

Original Research

Perceptions and beliefs of physical therapists regarding the mechanisms of manual therapy

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ABSTRACT

Background: Manual therapy (MT) is a widely utilized approach for managing musculoskeletal pain and functional disorders, particularly through joint mobilizations. Traditionally explained by immediate biomechanical processes, a paradigm shift has occurred in the last few decades, recognizing neurophysiological mechanisms as crucial contributors.

Objectives: To evaluate whether this shift is also reflected by clinicians, this study explores the beliefs and perceptions of physical therapists regarding the mechanisms underlying MT through an online survey design. The focus was if dominantly peripheral biomechanical model or a neurophysiological explanatory model prevails.

Methods: The study involved a national cross-sectional survey of 569 physical therapists, average age 36.5y (9.7), and 58 % female. Based on a fictitious case scenario, participants rated on a scale from 0 % to 100 %, the involvement of anatomical structures and physiological mechanisms and provided additional suggestions.

Results: The majority of responders attributed significant involvement to the brain (75 %), myofascial structures (71 %), peripheral nervous system (68 %), and cervical joints (60 %). Mechanisms such as endogenous pain modulation (73 %), placebo effects (72 %), muscle activity (68 %), and neuromuscular responses (62 %) were commonly endorsed. The data indicated that socio-demographic and work-related characteristics are weakly associated to specific beliefs, emphasizing the complex nature of these perspectives. The findings underscore the diversity in physical therapists' beliefs and highlight the importance of understanding the mechanisms, as they significantly contribute to the perceived effectiveness of MT.

Conclusion: This study provides valuable insights into the current landscape of beliefs among German physical therapists, contributing to the ongoing dialogue between basic research and clinical practice in MT.

Introduction

Manual therapy is a preferred therapeutic choice among physical therapists, chiropractors, and osteopaths, as well as patients for the treatment of pain and/or functional disorders of the musculoskeletal system.^{1–4} In this context, manual joint mobilizations are often applied to identify and target painful segmental dysfunctions of the spine.^{5,6} In an evidence-based physical therapy approach, it is fundamental to understand the actual underlying mechanisms involved in the treatment

techniques, crucial to determine its indications, expected response, and possibly establish a prognosis.

Due to the long history of manual therapy, the underlying immediate mechanisms of these joint mobilizations were primarily explained in the past by biomechanical processes.⁷ For example, segmental dysfunction, i.e. restricted joint gliding, is intended to be normalized through manual forces.^{8,9} In the last three decades, however, there has been a paradigm shift in the understanding of the mechanisms underlying responses to manual therapy.^{10–12} The exclusive consideration of biomechanical

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mechanisms therefore seems outdated. Instead, studies point towards a neurophysiological explanatory model that includes biomechanical influences as well as complex interactions within the peripheral, central, and autonomic nervous system.¹⁰ Furthermore, it has been repeatedly shown that this therapeutic effect from manual therapy is significantly influenced by contextual factors including patients' and therapists' beliefs, therapeutic alliance, setting/environment, and treatment characteristics.^{13,14}

The relationship between basic (mechanistic) research and its use as a basis for clinical research and clinical practice is at the core of any biomedical research strategy.¹⁵ Although the translation or implementation of mechanistic research into clinical practice is encouraged and required, this process is still slow and insufficient across healthcare settings.^{16,17} The extent to which the translation of these mechanistic scientific findings on manual therapy into the clinical practice of physical therapists is successful, is still unclear. The aim of this national survey is therefore to explore the beliefs and perceptions of German physical therapists regarding the underlying mechanisms of manual therapy. In particular, to examine whether a more peripheral biomechanical or a neurophysiological explanatory approach is represented and whether these beliefs are explained by socio-demographic and work-related characteristics or the perceived effectiveness of manual therapy.

Methods

Study design

In this cross-sectional and Germany-wide online survey, physical therapists were asked about their perceptions and beliefs regarding the underlying immediate mechanisms of manual therapy using a fictitious case scenario. The data collection period lasted three months in total, from July to October 2023. Beforehand, this study was approved by the Ethics Committee of the University of Luebeck (reference number: 2023–512) and preregistered in the Open Science Framework (<https://osf.io/xsv4y>). Before the start of the survey, the participants were informed about the aims and context of the questionnaire and were asked to confirm their participation. Participation in the survey was anonymous, voluntary, and no incentives were offered. Participants were given the opportunity to refuse to answer individual questions or to leave the entire questionnaire unanswered. The study was reported using the Checklists for Reporting Results of Internet E-Surveys (CHERRIES)¹⁸ and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).¹⁹

Participants

German adults with a degree in physical therapy were invited to participate in this study. Participants were recruited through announcements and advertisements in various physical therapy networks, social media, and relevant internet platforms, as well as through personal contacts of the study administration. This involved sending or posting the online questionnaire as a hyperlink. A snowball method was used, encouraging participants to distribute the invitation to further colleagues. Given the exploratory nature of this cross-sectional survey, a sample size calculation was conducted for surveys based on the total population of licensed physical therapists in Germany (206,000),²⁰ with a 95 % confidence level ($Z\text{-score} = 1.96$), maximum variability of $p = 0.05$ and a 5 % margin of error. These parameters were employed in the Cochran's sample size formula,²¹ which yielded a minimum requirement of 384 participants for the survey. However, considering the potential for missing data, the goal for the study was a sample size of 500 participants, which would also enable regression analyses with subgroups of sufficient sample size to be performed.

Online survey

The conceptualization of this questionnaire was based on the current framework model for mechanistic research in manual therapy.¹⁰ Using a case scenario, physical therapists were asked to assess the involvement of anatomical structures and physiological mechanisms that would directly or indirectly contribute to the immediate treatment effect. Even if a different form of therapy (i.e. exercises) was preferred, it was still important to be consistent with the scenario. Accordingly, questions were to be rated on a scale from 0 = "not involved at all" to 100 = "maximally involved" (alternatively "uncertain"). In addition, the physical therapists had the opportunity to suggest additional anatomical structures and physiological mechanisms in free text form. On the last page, the participants were also asked to rate the effectiveness of manual passive mobilization of the cervical spine in clinical practice on a scale from 0 (not effective at all) to 100 (maximally effective) using a digital 0–100 ruler. It was emphasized that the question evaluated exclusively the immediate effect (not longer-term) on pain relief and increased range of movement.

In this fictitious case scenario, a patient (male or female) consults one of your colleagues (male or female) with pain and an isolated restriction of movement in the cervical spine into rotation to the right. The symptoms have been present for 3 weeks. Based on the patient's medical history and physical examination, your colleague decides to perform a manual (direct or local) passive (intersegmental) mobilization of the middle cervical spine (C4/5). Subsequently, the patient reports significant pain relief and shows an increase in mobility to the right during the re-examination.

The questionnaire was based on the framework model for mechanistic research in manual therapy by Bialosky et al.¹⁰ Using the model, three different collaborators (CL, RS, TMS) extracted individually all anatomical structures and all underlying mechanisms suggested to be involved. Subsequently, 15 experts (eight clinical physical therapists, seven post-doctoral researchers with expertise in musculoskeletal therapy) were asked to evaluate the case scenario and the anatomical and mechanistic categories, which were presented as potential explanations for an immediate treatment response in the survey. At this point, face validity assessment of the questionnaire was performed as experts evaluated the descriptions for completeness and comprehensibility. Furthermore, they were encouraged to suggest appropriate changes or additions. The case scenario and the response categories were considered comprehensible by all 15 volunteers, and only minor rewording or additions were suggested. The following additional categories were suggested and added to the online survey: intervertebral disc (as an anatomical structure), endogenous pain modulation and blood flow (as a physiological mechanism).

In addition, the following demographic and professional characteristics were collected anonymously as part of this survey: sex, age, employment, work experience (years), degree, previous training in manual therapy, clinical situations (setting, patients, hours, etc.), and additional engagements in teaching or research. Both the German version of the complete questionnaire and its English translation can be provided by the authors upon request.

The SoSci Survey online platform (SoSci Survey GmbH, Munich, Germany), an online tool for research projects not conducted on behalf of companies or cooperations (www.sosicisurvey.de), was used for the online questionnaire. The estimated time frame for answering the questions was 10 to 15 min. The link to the survey remained accessible online without restrictions (no password or registration required). No duplicate cookie files or IP-based protection were used. The online survey consisted of 13 sections of questions on 9 to 12 pages. The number of pages and items per page were customized by filter questions. If any answers were recognized as "missing", participants were reminded to answer all questions before proceeding to the next page. Participants with missing values regarding the anatomical structures and physiological mechanisms were excluded from the analysis. A plausibility

check (e.g. practical experience exceeds age) was performed, and participants were excluded accordingly.

Data analysis

Exploratory-descriptive analyses were performed using the IBM Statistical Package for the Social Sciences (SPSS Version 28, Armonk, NY, USA) and 5 % alpha level was applied. The descriptive statistics of the characteristics are presented either in absolute and relative frequencies or mean values with respective standard deviations. The anatomical structures and mechanisms involved are represented by absolute and relative frequencies, dichotomized by a perceived involvement in the manual therapy response of <50 % or at least 50 %. Graphical representation was also done using commutative frequencies and boxplots (median, interquartile range, total range). The additionally proposed anatomical structures and mechanisms were summarized in categories. The anatomical structures and mechanisms were contrasted using the χ^2 -goodness of fit test, to compare the category distribution within the sample.

Multiple linear regression analyses with backward selection for variable exclusion were used to identify potential predictors based on demographic data for each anatomical structure and mechanism separately. Moreover, multiple linear regression analyses with backward selection for variable exclusion ($\alpha > 0.10$) were used to explain the perceived effectiveness of MT with the previously described predictors. These analyses were additionally repeated with both the anatomical structures studied and the underlying mechanisms.

Results

Survey response

In total, the survey link was accessed 2763 times, with 790 participants giving their consent. A total of 569 participants completed the questionnaire, i.e. answered the last page (72 % completion rate) and were therefore included in the data analysis. No data were excluded after the plausibility check. The included 569 participants completed 93 % (SD 5.0) of all questionnaire data.

Characteristics

Of the included participants (age 36.5 (SD 9.7)), 58 % were women. At the time of the survey, a total of 43 % had at least a bachelor's degree and 55 % had a diploma from a non-academic school. Ninety-one per cent ($n = 518$) of the participants were currently treating patients, predominantly in an outpatient clinic with predominantly musculoskeletal complaints and – at least to some degree – using manual therapy techniques. Participants rated the previously described cervical mobilization as 66 % (SD 24.4, $n = 563$) effective, with 0 % being not effective at all and 100 % being maximally effective. Details of participants and further characteristics can be found in Table 1 and in Fig. 1.

Involved anatomical structures

There was a difference in the distribution of structures rated as involved in manual therapy mechanisms ($\chi^2 = 575$, $p < 0.001$). Most of the participating physical therapists rated the brain ($n = 393$, 75 %), myofascial structures ($n = 390$, 71 %), the peripheral nervous system ($n = 373$, 68 %), and the cervical joints ($n = 330$, 60 %) as structures involved in the response to manual therapy with at least 50 % of contribution. The spinal cord and intervertebral discs were perceived to be less involved. The prevalence of responses to the individual anatomical structures during manual therapy are shown in Table 2 and Fig. 2. Furthermore, additional structures were suggested by participants as being involved (Supplementary online material 1). These included (among others) adjacent joints ($n = 14$), the autonomic

Table 1
Characteristics of participants.

Age (years), mean (SD), range, n	36.5 (SD 9.7), 22–66, $n = 568$
Sex, n (%)	
Female	330 (58.0)
Male	234 (41.1)
Diverse	1 (0.2)
Highest professional degree, n (%)	
non-academic PT education	314 (55.2)
Bachelor	156 (27.4)
Master	80 (14.1)
Doctorate	9 (1.6)
Other	9 (1.6)
Work experience (years), mean (SD), range, n	12.9 (9.5), 0–47, $n = 567$
Currently working with patients, n (%)	519 (91.2)
Working hours with patients per week, n (%)	
0	51 (9.0)
1 – 10h	35 (6.2)
11 – 20h	72 (12.7)
21 – 30h	115 (20.2)
31 – 40h	253 (44.5)
>40h	43 (7.6)
Type of patients being treated, n (%)	
Gynecology	51 (9.0)
Pediatrics	55 (9.7)
Geriatrics	140 (24.6)
Neurology	191 (33.6)
Musculoskeletal	470 (82.6)
Internal medicine	92 (16.2)
Psychiatry	26 (4.6)
Other	38 (6.7)
Setting	
Hospital clinic (outpatient)	419 (73.6)
Hospital clinic (inpatient)	48 (8.4)
Rehabilitation center (outpatient)	47 (8.3)
Rehabilitation center (inpatient)	37 (6.5)
Other	25 (4.4)
Postgraduate training in manual therapy, n (%)	436 (76.6)
Manual (hands-on) techniques applied in therapy, n (%)	
0 %	60 (10.5)
1–20 %	102 (17.9)
21–40 %	139 (24.4)
41–60 %	128 (22.5)
61–80 %	101 (17.8)
81–100 %	39 (6.9)
Currently working in teaching	105 (18.5)
Currently working in research	40 (7.0)

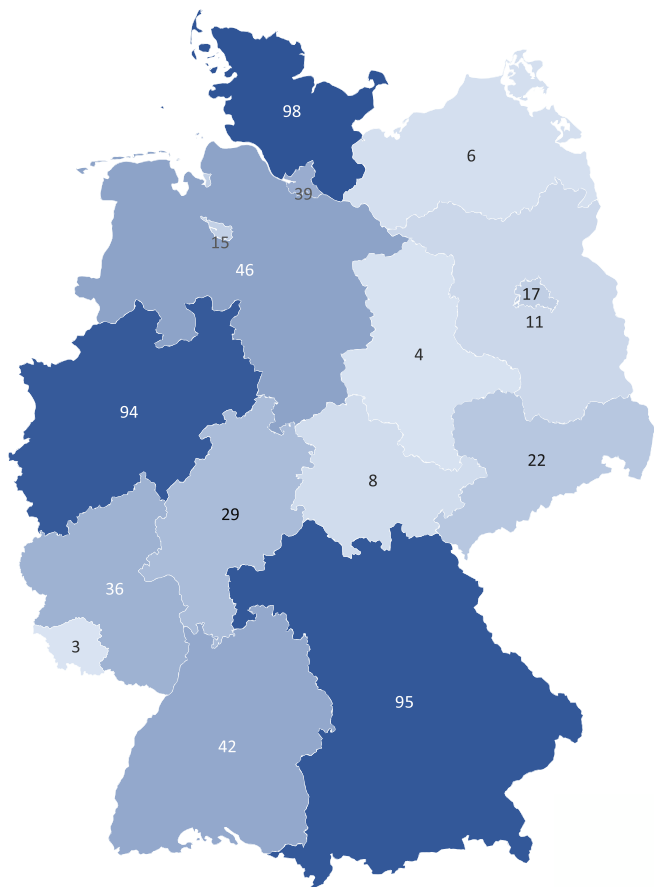
PT, physical therapy; SD, standard deviation.

nervous system ($n = 11$), and the joint capsules.

Using a linear multiple backward regression analysis, a significant explanatory model was established for each included anatomical structure using the basic characteristics (Supplementary online material 2). The variance in spinal joint involvement was explained by the variables of male sex, lack of postgraduate training in manual therapy, involvement in research or teaching, and greater hands-on time (Adjusted R^2 : 15 %, $F = 26.15$, $p < 0.001$). The variance for myofascial structures involvement was explained by the variables male sex, lower degree, and greater hands-on time practice (Adjusted R^2 : 13 %, $F = 28.63$, $p < 0.001$). Despite reaching significance, the adjusted regression coefficients between sample characteristics and the anatomical structures (vertebral disc, PNS, spinal cord, and brain) were below 6 % (Supplementary online material 2).

Involved physiological mechanisms

There was a difference in the distribution of physiological mechanisms rated as involved in responses to manual therapy ($\chi^2 = 565$, $p < 0.001$). Among the participating physical therapists, the majority believed in the following mechanisms (>50 % involvement): endogenous pain modulation ($n = 383$, 73 %), placebo ($n = 389$, 72 %),



Federal state (Germany)	N (%)
Baden-Württemberg	42 (7.4)
Bayern	95 (16.7)
Berlin	17 (3.0)
Brandenburg	11 (1.9)
Bremen	15 (2.6)
Hamburg	39 (6.9)
Hessen	29 (5.1)
Mecklenburg-Vorpommern	6 (1,1)
Niedersachsen	46 (8.1)
Nordrhein-Westfalen	94 (16.5)
Rheinland-Pfalz	36 (6.3)
Saarland	3 (0.5)
Sachsen	22 (3.9)
Sachsen-Anhalt	4 (0.7)
Schleswig-Holstein	98 (17.2)
Thüringen	8 (1.4)
No answer	4 (0.7)

Fig. 1. National representation of participants, subdivided into the various German federal states.

Table 2
Prevalence of responses for each anatomical structures and physiological mechanisms involved on manual therapy with at least 50 % of involvement.

		Sample (n = 569)	X ² goodness of fit
Anatomical Structure	Brain	75 % (393)	X² = 575, p < 0.001
	Myofascial structures	71 % (390)	
	Peripheral nervous system	68 % (373)	
	Spinal joints	60 % (330)	
	Spinal cord	25 % (126)	
	Vertebral disc	18 % (93)	
	Other	8 % (45)	
Physiological Mechanism	Endogenous pain modulation	73 % (383)	X² = 565, p < 0.001
	Placebo	72 % (389)	
	Muscle activity	68 % (374)	
	Neuromuscular reactions	62 % (313)	
	Autonomic reaction	58 % (309)	
	Blood circulation	56 % (304)	
	Myofascial biomechanics	53 % (283)	
	Endocrine system / neurotransmitter	51 % (242)	
	Joint biomechanics	47 % (249)	
	Inflammatory mediators	38 % (189)	
	Intervertebral disc biomechanics	20 % (102)	
	Other	1 % (5)	

Bold highlights significant p values. A mechanism or structure that contributed to manual therapy effects was considered if rated with at least 50 % of involvement by each participant. Missing data were excluded from the analysis.

regulation of muscle activity ($n = 374, 68 \%$), neuromuscular responses ($n = 313, 62 \%$), blood circulation ($n = 304, 56 \%$), myofascial biomechanics ($n = 283, 53 \%$) and the endocrine/neurotransmitter system ($n = 242, 51 \%$) (Table 2 and Fig. 3). Joint biomechanics, inflammatory mediators and intervertebral disc biomechanics only played a subordinate role ($<50 \%$). In addition, mechanisms such as psychological aspects, feeling of security and valued were proposed (Supplementary online material 1). Linear regression showed that male sex, lower degree, and greater hands-on time explained 18.0 % of the variance of suggesting myofascial biomechanics involvement ($F = 40.0, p < 0.001$). In contrast, male sex, involvement in teaching or research, higher practical experience and higher hands-on time explained 18 % of the joint biomechanics' involvement ($F = 30.87, p < 0.001$). Up to 14 % of blood circulation involvement was explained by male sex and hands-on time ($F = 46.3, p < 0.001$). Involvement of placebo effect was explained by less hands-on time, less years of practical experience and less involvement in research/teaching (adjusted $R^2=12 \%$, $F = 24.9, p < 0.001$). For muscle activity, lower degree, male sex and higher hands-on time explained by 11.6 % the variability ($F = 19, p < 0.001$). Significant models with R^2 lower than 10 % were observed for Intervertebral Disc Biomechanics, Inflammatory Mediators, Autonomic Reaction and Endogenous Pain Modulation mechanisms (Supplementary online material 3).

Factors explaining perceived effectiveness of manual therapy

Among the demographic characteristics, it could be found that being male, having a manual therapy training, less contact-time with patients and greater application of hands-on techniques could predict 14.1 % of perceiving manual therapy as effective ($F = 23.9, p < 0.001$).

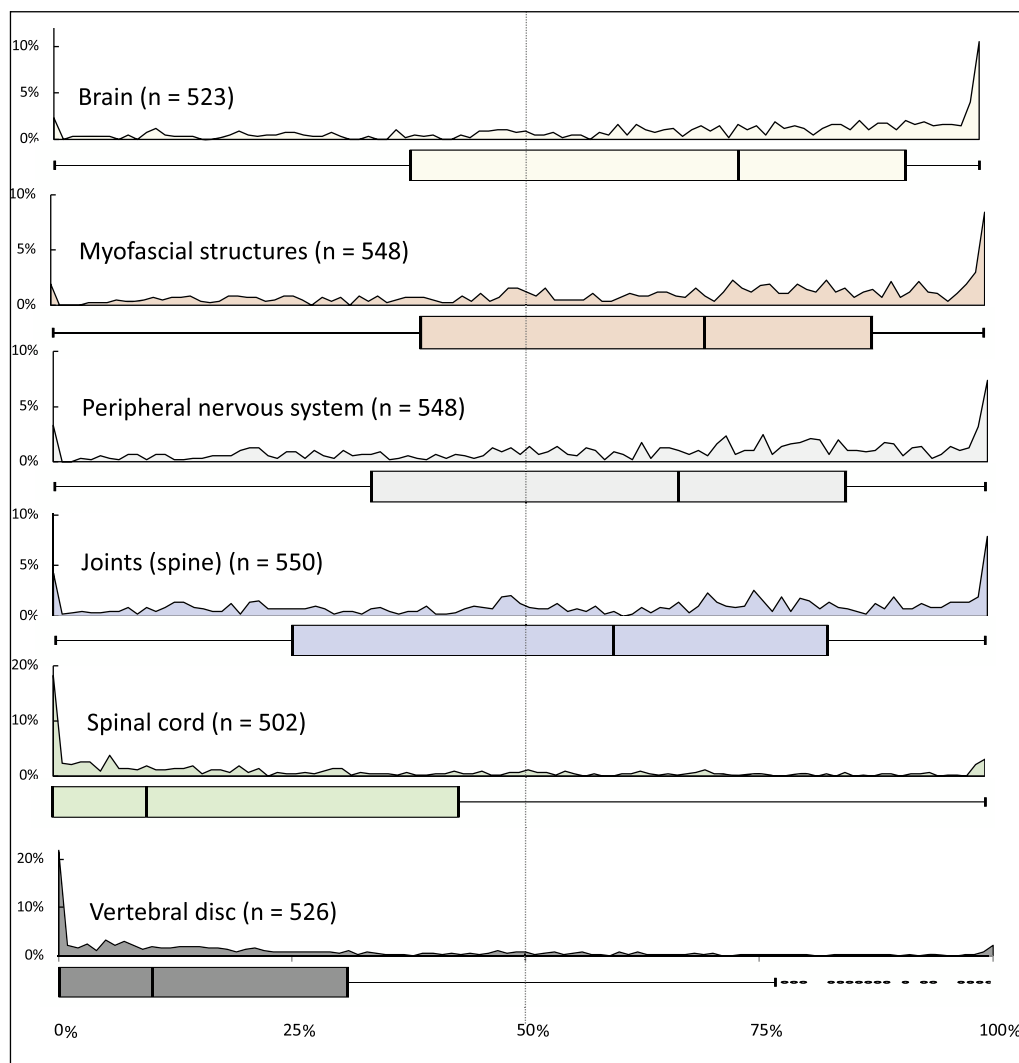


Fig. 2. Prevalence of responses for each anatomical structure involved with manual therapy. For each anatomical structure, the upper figure illustrates the frequency of the mentioned involvement (0 to 100 %) while the lower box plot presents the median and (interquartile) range.

Furthermore, multiple linear regression showed that belief in spinal joint and myofascial structure involvement explained 31.4 % of the variance in whether manual therapy treatment was rated as effective ($F = 99.4, p < 0.001$). Among the involved mechanisms on manual therapy, belief on muscle activity effects, joint biomechanics, endogenous pain modulation and less belief on placebo effects were shown to explain 26.5 % of the perceived manual therapy effectiveness ($F = 34.0, p < 0.001$) (Supplementary online material 4).

Discussion

German physical therapists identified several anatomical structures and physiological processes that are potentially involved in acute responses to manual therapy. The most suggested anatomical structures included the brain, myofascial tissues, the peripheral nervous system, and spinal joints. Mechanisms chosen included mostly endogenous pain modulation, placebo effects, muscle activity, neuromuscular responses, autonomic responses, blood circulation, myofascial biomechanics and the endocrine/neurotransmitter system. It is noteworthy that beliefs about the mechanisms of manual therapy cannot be attributed solely to socio-demographic, work-related, or educational characteristics, as these explain only a minor part of the variance (<20 %). Furthermore, the study emphasizes the importance of beliefs about the underlying

mechanisms and anatomic structures involved on manual therapy, as they may explain around one-third-of the therapists' perceived effectiveness of manual therapy.

The majority of the physical therapists selected the anatomical structures and physiological mechanisms in accordance with previous mechanistic research findings. This is particularly evident in the perceived influence of brain involvement, endogenous pain modulation, and placebo or contextual factors. Prior research has indicated the presence of a neurophysiological explanatory model that encompasses complex interactions within the central nervous system.^{10,22} For example, research has demonstrated that manual therapy -associated changes in cortical function can be detected using somatosensory evoked potentials.^{23,24} Moreover, functional magnetic resonance imaging studies show involvement of supra-spinal brain areas previously associated with the descending (endogenous) pain inhibition system.^{25–30} There is also increasing evidence that contextual factors such as beliefs, therapeutic alliance, and environment can have a significant influence on this effect.^{14,31} However, mechanistic research in this area is severely limited by the lack of adequate and valid sham treatment maneuvers in contrast to the actual manual intervention.^{32,33} It is therefore evident that there are significant research gaps, which are reflected in the involvement and importance of contextual factors.³⁴

The survey participants identified various autonomic responses, a

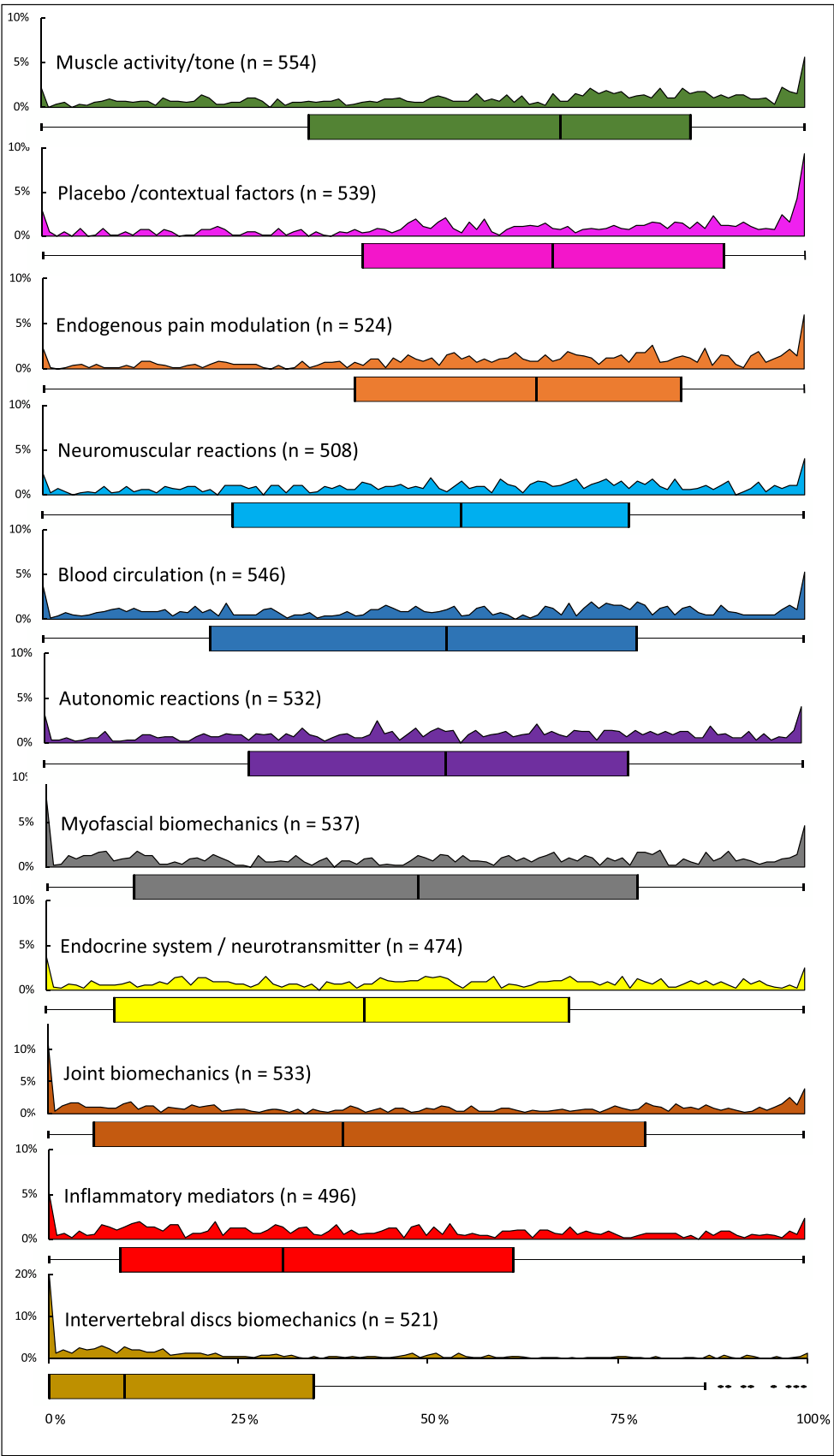


Fig. 3. Prevalence of responses for each mechanism involved on with manual therapy. For each mechanism, the upper figure illustrates the frequency of the mentioned involvement (0 to 100 %) while the lower box plot presents the median and (interquartile) range.

change in blood flow, a change in muscle activity, and the peripheral nervous system as being highly involved in the manual therapy effect. The results of recently published systematic reviews indicate that passive joint mobilization has the capacity to directly alter muscle function. This is evidenced by a reduction in the activation of superficial muscles.³⁵ Conversely, a previous review demonstrated that, in comparison to control or sham interventions, manual therapy did not result in alterations to the autonomic nervous system or corresponding surrogate measures, including heart rate variability, oxyhemoglobin, blood pressure, epinephrine, and nor-epinephrine.³⁶ Nevertheless, the authors also indicated that the findings should be interpreted with caution, given the presence of invalid methodologies and a lack of methodological rigor in the included studies. Furthermore, there is a significant requirement for high-quality research studies on the influence of blood flow and the role of the peripheral nervous system, which have not been or not adequately investigated in the context of manual therapy-associated mechanisms.

Surprisingly, only 38 % of the participants stated that a significant involvement of inflammatory mediators is to be expected. However, again a systematic summary shows that there is evidence (albeit of lower quality) that manual therapy influences biomechanical markers such as inflammatory markers (such as interleukin levels) and cortisol after the intervention.³⁷ On the other hand, no influence could be shown with regard to biochemical markers such as substance-P, neurotensin, oxytocin, orexin-A, and testosterone. The spinal involvement, however, has not yet been systematically summarized, although functional imaging studies in animal models³⁸ and changes in the flexor muscle reflex suggest a spinal cord-mediated manual therapy response.³⁹ Similarly, the biomechanical mechanisms including segmental vertebral movement and reduction in spinal stiffness is controversial and requires further research.⁴⁰ These findings demonstrate that physical therapists were likewise indifferent or highly heterogeneous in their beliefs of involvement of the underlying biomechanical mechanisms of manual therapy, reflecting also the contradictory evidence on the topic available to date.

In light of the aforementioned limitations and gaps in research, the summarized evidence suggests that the analgesic effect of manual therapy occurs independently of specific biomechanical parameters and may be attributed to the placebo effects, which involves endogenous pain modulation in response to the expectation of receiving care.^{10,14} In this context, therapists' expectations influence directly their interaction and communication with patients.⁴¹ Likewise, their therapeutic preferences, reputation and confidence – rather than precise manual therapy application – are associated with better therapeutic alliances and consequently better clinical outcomes, optimizing placebo analgesia.^{14,42} Based on this knowledge, it has been suggested that therapists' beliefs play a decisive role in manual therapy effectiveness and that randomized controlled trials often underestimate these effects, because preferences, beliefs, and expectations differ among therapists and patients in contrast to the clinical practice,¹⁴ as also observed in our survey.

In relation to the correlation between participants' characteristics and manual therapy beliefs, our study revealed that the variables "male sex" and "greater hands-on time" with beliefs involving spinal joints/joint biomechanics, vertebral discs/disc biomechanics, myofascial tissues/muscle activity, and blood circulation. Not surprisingly, the greater belief on placebo mechanisms was associated with reduced hands-on time and less years of experience. Our results also showed that perceived effectiveness of manual therapy was associated with being male, greater hands-on time, greater belief of involvement of spinal joints/joint biomechanics, changes in muscle activity, and endogenous pain modulation; and less belief in placebo mechanisms involvement.

While studies assessing therapists' beliefs towards manual therapy application are scarce, some studies explored patients' perceptions of manual therapy, which may also reflect information received from their therapists. A recent scoping review indicated that manual therapy is the intervention preferred and perceived as effective by patients with low

back pain, who valued therapists as trustful, emphatic, and effective communicators.⁴³ The same authors discussed that patients also may explain manual therapy effects based on obsolete biomedical paradigms such as spine realignment, optimizing vertebra position, or nerve release, which are also partially in line with our results. Considerable evidence demonstrates that such biomedical educational models are problematic as they have limited efficacy on pain and disability, and can further harm patients by increasing fear, anxiety, and stress levels.⁴⁴ On the other hand, other educational models based on pain neuroscience, explain the pain experience through physiological pain processing and involved contextual factors, changing the focus from isolated anatomical structures.⁴⁴ This view towards pain demonstrates reduction not just of pain ratings and disability, but also improvement levels of catastrophizing, fear-avoidance, and unhealthy behavior towards pain, improvement of physical movement and reduction of healthcare utilization. Due to the heterogeneous results, our study also evidences a discrepancy between research and clinical practice regarding current known mechanisms of pain and manual therapy. Among several reasons, the fact that treatment strategy is often provided in books and outdated knowledge can explain this transfer gap.⁴⁵

Strengths and limitations

Due to differences in physical therapy training options (academic/non-academic) in Germany, the generalizability of our results is limited. Within Germany, participants with academic background would have been over-represented. However, the results are in line with beliefs regarding manual therapy reported by patients.^{43,44}

With more than the needed 500 participants, a sufficient sample size was achieved. The sample was mainly composed of younger physical therapists and the questionnaire used was not a standardized instrument, but was developed through collaboration between experts and had its face validity assessed. Despite these limitations, this study sheds light on the beliefs and perceptions of German physical therapists regarding the underlying mechanisms of manual therapy, which have a significant impact on patients' beliefs, treatment effects, and health care system efficacy.

Conclusion

Physical therapists' beliefs about the mechanisms of manual therapy encompass both well-supported neurophysiological mechanisms, such as brain involvement, endogenous pain modulation, and placebo effects, and controversial biomechanical explanations, including myofascial biomechanics and joint-specific effects. These beliefs show weak associations with socio-demographic and work-related factors. However, perceived effectiveness of manual therapy correlates with greater hands-on time, being male, belief in specific biomechanical and neurophysiological mechanisms, and lesser reliance on placebo mechanisms. Physical therapists are encouraged to critically reflect on explanations for manual therapy mechanisms and become aware of the influence of contextual factors, as they have a significant impact on patients' beliefs, treatment effects, and health care system efficacy.

Declaration of competing interests

The authors declare no competing interests.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.bjpt.2025.101231](https://doi.org/10.1016/j.bjpt.2025.101231).

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