Η μεταφραστική διαδικασία ολοκληρώθηκε δίχως κάποια δυσκολία. Διαπιστώθηκε άριστη αξιοπιστία στον επαναληπτικό έλεγχο βαθμολογιών της ελληνικής εκδοχής του MACS τόσο από τους θεραπευτές (ICC=0,991, p<0,0001), όσο και από τους γονείς (ICC=0,97, p<0,0001). Η αξιοπιστία μεταξύ γονέων και θεραπευτών ήταν, επίσης, άριστη (ICC=0,92, p<0,0001). Καταδείχθηκε, ακόμα, ισχυρή συσχέτιση μεταξύ της ελληνικής εκδοχής του MACS και του GMFCS (r_s=0,65–0,66, p<0,0001). **ΣΥΜΠΕΡΑΣΜΑΤΑ** Η ελληνική εκδοχή του MACS καταδεικνύεται εξαιρετικά αξιόπιστη και μπορεί πλέον να χρησιμοποιηθεί με βεβαιότητα στην καθημερινή κλινική πρακτική από θεραπευτές και γονείς για την ταξινόμηση και την αξιολόγηση των παιδιών με εγκεφαλική παράλυση στον ελληνικό πληθυσμό.

Λέξεις ευρετηρίου: Αξιοπιστία, Διαπολιτισμική μετάφραση, Εγκεφαλική παράλυση, Σύστημα ταξινόμησης ικανότητας χειρισμού αντικειμένων, Συσχέτιση

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