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Spinal manipulation and mobilisation among infants, children, and adolescents: an international Delphi survey of expert physiotherapists

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ABSTRACT

Objective: The aim of this study was to establish international consensus regarding the use of spinal manipulation and mobilisation among infants, children, and adolescents among expert international physiotherapists.

Methods: Twenty-six international expert physiotherapists in manual therapy and paediatrics voluntarily participated in a 3-Round Delphi survey to reach a consensus via direct electronic mail solicitation using Qualtrics®. Consensus was defined a-priori as ≥75% agreement on all items with the same ranking of agreement or disagreement. Round 1 identified impairments and conditions where spinal mobilisation and manipulation might be utilised. In Rounds 2 and 3, panelists agreed or disagreed using a 4-point Likert scale.

Results: Eleven physiotherapists from seven countries representing five continents completed all three Delphi rounds. Consensus regarding spinal mobilisation or manipulation included:

- Manipulation is *not recommended*: (1) for infants across all conditions, impairments, and spinal levels; and (2) for children and adolescents across most conditions and spinal levels.
- Manipulation *may be recommended* for adolescents to treat spinal region-specific joint hypomobility (thoracic, lumbar), and pain (thoracic).
- Mobilisation *may be recommended* for children and adolescents with hypomobility, joint pain, muscle/myofascial pain, or stiffness at all spinal levels.

Conclusion: Consensus revealed spinal manipulation *should not be performed* on infants regardless of condition, impairment, or spinal level. Additionally, the panel agreed that manipulation *may be recommended* only for adolescents to treat joint pain and joint hypomobility (limited to thoracic and/or lumbar levels). Spinal mobilisation *may be recommended* for joint hypomobility, joint pain, muscle/myofascial pain, and muscle/myofascial stiffness at all spinal levels among children and adolescents.

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Introduction

The Executive Committees of the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) and the International Organisation of Physiotherapists in Paediatrics (IOPTP) created a joint task force to develop a physiotherapy position statement on the role of spinal manipulation and mobilisation techniques in the treatment of infants, children, and adolescents.

Orthopedic manipulative physiotherapy (OMPT) integrates a range of therapeutic procedures, including manipulation and mobilisation techniques [1]. Mobilisation has been defined by IFOMPT as 'a continuum of skilled passive movements applied at varying speeds and amplitudes to joints, muscles, or nerves with the intent to restore optimal motion, function, and reduce pain.' [1] IFOMPT defined manipulation as 'a passive, high velocity, low amplitude (HVLA) thrust applied to a joint complex within its anatomical limit with the intent to restore optimal motion, function and to reduce pain.' [1] Internationally, there are different schools of thought and theoretical views regarding manipulation and mobilisation, particularly

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for the spine in infants (birth to <2 years), children (2 to 12 years), and adolescents (13 to <18 years). Additionally, there are concerns regarding the safety of spinal manipulation in the paediatric population. Limited evidence exists regarding the safe use of these techniques in the paediatric population [2]. There is a significant need to map the current scientific evidence and seek input from clinical experts regarding the use of spinal manipulation and mobilisation among infants, children, and adolescents to inform evidence-based practice.

A systematic scoping review reported the efficacy and harms of spinal manipulation and mobilisation among infants, children, and adolescents [3]. Milne and colleagues (2022) identified the available evidence, synthesised (using a levels-of-evidence approach) and mapped the empirical research, reviews, published guidelines for practice, policies, regulations, and position statements informing the clinical use of such techniques [3]. synthesised findings from 87 included articles, exploring the use of spinal manipulation, suggested there was strong to very strong evidence that spinal manipulation was not effective for treating asthma, headache and nocturnal enuresis. Findings were inconclusive for all other conditions, except torticollis, where there was insufficient data to draw conclusions and there was insufficient evidence to support the use of spinal mobilisation for treating any condition in paediatric populations [3].

Adverse events from spinal manipulation or mobilisation with paediatric populations are sparsely reported in the scientific literature; however, mild-to-severe adverse events have been documented [3]. The systematic reviews conducted by Driehuis et al. and Milne et al. revealed the following severe adverse events: rib fractures, acute respiratory decompensation, neurological deficits, and subarachnoid hemorrhage leading to death [2,3]. The practice of OMPT for infants, children, and adolescents internationally is based on existing guidelines, protocols, policy statements, and surveillance strategies; albeit lacking high-quality evidence to support its use clinically [3]. Additionally, a Global Summit was conducted in 2019 with 50 researchers (primarily chiropractic) from North America, Europe, and Australia to conduct a systematic review of the literature to determine efficacy and effectiveness of spinal manipulative therapy (SMT) for the prevention of non-musculoskeletal disorders [4]. The group found six (6) randomised controlled trials of acceptable or high-quality investigation. They found no evidence of an effect of SMT to manage non-musculoskeletal conditions including infantile colic, childhood asthma, hypertension, primary dysmenorrhea, and migraine. Furthermore, the findings of the systematic review by Côté, et al., 2019 directly challenges the theory that SMT has a physiological effect on organs and how they function.[4]

Thus, an international Delphi survey of physiotherapy experts was considered the most appropriate method to inform a professional position statement to guide physiotherapy practice and develop recommendations regarding the use of spinal manipulation and mobilisation in paediatric populations with diverse medical conditions and impairments.

The Delphi design is a practical and structured method of obtaining opinions on given research questions from a range of experts [5]. It is used to gain consensus among a group of experts that constitute the Delphi panel. The Delphi design avoids situations in which the views of a single perspective dominate the group [5]. The purpose of this Delphi survey was to build consensus among an international panel of expert physiotherapists in manual therapy and paediatrics regarding the use of spinal mobilisation and manipulation in infants, children, and adolescents with various conditions and impairments.

Methods

Study design and recruitment

For this Delphi survey, the IFOMPT/IOPTP task force on paediatric spinal manipulation developed a set of questions to investigate the use of spinal manipulation and mobilisation in infants, children, and adolescents. The respondents took part in sequential questionnaires that constitute different rounds, and each round was refined based on answers from the previous. Qualtrics® platform was set to allow each respondent to answer each survey round once only. Respondents' answers were blinded from one another. The responses remained anonymous for data analysis, and after analysis were distributed back to the participants for further rounds of questions. Three rounds of this Delphi survey were planned to achieve consensus between panel members. Consensus was defined a-priori as greater than or equal to (≥) 75% agreement on all items with the same ranking of agreement or disagreement [5–7]. The CHERRIES guideline for Survey Research [8] was utilised to develop the Delphi design protocol.

Prior to recruitment, the Institutional Review Board (IRB) exemption was awarded by the Texas Tech University Health Sciences Center (TTUHSC), USA (#L21–151) and ethical approval was obtained by the Bond University Human Research Ethics Committee (#NM03322).

Survey participants

There is no guideline to define an 'expert' for a Delphi Survey or the number of experts required [9,10]. Twenty-six international physiotherapy experts from eight countries (Australia, Belgium, Canada, Republic of Korea, South Africa, the Netherlands, United Kingdom, and the United States) representing five continents were identified and invited via e-mail to participate. The selection of experts was based on a search for authors of peer-reviewed publications on paediatric and manipulative therapy, referral from the member countries of IFOMPT and IOPTP, paediatric representatives, and personal contacts. 'Experts' for this Delphi survey were defined as Physiotherapists who understand the English language who: (1) specialised in the exclusive treatment of paediatric orthopedic conditions utilising manual or manipulative therapy as a part of their management strategy; or (2) had specialised education in musculoskeletal manipulative therapy with at least 5 years of clinical experience; or (3) specialised in paediatrics with exposure to the use of manual therapy techniques and with at least 5 years of clinical experience; or (4) had a research background, including publications in the area of paediatrics and manipulative therapy.

Informed consent

Survey participants were sent an e-mail invitation explaining the Delphi process and the anonymity of the investigation. Additionally, they were made aware of the estimated time needed to complete each round voluntarily.

Survey questions round-1

Round-1 of the Delphi survey was presented to consenting physiotherapy experts using an electronic survey link via e-mail ($n = 26$). Round-1 included open-ended questions (see Figure 1) and limited demographic information. Finally, respondents who agreed to participate in Round-2, were directed to a separate survey link where they provided contact details to indicate their expression of interest in completing Round-2 of the Delphi survey. This method allowed data from Round-1 to remain anonymous.

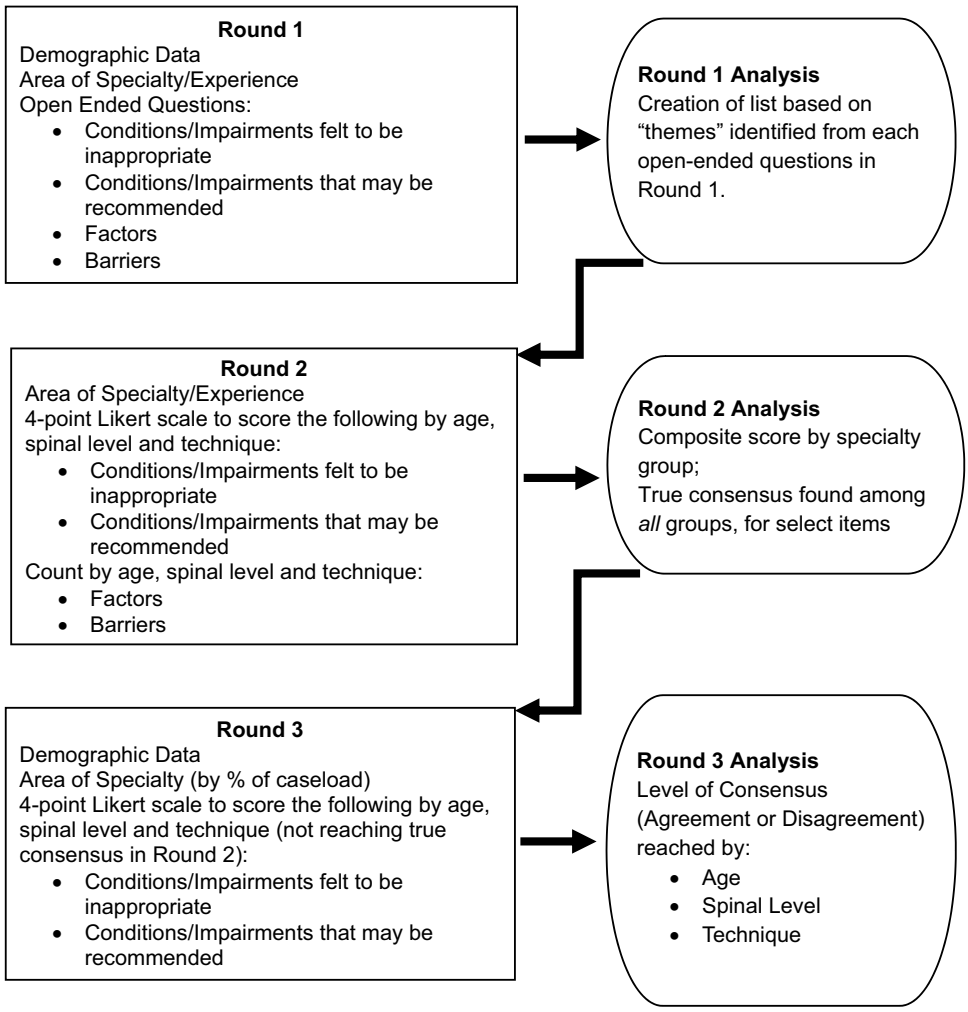


Figure 1. Delphi process.

Table 1. Conditions or impairment list generated from round-1.

Conditions - *Not appropriate*	Impairments - *May be recommended*
Acquired bony abnormality (e.g. fracture)	Decreased motor control
Acquired central nervous system injury (e.g. traumatic brain injury, shaken baby syndrome)	Decreased proprioceptive awareness
Bone disorder (e.g. osteogenesis imperfecta, Ricketts)	Joint hypomobility
Congenital bony abnormality (e.g. bony fusion or malformation)	Joint pain
Congenital central nervous system abnormality (e.g. neural tube defects, hypoxic ischemic encephalopathy)	Muscle/myofascial pain
Neurodevelopmental disorder (e.g. autism, developmental coordination disorder)	Muscle/myofascial stiffness (e.g. muscle guarding, muscle tightness)
Hypermobility (e.g. joint laxity, low tone)	Spasticity
Hypersensitivity	Plagiocephaly
Inflammatory/Systemic process (e.g. acute inflammatory process, rheumatological disorders)	Respiratory impairments (e.g. asthma)
Malignancy/neoplasm	Poor gastrointestinal function (e.g. colic, constipation)
Neuromuscular disorders (e.g. spinal muscular atrophy, muscular dystrophy)	
Peripheral nerve disorder	

Identification of Delphi round-1 variables

Two separate investigators (JD and RS) categorised and grouped the open-ended responses independently, then met and arrived at a consensus on the variables to include in Round-2 (Table 1). If there was disagreement for any variable, a third investigator (JH) evaluated the data and independently categorised the variables. Once categorised, a majority vote (2 out of 3 investigators) determined the group category for the variable(s) in question. In addition to the use of spinal manipulation and mobilisation with infants (defined as birth to <2 years), children (defined as 2 to 12-years), and adolescents (defined as 13 to <18 years), the respondents were asked to identify factors and barriers that influenced the utilisation of these techniques for each age group. The final lists of conditions and impairments (Table 1) were then presented for voting in Round-2 and Round-3. The factors and barriers identified will be discussed in a separate publication.

Survey questions round-2

Round-2 was sent to the e-mail addresses provided by the respondents at the end of Round-1 ($n = 21$). The expert physiotherapists were asked for their demographic information and primary practice population (adult, paediatrics, or both). A 4-point Likert scale (strongly disagree, disagree, agree, strongly agree) was utilised to identify the level of agreement for using spinal manipulation and mobilisation among infants, children, and adolescents across a variety of conditions, impairments, and spinal levels (cervical, thoracic, and lumbar). Participants indicated their willingness to participate in Round-3 by completing a separate survey link and entering their e-mail address, thus keeping answers in Round-2 anonymous to investigators.

Survey questions round-3

Round-3 was sent to the e-mail addresses provided by the respondents at the end of Round-2 ($n = 13$). When the highest response percentage for each answer did not reach full consensus among all groups in Round-2, the question was presented to the respondents again in Round-3. Each respondent then voted again on questions from Round-2 using the same 4-point Likert scale to reach a final consensus and ranking. Asking demographic information allowed investigators to identify differences in opinion based on experience levels in paediatrics.

Data analysis

Mean, standard deviation (SD), median, minimum values, maximum values, and frequency counts for the demographic characteristics of the physiotherapists participating were recorded. Data from each round was downloaded into an Excel spreadsheet and de-identified prior to analysis. Incomplete surveys or those not meeting inclusion criteria were excluded from data analysis. Microsoft Excel (version 365) was used to analyse descriptive statistics. The response rate for each round was determined by calculating the difference between the number of e-mails sent and completed responses received. Complete responses were those where each required response was completed within the round.

Respondents were grouped for each round according to their primary practice population: those respondents who primarily worked with (i) individuals ≥18 years (Adult); (ii) birth up to 18 years (Paeds), and (iii) individuals above and below the age of 18 years (Both). In Round-3, respondents who identified as 'Both' (treating paediatric and adult populations) were asked to report their average percentage of weekly caseload over 5-years. They were then placed in the 'Adult' or 'paediatric' group based on the top 80% of their caseload to observe heterogeneity of our sample to reduce and accurately report trends in bias between specialty areas.

An established a-priori consensus was obtained, and each item was considered in 'agreement' if the percentage of respondents answering 'agree' or

Table 2. Demographics of respondents.

Characteristic	Count (%) Round 1 n = 20	Count (%) Round 3 n = 11
Female	14 (70)	7 (64)
Male	6 (30)	4 (36)
Age in years, $\underline{X}$ [SD]	49.6 [11.2]	50.7 [10.8]
Years of practice $\underline{X}$ [SD]	23.3 [12.1]	26 [10.1]
Number of Countries represented	8	7
Australia	3	1
Belgium	1	0
Canada	2	1
Korea	2	1
Netherlands	3	3
South Africa	1	1
United Kingdom	2	1
United States of America	6	3
Specialisation		
Adult	2	4 (36)
Both	10	3 (27)
Paeds	8	4 (36)
Highest Physiotherapy Education Level (%)		
Bachelor of Science in Physiotherapy	1 (5)	2 (18)
Master of Science in Physiotherapy	5 (25)	3 (27)
Clinical Doctorate of PT/Masters (extended)	3 (15)	2 (18)
Post-Professional Doctorate Degree in PT	11 (55)	4 (36)
Advanced Certification in Orthopaedic Manual Therapy (OMT)	8 (40)	5 (45)
Advanced Certification in Paediatrics	6 (30)	4 (36)
Advanced Certification in OMT & Paediatrics	3 (15)	2 (18)
Teaching Setting (%)		
Not currently teaching physiotherapy	3	2 (18)
Academic	12	6 (55)
Continuing Education	7	6 (55)
Residency/Fellowship	1	1 (10)
Clinical Setting (clinical instructor)	7	3 (27)

PT: Physiotherapy, OMT: Orthopaedic Manipulative Therapy, SD: Standard Deviation.

'strongly agree' was ≥75%. Conversely, 'disagreement' was identified when the percentage of participants answering 'disagree' or 'strongly disagree' was ≥75%.

Items not achieving consensus in Round-2 were presented to the respondents in Round-3.

Results

Demographics of respondents

Demographic data, survey participants' expertise, and response rates are detailed in Table 2. Twenty international physiotherapists completed Round 1, 13 completed Round 2, and 11 completed Round-3 (55% of original expert panel). Ninety-two percent of Delphi panel respondents from Round-2 completed Round 3. Final responses represented views from seven countries across five continents. In Round-3, the respondents' average age was approximately 50 years, practicing physiotherapy for 26 years with approximately two-thirds of participants female. Demographic data, survey participants' expertise, and response rates are detailed in Table 2. The overall attrition from Round 1 to Round 2 was 40%, and the attrition rate between Round-2 and Round-3 was 8%. Six (6) of the 11 respondents in Round 3 reported teaching in the academic setting, but only three (3) of them reported <10% of their time in the clinical settings; the other three (3) reported 20–54% of their time in the clinical setting. One (1) of our experts reported having no caseload within the last 5 years reported 80% of their time in research and 21% teaching in the classroom. Lastly, four (4) of the 11 respondents in Round 3 did not hold advanced certification in orthopedic manual therapy or paediatrics, but there were two (2) individuals who were certified in both orthopedic manual therapy and paediatrics.

Conditions

Spinal Manipulation and Mobilisation Perceived Appropriateness

The perceived appropriateness of using manipulation or mobilisation of the spine to manage a variety of conditions in paediatric populations, as identified via the Delphi expert panel, is reported in Table 3.

Infants

(1) Consensus was achieved indicating spinal manipulation at all spinal levels is not appropriate to treat infants for any condition.
(2) Consensus was achieved that spinal mobilisation at all spinal levels is not appropriate, except mobilisation for neurodevelopmental disorders where there was no consensus.

Table 3. Consensus (≥75% agreement) by condition that mobilisation or manipulation of specified spinal regions is not appropriate (X) or remains unclear (?) for an infant, child, or adolescent.

CONDITION	Mobilisation						Manipulation					
• Age	Infant			Child			Adolescent			Infant			Child			Adolescent		
• Region	C	T	L	C	T	L	C	T	L	C	T	L	C	T	L	C	T	L
Acquired bony abnormality	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Acquired central nervous system injury	X	X	X	X	X	?	X	X	X	X	X	X	X	X	X	X	X	X
Bone disorder	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Congenital bony abnormality	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Congenital central nervous system abnormality	X	X	X	X	X	X	X	?	X	X	X	X	X	X	X	X	X	X
Neurodevelopmental disorder	?	?	?	?	?	?	?	?	?	X	X	X	X	?	X	X	?	X
Hypermobility	X	X	X	?	?	?	?	?	?	X	X	X	X	X	X	X	X	X
Hypersensitivity	X	X	X	?	?	?	?	?	?	X	X	X	X	X	X	X	?	X
Inflammatory/systemic process	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Malignancy/neoplasm	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Neuromuscular disorder	X	X	X	X	X	X	?	?	?	X	X	X	X	X	X	X	X	X
Peripheral nerve disorder	X	X	X	?	?	?	?	?	?	X	X	X	X	?	X	X	?	?

Key: Infant (birth to < 2-years); Child (2 to 12-years); Adolescent (13 to < 18-years); C = cervical; *T* = Thoracic; L = Lumbar; X = Consensus that the treatment (manipulation or mobilisation) is *NOT appropriate;* ? = No consensus.

Table 4. Consensus (≥75% agreement) by impairment that mobilisation or manipulation of specific spinal regions is recommended (+), not recommended (X) or unclear (?) for an infant, child, or adolescent.

IMPAIRMENT	Mobilisation									Manipulation								
• Age	Infant			Child			Adolescent			Infant			Child			Adolescent		
• Region	C	T	L	C	T	L	C	T	L	C	T	L	C	T	L	C	T	L
Decreased motor control	X	X	X	?	?	X	?	?	?	X	X	X	X	X	X	X	X	X
Decreased proprioceptive awareness	X	X	X	?	?	?	?	?	?	X	X	X	X	X	X	X	X	X
Spinal Joint hypomobility	?	?	?	+	+	+	+	+	+	X	X	X	X	?	X	?	+	+
Spinal Joint pain	?	?	?	+	+	+	+	+	+	X	X	X	X	?	X	?	+	?
Muscle/myofascial pain	?	?	?	+	+	+	+	+	+	X	X	X	X	X	X	?	?	?
Muscle/myofascial stiffness	?	?	?	+	+	+	+	+	+	X	X	X	X	?	X	?	?	?
Spasticity	X	?	?	?	?	?	?	?	?	X	X	X	X	X	X	X	X	X
Plagiocephaly	?	?	X	?	?	?	?	?	?	X	X	X	X	X	X	X	X	X
Respiratory impairments	X	?	X	?	?	?	?	?	X	X	X	X	X	X	X	X	X	X
Poor Gastrointestinal (GI) function	?	?	?	?	?	?	?	?	?	X	X	X	X	X	X	X	X	X

Key: Infant (birth to < 2-years); Child (2 to 12-years); Adolescent (13 to < 18-years); C = cervical; *T* = Thoracic; L = Lumbar; X = Consensus that the treatment (manipulation or mobilisation) is *NOT appropriate;* + = Consensus that the treatment (manipulation or mobilisation) could be used; ?= No consensus.

Children

(1) Consensus was achieved indicating spinal manipulation across all spinal levels is not appropriate for treating the majority of conditions explored in children. There was no consensus regarding the use of spinal manipulation for treating neuro-developmental disorders (thoracic spine) and peripheral nerve disorders (thoracic spine) in children.

(2) Consensus was achieved indicating spinal mobilisation across all spinal levels is not appropriate to treat most conditions explored in children. There was no consensus regarding the use of spinal mobilisation for treating neuro-developmental disorders, hypermobility, hypersensitivity, and peripheral nerve disorders.

Adolescents

(1) Consensus was achieved indicating spinal manipulation across all spinal levels is not appropriate for treating most conditions explored in adolescents. There was no consensus regarding the use of spinal manipulation for treating neuro-developmental disorders (thoracic spine), hypersensitivity (thoracic spine), and peripheral nerve disorders (thoracic and lumbar spine) in adolescents (see Table 3).

(2) Consensus was achieved indicating spinal mobilisation across most spinal levels is not appropriate for treating acquired bony abnormalities, acquired central nervous system injury, bone disorders, congenital bony abnormalities, congenital central nervous system abnormalities (cervical and lumbar), inflammatory/systemic processes, and malignancy/neoplasm in adolescents. There was no consensus regarding the appropriateness of using spinal mobilisation across all spinal levels to manage neurodevelopmental disorders, hypermobility, hypersensitivity, neuromuscular disorders or peripheral nerve disorders in adolescents.

Impairments

Spinal manipulation and mobilisation recommended

1. Consensus from the Delphi expert panel regarding the recommendation(s) for using spinal manipulation or mobilisation to treat a variety of impairments in paediatric populations is reported in Table 4.

Infants

(1) Consensus was achieved indicating spinal manipulation at all spinal levels is not recommended to treat infants.
(2) Consensus was achieved indicating spinal mobilisation at all spinal levels is not recommended to treat decreased motor control or decreased proprioceptive awareness in infants. Consensus was achieved indicating spinal mobilisation is not recommended to treat spasticity (cervical), plagiocephaly (lumbar), or respiratory impairments (cervical and lumbar) in infants. Consensus was not achieved regarding the use of spinal mobilisation (across all spinal levels) for treating the impairments of spinal joint hypomobility, joint pain, muscle/myofascial pain, and muscle/myofascial stiffness in infants.

Children

(1) Consensus was achieved indicating spinal manipulation is not recommended to treat the majority of impairments explored in children. Consensus was not reached regarding the use of spinal manipulation to treat spinal joint hypomobility (thoracic), spinal joint pain (thoracic), and muscle/myofascial stiffness (thoracic).
(2) Consensus was achieved indicating spinal mobilisation of the cervical, thoracic, and lumbar spine can be recommended for managing spinal joint hypomobility, spinal joint pain, muscle/myofascial pain, and muscle/myofascial stiffness in children. Consensus was achieved indicating spinal mobilisation at the lumbar level is not recommended to treat decreased motor control in children. Consensus was not achieved regarding the use of spinal mobilisation (at all spinal levels) for any other impairment in children.

Adolescents

(1) Consensus was achieved indicating spinal manipulation could be recommended to treat spinal joint hypomobility (thoracic and lumbar) and spinal joint pain (thoracic) in adolescents. Consensus was achieved indicating spinal manipulation (at all spinal levels) is not recommended to treat decreased motor control, decreased proprioceptive awareness, spasticity, plagiocephaly, respiratory impairments, or poor gastrointestinal function in adolescents.
(2) Consensus was achieved indicating that spinal mobilisation across all spinal levels can be recommended for treating spinal joint hypomobility, spinal joint pain, muscle/myofascial pain, and stiffness in adolescents. Consensus was not achieved regarding the use of spinal mobilisation for managing any other impairment explored except respiratory impairments where the expert panel consensus was that mobilisation was not appropriate at the lumbar level.

Discussion

When there is a sparsity of robust literature to quantify the effects of an intervention technique, the Delphi survey method together with existing evidence can be used to help formulate treatment guidelines.[10] This Delphi study investigated the appropriateness and recommendations for use of spinal manipulation and mobilisation in infants, children, and adolescents using an international panel of expert physiotherapists from Australia, Canada, Korea, the Netherlands, South Africa, United Kingdom, and the United States of America. The expert physiotherapists represented a variety of practice backgrounds, including those who treated the adult, paediatric or both populations, in addition to a contrast of academic, research, and clinically practising physiotherapists. The heterogeneous sample of experts, limited potential bias of the overall results.

Spinal manipulation

The expert panel deemed spinal manipulation at any spinal level for infants less than 2-years not appropriate for managing any condition. Similarly, the expert panel deemed spinal manipulation at all spinal levels for children to not be appropriate for treating any condition (except neurodevelopmental and peripheral nerve disorders in the thoracic spine) or impairment (except in the thoracic spine for joint hypomobility joint pain and muscle/myofascial stiffness). These findings align with those of a recent systematic review which reported that due to very low-quality evidence, it was uncertain whether high-velocity, low-amplitude manipulation had any effect on the reduction of impairments in children or adolescents with autism, asthma, nocturnal enuresis, headache, or idiopathic scoliosis [2]. A systematic review conducted in 2019 by a predominantly chiropractic review group reinforces the previous systematic review, indicating a lack of evidence to support the use of spinal manipulative therapy for the management of non-musculoskeletal disorders [4]. In the reviews

conducted by Driehuis and Milne, severe adverse events from spinal manipulation, such as rib fractures, acute respiratory decompensation, neurological deficits, and death were reported [2,3]. A rapid review published by Corso in 2020 on spinal manipulative therapy in children less than 10 years of age, concluded that the risk of moderate and severe adverse events was unknown as these events are poorly reported in the literature [11]. Adverse events from manipulation and mobilisation are also poorly reported in the adult population [12,13]. Furthermore, Homola [14] reasoned that manipulating an immature, cartilaginous spine may be dangerous. Thus, there is a need for robust clinical reasoning by the healthcare provider should they choose to utilise spinal manipulative therapy with paediatric populations and physiotherapy practice rights in certain jurisdictions may limit the use of manipulation.

The expert panel in the present Delphi survey did, however, recommend the use of spinal manipulation in adolescents for managing spinal joint hypomobility at the thoracic and lumbar levels and for managing spinal joint pain at the thoracic level. It is presumed that many physiotherapists may treat the older adolescent similarly to an adult. Heneghan and Rushton described the thoracic spine as an area where spinal manipulation has improved pain in adjacent areas such as the shoulder, neck, and low back pain, although the mechanism of these interventions is unclear [15]. This theory of interdependence is supported in part by a systematic review conducted by Cross et al. in 2011 which indicated that thoracic spine manipulation may provide short-term pain relief for adults with neck pain [16]. A survey of Italian physiotherapists revealed spinal manipulation to be safe and effective, specifically to the thoracic spine for musculoskeletal conditions, but educational background in traditional manual therapy was reported to significantly influence physiotherapists' attitudes and beliefs [17]. Furthermore, this is in line with findings of a survey to establish management options for thoracic spine pain, in an adult population, where the majority of participants (79.7%) recommended a multimodal treatment consisting of education, exercise, and manual therapy [18]. Sound clinical reasoning and extensive screening is important to avoid adverse events when conducting thoracic spine manipulation [19].

Spinal mobilisation

The expert panel determined spinal joint mobilisation was not appropriate for managing most conditions in infants. The lack of consensus for one condition suggested that some members of the expert panel felt it was appropriate to utilise mobilisation of the spine (at all levels) to treat infants with neurodevelopmental conditions. Additionally, spinal mobilisation of infants was not explicitly recommended by the expert panel for managing any impairment, however there was a lack of consensus for many musculoskeletal impairments and some neurological, respiratory, and gastrointestinal impairments. The lack of consensus is perhaps not unexpected, considering there is a substantial lack of empirical research regarding mobilisation of the infant spine to guide clinical practice [3].

The expert panel determined spinal joint mobilisation was appropriate to treat spinal joint hypomobility, spinal joint pain, and muscle/myofascial pain for each spinal level in children and adolescents. Further, the expert panel determined spinal manipulation at the thoracic level to be appropriate for treating spinal joint hypomobility and spinal joint pain and manipulation at the lumbar level for treating joint hypomobility in adolescents. This finding is consistent with findings in the adult population. That is, thoracic spinal manipulation can be an effective treatment for the neck or shoulder pain [16,20–22].

These findings are somewhat comparable to a Delphi investigation by Dice, et al.. (2021) of expert physiotherapists, consisting of board-certified paediatric specialists and fellows of the American Academy of Orthopaedic Manual Physical Therapists in the United States [7]. Dice and colleagues (2021) investigated the appropriateness of joint mobilisation (grades I to IV) in children 0–12 years of age [7]. They found spinal mobilisation was appropriate for treating joint, muscle, and myofascial impairments [7]. However, no consensus was reached regarding the use of manipulation in this population. While the present Delphi did not split mobilisation into grades, the general findings align with the 2021 Delphi survey by Dice and colleagues; that spinal mobilisation may be recommended as a possible treatment for joint pain, joint hypomobility, muscle/myofascial pain, and muscle/myofascial stiffness among children [7].

Whilst some consistency among physiotherapists is emerging regarding the potential use of spinal mobilisation to manage some musculoskeletal impairments in children and adolescents, clinicians must be mindful that there remains very little empirical evidence of effectiveness from spinal mobilisation in this population [3].

The present Delphi survey could serve to further guide physiotherapists' clinical judgment regarding the use of spinal manipulation and mobilisation with paediatric populations; however, once further

empirical evidence of effectiveness or harms is available to support or prohibit the use of these techniques, further Delphi investigations may be warranted.

Limitations

While the number of experts is not a specific limitation to the Delphi process [9,10], caution should be exercised with international generalisation as all countries were not represented among the Delphi respondents. Round 2 and 3 were completed by 55% of Round 1 participants and this may have skewed results. However, a systematic review of Delphi surveys by Gargon et al., indicates that the more items included in the study tend to affect the overall attrition [23]. We asked about three different age ranges and three different spinal levels each for both mobilisation and manipulation. Round-2 included a minimum of 396 items that required scoring and Round-3 included a minimum of 203 items. Furthermore, the initial number of experts were identified by the IFOMPT/IOPTP Task Force on Paediatric Spinal Manipulation, and all expert members of the Delphi panel were required to have mastery of the English language, thus limiting the initial reach to experts and potentially excluding those who could have added to the overall results. Additionally, a larger initial sample would have likely resulted in a larger final sample.

Strengths

The present Delphi survey demonstrated a retainment rate of 92% between Rounds-2 and 3, indicating that the sample remained stable during the consensus process. Additionally, in Round-3, there was a relatively even number of expert physiotherapists that treated adults, paediatric clients, or both, indicating no evidence of bias toward responses of one group's opinions.

Conclusion

Based on ≥75% agreement, the expert physiotherapists from this Delphi survey believe spinal manipulation is *not appropriate* as a treatment technique for all conditions or impairments at all spinal levels when treating infants, and all conditions and most spinal levels for children. Conversely, there was consensus that manipulation of the thoracic and lumbar spine is appropriate for treating spinal joint hypomobility, and manipulation of the thoracic spine is appropriate for treating spinal joint pain in adolescents. Similarly, for children, the panel concluded that mobilisation is appropriate for treating spinal joint hypomobility, spinal joint pain, muscle/myofascial pain, and muscle/myofascial stiffness at all spinal levels. Whilst sound clinical judgment and clinical reasoning should be applied when utilising spinal mobilisation at any time [3], it is especially important in the paediatric population for any condition or impairment where consensus regarding its use was not achieved. Additional research is needed to support decision-making regarding evidence-based practice, especially where there is consensus for using spinal manipulation or mobilisation without evidence of effectiveness in paediatric populations.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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