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ORIGINAL ARTICLE

# Pediatric Musculoskeletal Assessment Using Two Screening Tools: The Early Arthritis Diagnostic Questionnaire (EAD) and the pGALS (Pediatric Gait, Legs, Arms and Spine)

Bárbara Geane Alves Fonseca[1], Claudia Saad Magalhães[2], José Eduardo Corrente[3]

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Arthritis,
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## Abstract

**Introduction:** There are limitations in the teaching and training of the musculoskeletal exam for the general practitioner, but two screening tools have become available in recent years. **Objectives:** Evaluate feasibility and concordance of two musculoskeletal screening tools, the 12-item questionnaire for early arthritis detection of (DPA-12) and the musculoskeletal examination pGALS (pediatric, gait, arms, legs and spine), in the same patient, during the routine practice. **Methods:** Participants between 5 and 18 years of age were examined by a trained resident, performing pGALS maneuvers and applying DPA-12 for parents. The diagnoses, descriptive analysis and scores were analyzed, categorizing the pGALS maneuvers as normal or abnormal and DPA-12 scores greater or lower than six. The internal consistency was calculated by Cronbach alpha coefficient and the correlation between categorical measures by kappa statistics. **Results:** Sixtyseven participants were included, 40 (59.7%) were boys. Forty (59.7%) had at least one abnormal pGALS manoeuver. The diagnoses were classified as musculoskeletal (juvenile idiopathic arthritis and connective tissue diseases, flat feet, hypermobility syndrome, mechanical limb pain) and nonmusculoskeletal (cellulitis and constipation). There were 65 valid questionnaires, 21 (32.3%) scored greater or ecqual to 6, indicating higher probability of musculoskeletal diagnoses. The internal consistency scoreswere 0.79 and 0.87, respectively. The comparison of normal and abnormal variables results, resulted in low agreement by the Cohen kappa coefficient (0.31). **Conclusion:** The application of both tools in the same patients performed well, showing simplicity and feasibility, for identifying functional or structural abnormalities, regardless of the diagnosis. In practice, both tools may be useful and complementary for screening.

[1] UNESP, Resident in Pediatric Rheumatology, Department of Pediatrics - Botucatu - São Paulo - Brazil.
[2] UNESP, Professor of Pediatrics, Department of Pediatrics - Botucatu - São Paulo - Brazil.
[3] UNESP, Associate Professor of Biostatistics, Department of Biostatistics - Botucatu - São Paulo - Brazil.

**Correspondence to:**
Bárbara Geane Alves Fonseca.
Paulista State University in Franca. Av. Prof. Montenegro, s/n - Vila Paraiso, Botucatu - SP, 18618-687. E-mail barbaraf.uni@gmail.com


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## INTRODUCTION

Pediatric musculoskeletal presentations are frequent in primary care, ranging from 4% to 30% of individuals, with a higher prevalence than epilepsy or diabetes. Pediatricians must develop competence and skills in exploring these complaints and also in performing the musculoskeletal examination, which includes appropriate techniques according to the age group[1]. Most complaints refer to self-limiting problems related to trauma or mechanical stress, but they can also be a feature of potentially serious conditions such as infection (sepsis, arthritis, or osteomyelitis), malignancy (leukemia, neuroblastoma, or bone tumor), or severe trauma (including non-accidental injuries) and some age-specific conditions in childhood (eg, hip pain may represent congenital dislocation, Perthes disease, or femoral epiphysis). They are also common in many chronic pediatric conditions such as inflammatory bowel disease, cystic fibrosis, juvenile idiopathic arthritis and connective tissue diseases[2].

Systemic manifestations or more serious diseases should be suspected early, so that they can be treated in a timely manner. Diagnostic delays are frequently observed in these diseases, in addition to the limitations inherent to the diagnosis of rarer diseases[3].

Changes such as arthritis, muscle weakness or structural deformities impact health and well-being due to pain and physical disability, occurring persistently in pediatric rheumatic diseases[4]. However, it is often observed that these signs and symptoms are not routinely addressed by prioritizing the involvement of other organs and systems, such as the cardiovascular, gastrointestinal, and neurological systems. It is possible that this is due to limited training and priorities in medical education regarding the clinical spectrum of musculoskeletal manifestations[5].

Systematic teaching of musculoskeletal examination has been implemented through musculoskeletal examination screening tools as a cost-effective health technology for diagnosis, saving expensive and unspecific complementary investigations. Directed questionnaires and examination maneuvers appropriate for all age groups and the peculiar involvement of the age group are based on the functionality of different body segments during movement, such as gait and range of motion in different body segments, have been useful in training of pediatricians.

An adapted instrument, the pGALS ( Pediatric, Gait, Arms, Legs and Spine)[6] was developed to overcome difficulties in the examination of the child, using the observation of functionality in usual activities, from walking when she enters the office, to maneuvers that are part of usual games like walking on tiptoe, walking on heels, or trying to reach the ceiling. The maneuvers are commanded by instructions and demonstrations of movement through illustrations. The Portuguese version of pGALS as well as maneuvers can be obtained free of charge as an Apple and/or Google app and with illustrative videos, also accessible on the website: www.pmmonline.org through registration and restricted access, authorized by the developers. A translated and adapted version into Portuguese can be viewed on the website and in the app in the international version. ( https://edisciplinas.usp.br/pluginfile.php/229642/mod_resource/content/1/PGALS%20Semiologia%20Reumatol%C3%B3gica-15-07.pdf) .

Regarding the screening questionnaire for musculoskeletal problems, an instrument for the early identification of arthritis through 12 specific questions was developed in 2006[7], aiming at the early recognition of children with arthritis and referral to a specialist. The questionnaire consists of 12 questions, being answered by parents scoring from 0-12, where the highest score indicates the greater probability of having arthritis and the limits established as greater than or equal to or less than six.

The objective was to evaluate the practicality and applicability of the instruments: questionnaire for early detection of arthritis (APD-12) and the musculoskeletal examination by pGALS, in simultaneous application of these two instruments, during routine pediatric practice and for the identification of musculoskeletal problems.

## MATERIALS AND METHODS

Inclusion criteria were: age between 5 and 18 years, ability to understand the commands of musculoskeletal examination maneuvers, ability to read and understand the DPA questionnaire self-administered by parents or guardians. Exclusion criteria were: patients with cognitive dysfunctions that would make it impossible for children to follow and understand verbal commands. Data losses were considered incomplete or invalid responses to the DPA-12 questionnaire.

Pediatric patients between 5 and 18 years old and their respective guardians, in a single approach , were invited to participate voluntarily. The examiner had no prior knowledge of the diagnosis, and the patients were previously informed about the tests to be applied. All included patients agreed to participate by signing the Free and Informed Consent Form for parents or legal representatives (ICF). The protocol had ethical approval (CEP-822,087 of 10/06/2014), according to CNS Resolution 466/2012.

Consecutive patients who sought general pediatric care in the different hospital sectors, in the emergency room, wards, outpatient clinics and health posts that are part of the university complex were invited to participate . composed of 12 items and each item scored 1 if positive, scored as 0 if negative and if the answer is “don’t know” in more than 4 items it is classified as not valid. The sum of the positive scores resulted in the final score from 0 to 12 points. The observer physician was unaware of the previous diagnosis, clinical care was performed by another resident and the pGALS maneuvers (Charts 1 and 2) were performed by the child himself, under

the command of the observer physician in order to imitate the performance of each maneuver as the " copy what I do" and were categorically classified into normal or abnormal maneuver.

Demographic data, questionnaires and exam sheets were filled out in standardized forms and the results of the questionnaire scores and registration of normal or abnormal pGALS maneuvers were recorded, which were later transcribed into MS Excel worksheets. The protocols were collected in a coded and anonymous way.

Clinical data were subsequently identified by consulting the electronic medical record, compiling the diagnoses established by the respective resident and assistant physicians and containing the subject's coded record, hospital record number, age, date and diagnoses.

The examiner's training was carried out through the illustrations of the maneuvers available in the Apple and/or Google application called pGALS with aversion translated into Portuguese. Instruction and training were also provided through demo videos on www.pmmonline.org .

### Statistical analysis

Data are presented through categorical variables for pGALS (normal or abnormal maneuver) and qualitative description of abnormal maneuvers, frequency or percentage. The DPA-12 questionnaire score was described by the median, through its distribution. The analysis of internal consistency between the items of the respective instruments was performed using Cronbach's alpha coefficient. The correlation between the pGALS abnormal maneuver scores and the DPA-12 score was performed using the kappa statistic, expressed by the Cohen coefficient. This coefficient estimates the agreement between two different methods used for the same purpose and values <0.40 were considered to have low agreement, 0.41-0.60 moderate, 0.61-0.80 high and 0.81- 1.00 perfect. Still, for the value 0 it is indicated that there is no agreement. In the comparisons, the differences were considered significant if the p- value <0.05 and all calculations were performed using Microsoft Excel spreadsheets and statistical software SPSS version 21 and SAS for Windows version 9.3, with the collaboration of the Office of Support for Institutional Research.

## RESULTS

Among the 70 invited patients, and their respective parents, 67 agreed to participate and 3 refused. Of the 67 survey participants, 2 had incomplete responses and invalid questionnaire score results, 40 (59.7%) were male and 27 (40.3%) were female. Of these, 40 (59.7%) had some changes in the musculoskeletal examination using pGALS and the list of abnormalities found in the pGALS musculoskeletal examination was presented in Table 1, classified as musculoskeletal and non-musculoskeletal.

The results of the DPA-12, completed by 67 parents, 65 (97%) were considered valid and 2 (2.9%) were not considered valid because they had 4 or more items with "I don't know" answers. Among the 65 valid questionnaires, 21 (32.3%) resulted in a score greater than 6, indicating the need for a specialized musculoskeletal assessment. The analysis of the DPA-12 score is presented in Table 2, according to the respective diagnoses, musculoskeletal (juvenile idiopathic arthritis, congenital flat feet, joint hypermobility syndrome, mechanical limb pain) and non-musculoskeletal (cellulitis and constipation) .

The results of abnormal maneuvers and high scores of the questionnaires are not corresponding and were analyzed independently, the qualitative data are summarized in Tables 1 and 2. The agreement between the categorical variables of both questionnaires, with normal and abnormal maneuvers was evaluated by means of statistics. kappa. The analysis of internal consistency between the items of the two instruments was performed using the alpha Cronbach test, obtaining an alpha coefficient of 0.79 and 0.87 respectively for pGALS and the questionnaire for early diagnosis of arthritis

**Chart 1.** Questionnaire for early detection of chronic arthropathy (APD – 12).

| |
|---|
| 01) Have you noticed swelling of the joints or joints in your child in the last seven days? |
| 02) Has your child complained of pain in the joints, muscles or bones in the last seven days, without having fallen or injured? |
| 03) Has your child ever had any swelling in the joints or joints that lasted longer than 30 days? |
| 04) Has your child ever had joint or joint pain that lasted longer than 30 days? |
| 05) Has your child ever had difficulty closing his hands, moving his wrists, knees or ankles? |
| 06) Has your child limped or walked differently in the last month? |
| 07) Is there anything your child cannot do, such as playing or running, because he/she has had any joint or joint problems? |
| 08) Has your child ever woken up complaining about joints or joints? |
| 09) Has your child ever had to cancel any activity, such as going to school or playing, because of joint or joint pain? |
| 10) Does your child have any deformities in any joints or joints? |
| 11) Has your child ever had a fever for more than 30 days, with no apparent cause, followed by swelling in the joints or joints? |
| 12) Has your child ever had any redness in the body followed by swelling or pain in the joints? |

**Chart 2.** Verbal commands and maneuvers of pGALS (Pediatric Gait, Arms, Legs and Spine).

| | |
|---|---|
| Questions | A. Does your child have any pain or difficulty moving a joint (joint), any muscle, or in the back or spine? B. Can your child get dressed unaided? Do you have any difficulty putting on any item of clothing (shirt over your head, for example)? C. Does your child have any difficulty going up or down stairs? |
| Observation | 1. Observe the child standing (front, back and sides) |
| March | 2. Observe the child walking normally, on heels and on tiptoes. |
| Upper limbs | 3. Place your arms and hands out in front of you 4. Turn your hands over and clasp them tightly 5. Place your index fingers against your thumbs 6. Touch the tips of each of your fingers with your thumb 7. Squeeze the metacarpal joints phalangeal joints to detect pain or discomfort 8. Put your palms together 9. Put the backs of your hands together 10. Raise your arms and look at the ceiling 11. Place your hands behind your neck |
| Cervical spine | 12. Try putting your ear to your shoulder |
| Temporomandibular joint (TMJ) | 13. Open your mouth wide and place 3 fingers inside it |
| Lower members | 14. Palpate the knee and press on the patella. 15. Flex and extend knee, palpate during movement to look for crackles 16. With knee flexed to 90 degrees, rotate leg outward (internal hip rotation) and in (external hip rotation) |
| Lumbar spine | 17. Bend your spine without bending your knees. How far can you go? |

**Table 1.** List and description of abnormalities identified through pGALS maneuvers and musculoskeletal and non-musculoskeletal diagnosis

| **Diagnosis Main (skeletal muscle)** | **Musculoskeletal abnormalities identified fur pGALS** |
|---|---|
| Sclerosis systemic progressive | Scoliosis (n = 5), |
| Juvenile Idiopathic Arthritis | kyphosis (no = 1), |
| (JIA) Crooked foot congenital | Lame gait (n = 2), |
| Fever rheumatic | Hypermobility (n = two), |
| Anemia sickle cell | Change From knees (no = 5), |
| Syndrome in hypermobility | Limitation in movements (no = 3) |
| **Diagnosis Main (no skeletal muscle)** | **Musculoskeletal abnormalities identified fur pGALS** |
| Abdominal pain | Scoliosis (n = 8), |
| Appendicitis | kyphosis (no = two), |
| Dyspepsia | march limp (n = two), |
| Enuresis | Localized joint hypermobility (n = 11), |
| Nocturnal | plantar arches plans (no = 7), |
| constipation Infection of tract urinary | |
| Respiratory infection | Knee changes (n = 5), |
| Cellulitis | |
| Hepatitis | |
| Epilepsy | Limitation in movements (no = 4) |
| Diabetes | |
| Dermatitis atopic | |

, which indicates that the score was not random, confirming its validity. Comparing the categorized results of the respective instruments, there was a low agreement by the kappa coefficient of 0.31.

## DISCUSSION

Musculoskeletal problems affect about 4 to 30% of patients in emergency care, with claudication being the most frequently observed symptom[4,8]. This was the first study, to our knowledge, that systematically evaluated two musculoskeletal screening instruments simultaneously, one through the response by the parents and the other through the performance of the simplified musculoskeletal examination, bringing divergent results, as they were different observations, those of the parents and/or parents. or guardians and performed by the doctor's examination.

The practicality and applicability were demonstrated in routine consultations by an observer in training, contributing to the training process[8] during the Pediatrics Residency. Musculoskeletal abnormalities were identified in patients with already confirmed diagnoses of rheumatic diseases and

**Table 2.** Score greater than 6 on the DPA-12 questionnaire, according to the diagnosis main.

| Diagnosis Main | Punctuation |
|---|---|
| Arthritis idiopathic juvenile systemic | 11 |
| Arthritis idiopathic juvenile systemic | 10 |
| Arthritis idiopathic juvenile polyarticular | 8 |
| Pain in limbs | 8 |
| Pain in limbs | 8 |
| Lupus erythematous systemic in start at child | 8 |
| Síndrome de hipermobilidade articular | 6 |
| Syndrome in hypermobility articulate | 6 |
| Arthritis idiopathic juvenile oligoarticular | 6 |
| Constipation Intestinal | 11 |
| Cellulitis in member higher | 8 |
| Cellulitis in hallux | 7 |

children with other non-rheumatic diagnoses. One of the most frequently seen alterations was alterations in the alignment of the spine, such as kyphosis or scoliosis with a functional characteristic or variant of normality (13.8%), which demonstrates that these tools could be used for screening and referrals to a specialist in Pediatric Rheumatology. or orthopedist.

Preschool and school age children were approached, where the interpretation of results requires knowledge of variations of normality for each age group, the perception of pain or discomfort when performing the pGALS maneuvers. Still, in these children it proved to be practical and cost-effective, as it can save additional tests, being easy to apply, fast, and can be performed between 5 to 10 minutes with practice, and in a playful way. early detection of arthritis (APD-12) answered by parents, may represent good screening tools for pediatric musculoskeletal problems.

Both pGALS and DPA-12 instruments showed concordance measures between items, observed through Cronbach's alpha coefficient of 0.79 and 0.87, respectively, indicating that they are reliable instruments, and their respective scales are aligned. However, the result of the Kappa statistic showed low agreement between the two instruments (kappa = 0.3) which indicates properties of diverse and non-redundant constructs, which may complement each other in the identification of musculoskeletal problems, that is, they must be applied in a complementary way to with musculoskeletal problems, including pediatric rheumatic diseases.

Although we were unable to analyze the correspondence between musculoskeletal examination abnormalities categorized as normal or abnormal and the 0-12 score of the DPA-12 questionnaire, we qualitatively observed that higher DPA-12 scores and higher number of pGALS abnormalities and abnormal maneuvers were observed in those with a musculoskeletal diagnosis. It was not possible to analyze the abnormalities found in the scores of the two instruments in the same patient. Among other limitations of this study are also: the pGALS exam was applied by only one observer. However, diagnoses were certified in supervised care. The complementation with another questionnaire, answered by the parents, added validity to the process. Other authors, using the adapted version for another language in Malaysia and Peru, confirm its applicability in other scenarios, in other countries, where this tool has proved useful in the hands of other health professionals such as nurses, physiotherapists and medical students[9,10].

We conclude that both instruments are adequate constructs and complement each other in the musculoskeletal assessment, and can be implemented for students and health professionals.

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