



What are the Options for Reporting Development Below the Floor of a Standardized Test? Themes From the Past 15 Years Literature



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Abstract

Aim: To identify and describe the published literature that addresses the reporting of development, particularly its specificity and clarity, of children who fall more than 2 S.D.s behind their peers on a standardized developmental test.

Method: A scoping review methodology in Phase 1 with clinical review of literature in Phase 2.

Results: No papers reporting children's development below the floor of a standardized test were found. Eight research questions identified 65 papers during 2005-2020 after clinical review. Extraction of descriptive data by charting led to isolation of 6 themes for analysis. The literature clarifies what is not appropriate such as extrapolation of scores below the floor of the test but offers little guidance on appropriate methods of reporting. Assessment should be within a psychosocial and ecological model. Five sets of general guidelines were found.

Interpretation: The review highlights a wide discrepancy of perspectives ranging from traditional testing to emphasis on environment and culture. Two underlying dimensions with agreement were: 1) the importance of assessing both strengths and needs and 2) the way the assessment takes place. Further work to develop a route from developmental assessment to the ICF-CY would be helpful.

Keywords: Child development assessment; Child disability; Floor of test; Review; Fair assessment

Introduction

Tests of child development have been used since the 1950s in both clinical and research practice [1,2]. Testing development using a standardized test offers a measurement to compare a child's development to that of the standardized test sample of typically developing children. Developmental concerns about a child can arise by different routes and further evaluation may be required to identify potential difficulties that necessitate intervention or special education services [3,4]. Tests of child development are also used to look in-depth at a child's needs after identification by screening, to recommend appropriate educational provision or intervention or to monitor the effects of this.

Norming standardization conveys important and useful information about relative standing but cannot be absolute especially in relation to real events and context [5]. Measurement of the discrepancy between a child's performance and that of a typically developing peer is sufficient for selection for access to services. However, for progress planning, progress monitoring,

the effect of treatment and program evaluation more individual information about the child's development is needed. In addition, these processes require comparative data from other similar children in order to distinguish between changes found generally in these children over time and changes that can be stated to have occurred because of the input or treatment given. Creation of a comparison group using a representative sample is difficult for children whose development is at the lower end of the curve due to the mixed nature of the co-morbidities accompanying a single diagnosis, and the lack of agreement on the classification and description of children with disability [6].

From the 1980s onwards the dynamic systems approach to development and Bronfenbrenner's ecological systems theory of child development considered the true balance of influences likely to play a part in the development of a young child [7,8]. The publication in 2001 of the International Classification of Functioning, Disability and Health [9] reflected the biopsychosocial

model, with a version of the ICF for children and youth, the ICF-CY [10], published in 2007. During the same time period, authenticity in early childhood assessment that also reflected the biopsychosocial model became important, especially in early childhood education assessment [11]. In authentic assessment, children are observed, or reports are obtained about the child’s performance both in and across natural settings. Development of the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [12] started from 1999. Changes linked to assessment reflected a growing concern about excessive and inappropriate reliance on Intelligence Quotient (IQ) cut-offs and encouraged clinicians to consider various sources of measurement and test error. The definition of learning disability in the DSM-5 encourages a more comprehensive view of the individual than its predecessor without specific scores as a diagnostic criterion and decreased reliance on psychometrics. The severity rating is based on adaptive function in the 3 domains of conceptual, social and practical function with descriptive specifiers to determine severity.

There are several guidelines for assessing children with and without disability by the British Psychological Society (BPS) [13], the American Psychological Association (APA) [14] and The International Test Commission (ITC) [15]. Despite this guidance, practitioners continue to seek more specific guidance when the child’s performance falls below or near the floor of the test. To provide enhanced guidance for practitioners, it was decided that a scoping review methodology would identify and describe the published literature that addresses the reporting of development, particularly its specificity and clarity, of children who fall more than 2 standard deviations (S.D.s) behind their peers on a standardized developmental test.

The review would describe options available to practitioners in reporting a child’s development near or below the floor of the test and assist practitioners who wish to extract more meaningful information from standardized measures rather than just a general confirmation of disability.

Methods

Phase 1

A scoping review framework [16] was chosen to

examine evidence emerging since the work on DSM-5 and its recommendations for a more comprehensive view of the individual who falls outside the parametric boundaries of a standardized test. The review followed 5 recommended stages: identifying the research questions; identifying relevant studies; study selection; charting of data and collating; and summarizing and reporting the results. An iterative approach was used to develop guiding research questions, and each revision was driven by increasing familiarity with the literature [17].

- (i) The initial research question was ‘How should a child’s development which falls below the floor of a standardised developmental test be reported?’
- (ii) Further research questions evolved:
- (iii) (i) ‘How to report development of children with intellectual disability?’
- (iv) (ii) ‘How to evaluate children with severe developmental delay or disorder?’
- (v) (iii) ‘What is published about the ICF-CY and developmental assessment?’
- (vi) (iv) ‘Why evaluate strengths and needs in children with severe disability who fall below the floor of a developmental test?’

The population was children with developmental delay or disorder whose assessment results on a standardised developmental test fall near or below the floor of the test. The search was limited to the years 2005-2020 of the transition towards DSM-5 and years since publication. The databases used were Allied & Complementary Medicine™, Embase®, MEDLINE® Academic Ultimate, APA Psycinfo, Cinahl Complete, Cinahl with full text, E-book Clinical Trial, E-book collection (EBSCO), E-book Nursing collection trial, ERIC, Health Consumer ed., Health Nursing/Academic ed., Humanities International Complete, Library Information and Technology abstracts, Masterfile Premier, Masterfile Reference Book e-collection, Medline Complete, Open Dissertations and Teachers’ Reference Centre.

The criteria for including or excluding studies are outlined in Table 1. Studies were not required to meet a quality threshold, but peer-reviewed publications were chosen if possible. A flowchart of the process is shown in Figure 1.

Table 1: The criteria for including or excluding studies.

Inclusion Criteria	Exclusion Criteria
Papers January 2005 to 2020	Developmental screening measures
English language papers with abstracts	Functional assessment without a developmental basis
Content relating to children under 11 years assessed on standardised developmental test or measure and performing around or below the floor of the test.	Relating to children older than 11 years or adults Rating scales
Guidelines and recommendations on testing people with disability of any age.	Questionnaire or interview-based research or assessment
A wide range of settings.	
Papers pre 2005 if in series of papers or major originator of research.	

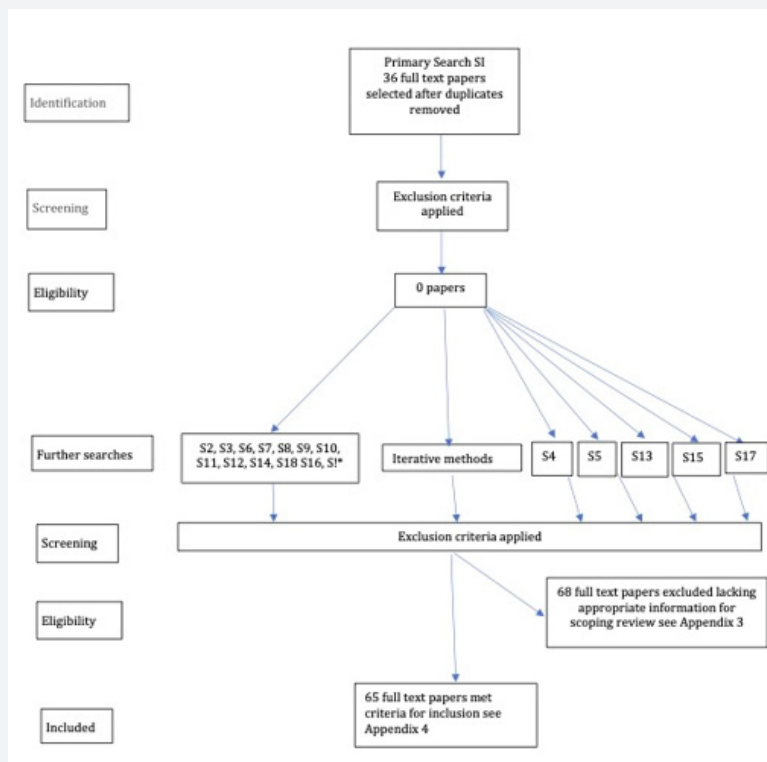


Figure 1: Flow diagram for the scoping review process.

Phase 2

This phase evolved when it became clear that sufficient data was not available to be compliant with the scoping review methodology using pre-determined keyword searches the authors therefore expanded the search using their expertise in the field to retrieve clinically relevant information from sites such as ResearchGate, Google and Google Scholar. Potential material

meeting the inclusion criteria of the review was harvested from the references of further papers sourced.

Charting of data

Both Phase 1 and Phase 2 data was charted in categorized tables detailing the authors, year of publication, country/countries of origin and key findings. As data was collated, some of the categories were sub-divided to clarify the findings.

Table 2: Checklist for practitioners reporting standardized developmental tests.

Depending on the context and goals of assessment and testing, practitioners should use the assessment approach that is most psychometrically sound, fair, comprehensive, and appropriate for children with disabilities.
Assessment activity should be conducted within a coherent system of medical, educational, and family support services that promote optimal development for all children.
Define common goals and reframe referral question if necessary.
Adopt both an inter-professional and family perspective.
Identify the key environments linked to the child.
Identify key people for the child and create a positive collaborative relationship
Use more than one method of assessment and triangulate the findings and opinions of key people for confirmation of findings.
Translate standardized measurements and use them in relation to a qualitative description of the child.
Describe both the strengths and the needs of the child.
Communicate in plain language and give practical recommendations in relation to the child’s individual strengths and needs.
Consider the barriers to learning for that child and suggest practical options for management.
Communicate the findings in an inclusive and optimistic way.

Findings

Patterns of findings from the studies were explored to produce a narrative synthesis, using a themed approach of the different viewpoints and methodologies. A checklist for practitioners reporting standardized developmental tests was compiled from the information gathered. See Table 2.

The initial search in Phase 1 produced 36 possible references, none of which met the inclusion criteria. The additional 8 research questions developed led to a total of 18 different searches. 11 searches highlighted no studies, and a further 2 produced no data after exclusion criteria were applied. In Phase 2, 65 additional papers were examined for available data and summarized under different topic areas.

Themed synthesis of data

International classification of functioning, disability and health - children and youth (ICF-CY) [10]: The paradigm shift from a medical to a broader biopsychosocial model of disability led to an approach consistent with children's rights. This biopsychosocial model of disability was developed to capture profiles of individual differences of children. The purpose of the ICF-CY is to describe the nature and severity of the limitations of a child's functioning and to identify the environmental factors influencing such functioning. As the ICF-CY is not an assessment instrument but a system of classifying disability, there is a need for new and extant measurements to be aligned with ICF-CY. This alignment confirms functioning components in traditional developmental tools plus identifies those absent. Mapping studies have been carried out between developmental assessment measures and the ICF-CY [18-20].

General approaches to assessment of children with disabilities

Authentic assessment refers to a set of methods and techniques used to assess a child's academic achievement. It includes activities which require the application of acquired knowledge and skills to a real-life situation. By 2005, the emerging evidence-based practice in an authentic alternative for assessment in early intervention was growing in the US and best practice guidelines expressed concerns about the use of standardized tests for children with disabilities [11,21,22]. A study [23] confirmed that authentic assessment practices are collaborative with families, equitable, sensitive, and congruent with child-centered practices (e.g., appropriate materials and methods that match the child's interests and developmental level). New forms of assessment are needed which look at a child 'with a different glance', aiming to understand a child's functioning in a dynamic and interactive way, how to improve functioning, learning and participation and what might be hindering participation. Assessment should be directed at evaluating the school context with an adequate plan, allowing the child to be maximally included. This requires a mind-shift and a change of practice by clinicians [24].

Dynamic assessment is defined as 'an interactive approach to conducting assessments within the domains of psychology, speech/ language or education that focuses on the ability of the learner to respond to intervention' [25]. A study [26] noted that it is the way that test results are used and interpreted that becomes an area of friction between the culturally dominant 'biological disturbance' testing paradigm and the more recent cultural, contextual, or ecological paradigm. The authors recognized that evaluating the evolution of the child across time would be better. A concept of chronogeneity [27] adds to the understanding of the individualized pathways of children over time, especially in relation to varying etiologies and/or treatment received.

Particular issues related to the assessment of children with disability

Difficulty in capturing the experience of children with disability using research methods that strive for reproducibility and generalizability has been noted [27]. Others state that standardized instruments are the only tool for obtaining objective developmental information directly from the child. Standardized instruments are helpful if education service eligibility criteria incorporate a quantitative element.

There are specific issues related to the use of standardized instruments for the assessment of children with disability. Standardized instruments for such children assume a developmental process that is only quantitatively, and not qualitatively, different from typically developing children [28]. However, the hallmarks of developmental disorders are disrupted developmental timing and slow acquisitional pace [29]. Developmental divergence occurs, such as that seen in motor trajectories, in children with fragile X syndrome which co-occurs with and/or without autism [30].

The lack of reference standards or procedures in tests relating to children with a disability is an issue [31], and addition of children with disabilities to the norming group can negatively impact a test's discrimination accuracy or its ability to differentiate between typically developing children and children with disability. The reason for this being that, as the mean score is lowered, the test's ability to diagnose children with mild disability is limited [32,33].

Psychometric factors

Test floor effects and sampling solutions

Cognitively disabled individuals often obtain scaled (weighted) scores of 1 on all subtests of standardized tests normed against a typically performing sample, therefore displaying a flat profile that hides individual strengths and weaknesses. At the same time, however, clinicians are aware of the existence of very diverse ability profiles in such individuals [34]. Floor effects emerge because the practice of transforming raw scores into scaled scores eliminates any variability present in participants with low intellectual ability. Test floor effects prevent characterization of

strengths and weaknesses, poorer estimates of cognitive abilities in research applications and, in clinical settings, limited utility for assessment, prognosis estimation, and planning intervention [35]. Computations using modern score analysis have revealed greater variability of scores [34,36,37], and the need for earlier intervention such as new-born screening and innovative intervention [38-40].

Disaggregating data is another critical step to gaining increased knowledge from collective or aggregated information, such as in a standardized test. Disaggregating data involves delving more deeply into a set of results to highlight issues that pertain to individual subsets of results and/or outcomes of aggregated data [41].

Issues of measurement

Unstable developmental changes [42] and intraindividual variability [43,44] ensure any measurement of skills within developmental domains cannot be very accurate. Standardized tests may reduce variability of the context, but many argue that it is the child's performance in their usual context which is important to measure.

Some quantitative metrics have definite issues for children with developmental disability. Ratio developmental quotients (calculated by mental age / chronological age x 100) reflect the rate of development and are not comparable at different age levels because the standard deviation of the ratios does not remain constant. Moreover, confidence intervals vary tremendously. The pace of an increase in each developmental construct changes at different ages as well [45].

Developmental age equivalents (AE) represent the average age that a raw score is typical rather than accurate information about the child being assessed and falsely imply that abilities increase at a constant rate from year to year [46,47]. Unlike standard scores, which follow an equal-interval scale, AE scales are ordinal, with a flattening of the curve as age increases [48]. Although ratio developmental quotients are now considered poor practice, AE scores do provide some practical information for teachers or parents, to secure funding, to report scores when norms do not apply, and as an initial measure to evaluate the severity of disorders and to guide additional testing [49].

Qualitative measurement can be intangible or ambiguous as it uses human experience and judgement. However, 'a researcher who appreciates the gap between a psychological metric and a psychological reality knows to look past a person's score and search for something meaningful' [6]. The interpretation of the metric is essential to understanding what it means in the wider context of the child [50].

Evaluation involves the meaningful synthesis of different results (test scores and individual perceptions of information) and qualitative information should be combined with quantitative data in developmental testing [45,51].

Qualitative assessment instruments do not assume successive developmental stages and can offer valuable information in clinical practice, depending on the aim of the assessment [28], and capturing the experience of the children and their carers is important [52]. Such qualitative information is often gained through completion of parental or teacher questionnaires.

Clinical reasoning uses both qualitative and quantitative information in a process [51].

The ICF-CY notes that qualitative descriptions of the child, based on direct observation, may be useful in gathering evidence in areas of functioning where assessment tests are not available or not appropriate.

Guidelines retrieved and related to testing children with disability

A number of guidelines or standards were retrieved which may be helpful in reporting the development of children below the floor of the test (see Table 3. Additional guidelines retrieved).

Quality assessments of young children include the use of multiple methods; conduction within naturalistic environments; connection between the intent of the assessment and the way it is being used; and participation of families in the assessment process [53].

Why assess at all?

For a child with specific instructional needs, knowledge about the child's sensory function, language comprehension and learning ability are important. Accurate assessment of intellectual ability is necessary in interpreting results from autism diagnostic instruments in a comprehensive ASD differential diagnosis. The DSM-5 states that the disturbances in social communication and repetitive behavior must not be better explained by intellectual disability or global developmental delay. In practice, this means that the behaviors found deviant on assessment must be abnormal for peers at the child's general developmental level, not for chronological-age peers [54].

What might help?

Assessment should be future focused, considering changes that occur in the child's skills and capacity to learn over time [55]. In addition, an evaluation should be made of how different contexts and interventions in the past might have impacted on the child's learning. For interventions to facilitate progress, assessments need to be wide-ranging and present a real picture of the child's strengths and needs.

Active participation of the learner is an important principle of socio-cultural educational theory [56,57]. Scaffolding is defined as a process 'that enables a child or novice to solve a task or achieve a goal that would be beyond his unassisted efforts' [58,59]. For children with special needs, the principle of a 'zone of potential development' is important as it assesses both the tasks a child

can perform independently and the potential development a child may reach with the assistance of another person [60].

A relatively easy way to minimize the test floor and item gradient problems without lengthening the test is to increase

the number of scoring alternatives. A polytomous scoring system enables a better differentiation to be made within the group of children who do not pass an item, thereby improving reliability [28,60].

Table 3: Additional guidelines retrieved.

US National Research Council Assessment: Why, What, and How [65]	Daffodil Project guidelines [26]
The purpose of an assessment should guide assessment decisions.	<ul style="list-style-type: none"> • Adopt an inter-professional perspective • Be aware of values and concepts regarding assessment and inclusion <ul style="list-style-type: none"> • Identify key people • Construct the assessment as a learning opportunity • Define common goals & reframe referral questions • Assess learning in context, strengths and needs • Adopt a perspective on potential and learning possibilities <ul style="list-style-type: none"> • Create a positive collaborative relationship • Communicate findings in an inclusive, & optimistic way • Translate standardized measurements and use them in relation to a qualitative description of the child • Communicate in plain language and give practical recommendations • Connect assessment to an activating and inclusive programme • Assessment should include formative assessment, dealing with curriculum and IEP objectives impairments, and its difficulties to execute activities and to participate in classroom and school life
Assessment activity should be conducted within a coherent system of medical, educational, and family support services that promote optimal development for all children.	
Using Authentic Assessment to Evidence Children’s Progress Toward Early Learning Standards [52]	
Use of multiple methods	
Conduction within naturalistic environments	
Connection between the intent of the assessment and the way it is being used	
Participation of families in the assessment process	
Journal of Early Intervention guidelines [67] for manuscripts suggest	
Monitoring hierarchy	
Disaggregation of normed data for diverse populations	
Developmentally Appropriate Practice [22] (DAP) 8 Standards:	
utility	
sensitivity	
acceptability	
convergence	
authenticity	
collaboration	
equity	
congruence	

Discussion

A scoping review framework was chosen to inform practitioners who wish to extract more meaningful information from standardized measures rather than just a general confirmation of disability. However, the formal scoping review methodology requires a replicable search approach which cannot be done with scanty meaningful data from literature searches. The formal methodology did confirm the wide disparity of perspectives remaining 15 years after the introduction of DSM-5, ranging from a total emphasis on traditional standardized testing to an emphasis only on the environment and culture. The less formal methodology of Phase 2 clarified a range of issues. Time constraints in many services have supported the change to less individual testing.

There were two underlying dimensions to the themes noted in the review. There is consensus that both the strengths and needs of a child with disability, and the way an assessment takes place, are necessary considerations. The guidelines shown in Table 2 demonstrate this. There is increasing work with children from diagnostic groups to produce statistical computations to ensure that variability is not lost at the floor of a standardized test. However, studies providing a clear route from tests assessing only bodily functions for children with disability were not found.

Testing child development is fraught with challenges due to its dynamic nature, individually complex developmental inter-related domains, the spurting nature of developmental growth [42] and different personal and external variables on the day of testing. The compounding factor of disability leads to a multi-faceted conundrum especially when examining a test which is standardized against a sample of typically developing children.

Numerical measures of developmental status compared with typically developing children continue to be useful in the measurement of treatment effects, progress planning and monitoring. Whilst not directly related to the questions of this study, the iterative process of the review identified evidence that children for whom a numerical score is not achievable are excluded from many research studies [61]. Whilst this is understandable from a research methodological perspective, it means that the effects of treatment, do not reflect some of the population investigated.

The APA’s [14] Guideline 14 recommends an approach that is the most psychometrically sound and appropriate for clients with disabilities. In the last few years, solutions have been found to enable fair reporting of development below the floor of standardized tests such as the statistical computation applied to those in comparable populations. Some traditional methods for reporting below the floor of the test is now viewed

as unacceptable such as ratio developmental quotients and quantifying extrapolation of scores below -3 S.D. No studies using a heterogeneous sample and a computational methodology were found in the review for developmental tests although the approach appears to be appropriate for further studies.

As individualization is central to the development of intervention plans for children with disabilities, a key component of clinical assessment is measurement that can yield profiles of individual functional characteristics [62]. The profile of strengths and needs in a child's developmental domains can be established through testing and used to ensure that the environment is appropriate for that child. Developmental tests were found to have received the highest ratings in the group of conventional tests in a survey on authentic assessment [23].

For example, the Griffiths III [63] is a test where the first dimension to the themes noted in the review, that of clarification of a child's strengths and needs, is straightforward. The Griffiths III (Griffiths Scales of Child Development - 3rd Edition) was published in 2016 and, like other psychometric tests of general child development, it was normed against a population of typically developing children. This normative sample provides a standard to measure the developmental performance of a particular child. However, the shape of the normal distribution curve provides sparse comparison data for children at the lower end of the curve (-2 S.D. to -3 S.D.). This means that for the 2.5% of children whose performance falls in the lower tail of the bell curve, the specific degree of impairment cannot be determined with confidence from the normed data.

The Griffiths III brings together the most recent research in five developmental domains or avenues of learning (Foundations of Learning, Language and Communication, Eye and Hand Coordination, Personal-Social- Emotional, Gross Motor) in the measurement of infant and child development from birth to six years. It is a test which is often used for both clinical and research-based assessment of children in special populations whose developmental function lies within the test age range [64]. However, these children's development can fall near or below the test floor confirming severe disability but making any psychometric scores unreliable or lacking meaning.

Practitioners can however use the accompanying Quartile Charts for disaggregation and fine-grained analysis of both items and constructs at item level [65] (ARICD, 2020). Each year Quartile Chart shows the items in the 5 subscales of Griffiths III arranged in quartile groupings according to the level of difficulty of that item. Analysis of items achieved allows a description of the child's strengths and needs, from which plan can be developed for the child's education and therapy. This is an example of how a test can move beyond theoretical psychometric constraints into application to assist clinicians in interpreting test performance for the context and skillset of each child.

The second dimension to the themes is related to the manner

the assessment is conducted. This dimension was identified from contexts such as early education, inclusive education, research, and early intervention but not specifically related to developmental testing. A checklist as in Table 1. would be helpful to practitioners of Griffiths III and other standardized developmental tests.

This review highlighted the lack of information available regarding the reporting of development below the floor of a developmental test but has signaled possible ways to move forward to widen the methodology of assessment in general for children with disability.

Perhaps the most important of these is to consider other strategies for disaggregation of data such as the use of statistical computations. Studies are needed to test similar methodology using developmental tests. Qualitative and descriptive analysis are also ways to disaggregate test data. Finer analysis of the specific linkages of developmental tests to specific ICY-CY qualifiers and core sets would be helpful to ensure breadth of assessment.

Other strategies include the use of scaffolding techniques in assessment tests to clarify potential development in a skill, and polytomous scoring would offer graduations of a particular test item rather than a pass or fail score.

Finally, it is important to remember not to aggregate test data by using outdated methodology such as developmental age divided by chronological age quotients, especially below the floor of the test. Any extrapolation of test scores below the test floor compounds the aggregation effect.

For research, the lack of appropriate quantitative methods to measure developmental outcomes following surgery or drug treatment remains a particular area of need for children with severe disabilities. Statistical computations may be of use for comparable groups and for non-comparable groups, longitudinal studies pre-treatment and post-treatment may be helpful as well as further longitudinal studies to clarify the developmental trajectories for individual medical conditions affecting developmental progress [66,67].

Conclusion

The lack of data achieved from the initial scoping review highlights important gaps in knowledge related to meaningful reporting of development for those children who fall around or below the floor of the test. The literature is clear about what is not appropriate but offers less guidance on appropriate methods to use. All children have the right to a fair assessment. The use of a checklist plus a qualitative approach looking at an individual child's strengths and needs and an analysis of barriers to learning offers one solution.

What this paper adds are:

- i. Test development within a biopsychosocial model for authenticity.

- ii. Fine grained analysis of disaggregated qualitative data for strengths and needs.
- iii. Ratio developmental quotients should not be used.
- iv. Extrapolation of scores below the test floor should not be used.
- v. Test developers and researchers should consider computational solutions to test floor issues for homogeneous population samples.

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