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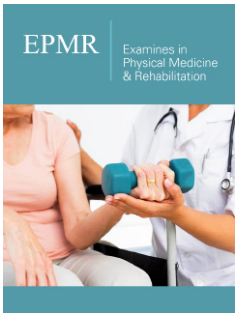
Acupuncture as an Adjunct to Physical Medicine and Rehabilitation in Gynaecological and Paediatric Disorders: A Mini Review

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Abstract

Acupuncture is increasingly delivered inside Physical Medicine and Rehabilitation (PM&R) services, where it is used less as a stand-alone treatment than as an adjunct that modifies pain, muscle tone, pelvic floor function and autonomic arousal while active training continues. This mini-review examines the rehabilitation-relevant evidence for acupuncture in two populations that remain underserved by mainstream PM&R: women with gynaecological and pelvic floor disorders, and children with developmental, behavioural and supportive-care needs. Targeted searches of PubMed, the Cochrane Library and reference lists (inception to 2025) were used, prioritising systematic reviews and meta-analyses of Randomised Controlled Trials (RCTs). In gynaecology, the most consistent signals concern primary dysmenorrhoea and endometriosis-related pelvic pain, and stress urinary incontinence, where acupuncture added to Pelvic Floor Muscle Training (PFMT) outperforms PFMT alone. In paediatrics, adjunctive acupuncture with rehabilitation training is associated with modest gains in gross motor function in cerebral palsy, whereas evidence in autism spectrum disorder, tic disorders, nocturnal enuresis and chemotherapy-related nausea is heterogeneous and of low to moderate certainty. Serious adverse events are uncommon but not negligible, and paediatric delivery demands specific safeguards. The principal limitations are non-blinded designs, small samples, short follow-up and a scarcity of function- and participation-level outcomes. A rehabilitation-oriented research agenda is proposed in which needling is evaluated as a priming and adherence-supporting component of multidisciplinary care rather than as a competing monotherapy. Because the practical question for a rehabilitation service is whether needling produces measurable biological change, the candidate plasma and serum markers are also appraised here -prostanoids and β-endorphin in dysmenorrhoea, gonadotrophins, androgens and insulin-resistance indices in polycystic ovary syndrome, neurotrophins and neuronal injury proteins in cerebral palsy, monoamines and neuropeptides in autism spectrum disorder, the vasopressin axis in nocturnal enuresis and emetic neurotransmitters in chemotherapy-induced nausea - and are graded in a dedicated table (Table 1) against the framework used to evaluate diagnostic tests.

Keywords: Acupuncture; Physical medicine and rehabilitation; Dysmenorrhea; Pelvic floor; Cerebral palsy; Paediatric rehabilitation; Evidence-based practice; Biomarkers; Plasma Biomarkers; Treatment monitoring

Introduction

Physical Medicine and Rehabilitation (PM&R) is organised around function rather than around diagnosis alone: the clinical question is not simply whether a symptom recedes, but whether the person can move, participate and sustain activity. Judged by that standard, acupuncture occupies an ambiguous position. It is widely used, frequently requested by patients, and increasingly embedded in rehabilitation departments, yet it is usually evaluated as a disease-specific monotherapy in trials that pay little attention to dosing

alongside exercise, tone management or behavioural training. This mini-review takes the opposite starting point. It asks what acupuncture contributes when it is positioned as a component of a rehabilitation programme, and it concentrates on two groups in which this question is clinically pressing but analytically neglected: women with gynaecological and pelvic floor conditions, and children with developmental, behavioural and supportive-care needs. Both groups share features that make adjunctive, low-risk, non-pharmacological options attractive: symptoms are chronic or recurrent, pharmacological options are limited by side-effects or are unacceptable during pregnancy and lactation, and adherence to active therapy is often the rate-limiting step.

Why Needling Belongs in a Rehabilitation Plan

The biological rationale for combining acupuncture with rehabilitation rests on three overlapping mechanisms. First, needling activates fine myelinated afferents from muscle and connective tissue and engages segmental gating together with descending inhibitory pathways from the periaqueductal grey and rostral ventromedial medulla, with accompanying release of endogenous opioids [1]. This produces a short analgesic window during which movement that is normally avoided becomes tolerable, which is precisely the window in which graded exercise and functional retraining are most productive. Second, electroacupuncture at defined frequencies recruits autonomic and neuroimmune responses and, in preclinical models, upregulates plasticity-related markers such as BDNF and synaptic proteins in sensorimotor cortex and corticospinal pathways [2]. Third, needling of myofascial and segmental points reduces local trigger-point irritability and spasticity, an effect that therapists can exploit before manual stretching or neurodevelopmental handling. These mechanisms are plausible but not equivalent to clinical proof, and they carry a practical implication: if acupuncture works mainly by opening a window for active therapy, then trials that compare needling with a sham while holding exercise constant will systematically underestimate its rehabilitation value, whereas trials that add needling to an optimised training programme will capture it. The evidence summarised below should be read with this design asymmetry in mind. If that reading is correct, the effect of a session should be detectable in plasma within hours of needling, and the size of the biochemical change should covary with the functional gain obtained from the therapy that follows. Section 5 examines how far that expectation is actually met.

Gynaecological and Pelvic Floor Rehabilitation

Dysmenorrhoea and endometriosis-related pelvic pain

Primary dysmenorrhoea is the most intensively studied gynaecological indication. A systematic review and meta-analysis of 60 RCTs, 49 of which were pooled, found that manual acupuncture reduced menstrual pain intensity relative to no treatment and to some pharmacological comparators, with most trials at low or unclear risk of bias [3]. For endometriosis-related pain, a meta-analysis of six RCTs involving 371 women reported reductions in menstrual and pelvic pain severity exceeding 20% on visual analogue scales when acupuncture was compared with non-specific acupuncture, usual care or Chinese herbal medicine [4]. These effects are clinically meaningful in a condition where conventional treatment frequently leaves residual pain. Rehabilitation relevance: recurrent pelvic pain is a major barrier to exercise participation and to work and school attendance. Framing acupuncture as episodic pain-window management, delivered in the days before and during menses and paired with breathing, pelvic floor downtraining and graded aerobic activity, is more consistent with rehabilitation logic than open-ended maintenance needling, although this sequencing has not been tested head-to-head.

Stress urinary incontinence and postpartum pelvic floor recovery

Pelvic floor muscle training is first-line care for Stress Urinary Incontinence (SUI), but adherence is modest and long-term effectiveness uncertain. A meta-analysis of acupuncture alone or combined with PFMT found that electroacupuncture improved one-hour pad-test leakage and quality-of-life scores compared with placebo electroacupuncture without increasing adverse events, and that acupuncture plus PFMT was superior to PFMT alone [5]. A separate meta-analysis focused on the postpartum period reached a consistent conclusion: adding acupuncture to pelvic floor rehabilitation training produced greater improvement in leakage and condition-specific quality of life than training alone [6]. Rehabilitation relevance: these are among the few trials in the field designed as add-on studies, and they therefore speak directly to PM&R practice. The plausible mechanisms include improved local circulation, reduced levator ani hypertonicity and better proprioceptive awareness, all of which may help a patient to perform a correct contraction. Practical cautions are that bladder outlet obstruction, urinary retention and pelvic organ prolapse require assessment before needling is credited with improvement, and that needling must not displace supervised training.

Vasomotor symptoms and postpartum mood

Menopausal hot flushes impair sleep, exercise tolerance and mood. The Cochrane review of 16 trials and 1155 women found no significant difference between acupuncture and sham acupuncture in flush frequency, a moderate benefit relative to no intervention or waiting list, and inferior effect relative to hormone therapy [7]. The honest reading is that acupuncture is a reasonable option for women who cannot or will not use hormonal treatment, provided expectations are calibrated. For postpartum depression, a meta-analysis of RCTs reported higher response rates with acupuncture than with control conditions, but the trials were few, small and heterogeneous, and pharmacological or psychological care remains the reference standard for moderate-to-severe illness [8]. Rehabilitation relevance: in both conditions the rehabilitation target is participation. Sleep disruption and low mood reduce the capacity to attend therapy and to care for an infant; short, structured courses of needling may protect that capacity, but they are supportive rather than curative.

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Polycystic Ovary Syndrome and Fertility-Oriented Rehabilitation

Lifestyle intervention and exercise remain the cornerstone of management in Polycystic Ovary Syndrome (PCOS). The Cochrane review of eight RCTs found that acupuncture, compared with sham, was associated with more regular menstrual cycles, but concluded there was insufficient evidence that it improves ovulation, pregnancy or live-birth rates [9]. In a rehabilitation frame, this positions acupuncture as a possible adjunct for cycle regularity and treatment burden rather than as a fertility treatment.

Paediatric Rehabilitation

Cerebral palsy

Cerebral Palsy (CP) is the paediatric condition with the largest acupuncture evidence base. A meta-analysis of RCTs comparing acupuncture plus rehabilitation training with rehabilitation training alone found greater improvement in gross motor function, reduced spasticity and better activity-of-daily-living scores, while cautioning that included trials were few and small [10]. A subsequent meta-analysis of 20 RCTs and 1797 children reported a mean gain of 5.93 points on the Gross Motor Function Measure (95% CI 3.67-8.19) and a higher probability of clinically meaningful improvement, with scalp and trunk points among the most frequently used [11]. Rehabilitation relevance: a five-point GMFM gain is modest but not trivial, and it is consistent with the hypothesis that needling temporarily lowers tone and irritability, allowing more productive neurodevelopmental therapy and task-oriented practice. The absence of long-term, blinded follow-up means that durability, and the extent to which gains reflect co-intervention intensity, remain unresolved.

Autism spectrum disorder

The Cochrane review of 10 trials and 390 children found no difference between needle acupuncture and sham acupuncture on the primary outcome of core autistic features, although some secondary communication outcomes favoured needling [12]. A later meta-analysis reached a similar position: some trials reported improvement on autism behaviour and rating scales, but the evidence was limited by small samples, co-interventions and risk of bias [13]. Rehabilitation relevance: behavioural, developmental and educational interventions remain the mainstay. Acupuncture may have a role for comorbidities that interfere with participation, such as sleep disturbance, gastrointestinal complaints and anxiety, but this remains a hypothesis rather than an established indication.

Tic disorders

A meta-analysis of 26 studies including 1862 children with Tourette syndrome reported an approximately 18% higher effective rate and fewer adverse reactions with acupuncture, alone or as an adjunct, compared with pharmacological treatment [14]. Rehabilitation relevance: tics frequently coexist with attention and anxiety problems, and needling can be sequenced with habit-reversal or comprehensive behavioural intervention for tics, particularly when families wish to reduce antipsychotic exposure.

Nocturnal enuresis

A meta-analysis of RCTs of acupuncture for nocturnal enuresis reported favourable pooled effects on wet nights and response rates, while noting clinical heterogeneity and generally low methodological quality [15]. Rehabilitation relevance: bladder and bowel training, fluid management and alarm therapy remain first-line; acupuncture is best regarded as an adjunct after organic causes and daytime lower urinary tract dysfunction have been excluded.

Supportive rehabilitation in paediatric oncology

Chemotherapy-Induced Nausea and Vomiting (CINV) is the best-supported paediatric indication. A meta-analysis of complementary modalities in children and young adults found a significant effect of acupuncture versus control on CINV intensity and episodes (SMD -0.59, 95% CI -0.85 to -0.33) [16], and a systematic review of acupuncture and related techniques in paediatric oncology concluded that the intervention is useful as an adjunct for CINV with a reassuring safety profile [17]. Rehabilitation relevance: controlling nausea protects nutrition, mobility and participation in school and play, and acupoint stimulation can be delivered by trained staff or caregivers with minimal disruption to chemotherapy schedules.

Safety in children

A systematic review of 37 reports found that most adverse events of paediatric needling were mild: pain, bruising, bleeding and transient worsening of symptoms [18]. Serious events are rare but described, including pneumothorax, infection and retained needles. Children require shorter needles, fewer points, brief retention, continuous caregiver presence and explicit infection-control procedures; distressed or uncooperative children should not be restrained for needling.

Plasma Biomarkers as Monitors of Acupuncture Response

A rehabilitation service that embeds needling in a multidisciplinary programme faces a measurement problem that function alone answers slowly. Function is the right endpoint, but it moves over weeks, it is sensitive to attention, expectation and co-intervention, and it cannot tell a therapist whether the needles are doing anything at all. A plasma marker that tracks the biological effect of needling would give such a service an intermediate readout: it would allow dose and scheduling to be adjusted within a course, and it would make it possible to identify likely non-responders before twelve sessions have been spent. The question is therefore not whether acupuncture 'has' biomarkers, but which analytes behave well enough to be worth a venepuncture in a woman with dysmenorrhoea or a child with cerebral palsy.

What a biomarker must demonstrate before it can guide practice

Biomarkers do not become useful merely by being measured. The framework used to evaluate diagnostic tests transfers directly: a candidate analyte must first be shown to discriminate - with acceptable sensitivity, specificity, positive and negative

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predictive values, likelihood ratios and an interpretable receiver operating characteristic curve - and must then be shown to change management or improve outcome [19]. For a monitoring marker the bar is different but not lower. What matters is responsiveness: the standardised response mean, the smallest change that corresponds to a clinically important gain in function, and acceptable within-subject reproducibility. A marker that is abnormal at baseline but does not move with treatment is a trait marker; a marker that moves without any corresponding functional change is a surrogate of uncertain meaning. Almost all acupuncture biomarker studies report only a within-group before-and-after comparison, which cannot separate needling from menstrual phase, season, co-intervention or regression to the mean.

Three families of analyte recur in this literature: mediators of the needling response itself (prostanoids, β-endorphin, monoamines), markers of neurotrophic support and neural injury (BDNF, NGF, GDNF, IGF-1, NSE, GFAP, MBP, UCH-L1), and markers of systemic inflammation and oxidative stress (IL-6, TNF-α, IL-33, hs-CRP, malondialdehyde, superoxide dismutase). Pre-analytical standardisation matters more than the choice of assay. Sampling should be fixed relative to the menstrual cycle and, where relevant, the time of day (essential for antidiuretic hormone) and fasting status (essential for insulin and HOMA-IR); the interval between needling and venesection should be stated; and a single batch on a single platform should be used. In children the binding constraint is the volume that may be drawn, so panels must be small, timed with clinically indicated blood draws, and preferably capillary or dried-blood-spot based.

Gynaecological conditions

Primary dysmenorrhoea is where the prostanoid hypothesis is most testable, and the result is instructive. In a four-arm randomised study of 40 women, electroacupuncture at Sanyinjiao (SP6) reduced pain intensity immediately, yet plasma PGE2, PGF2α, TXB2, 6-keto-PGF1α and both prostanoid ratios were unchanged [20]. That negative finding is an argument about timing rather than against needling: analgesia within 30 minutes is more plausibly segmental and opioid-mediated than prostanoid-mediated, whereas trials that deliver three monthly courses do report lower serum PGF2α, higher PGE2 and higher plasma β-endorphin. Those trials are mostly unblinded, single-centre and published in Chinese, and their sampling point ranges from cycle day 1 to the end of treatment, so much of the heterogeneity lies in the design rather than in the biology. A defensible panel for a rehabilitation trial is therefore a single pre-specified sampling point (late luteal phase, or day 1 of menses), PGF2α and PGE2 as the primary analytes, and β-endorphin and hs-CRP as secondary ones.

In endometriosis-related pain and in Polycystic Ovary Syndrome (PCOS) the informative markers are endocrine and inflammatory rather than prostanoid. For PCOS, gonadotrophins, total and free testosterone, SHBG, fasting insulin and HOMA-IR form a coherent panel, and one sham-controlled trial provides the most useful caution in the field: true and sham acupuncture produced the same fall in the LH:FSH ratio and the same ovulation rate, yet within the true-acupuncture arm a lower fasting insulin and free testosterone were associated with a higher ovulation rate [21]. The analyte thus behaved as a non-specific marker of needling and attention when compared between arms, and as a plausible correlate of response within an arm. Only a pre-specified responder analysis can separate those two readings, and it is the analysis future trials should plan for. Anti-Müllerian hormone is often proposed as an ovarian-reserve endpoint, but no acupuncture trial has been powered for it.

For menopausal hot flushes, FSH and estradiol are descriptive anchors rather than response markers: the Cochrane review found no advantage of acupuncture over sham for flush frequency [7], so a change in gonadotrophins cannot be used as a surrogate for symptom benefit. For stress urinary incontinence, including the postpartum period, there is at present no validated circulating marker at all. Collagen turnover peptides and TGF-β1 are biologically reasonable and remain exploratory; until they are validated, the one-hour pad test, the International Consultation on Incontinence Questionnaire score and adherence to pelvic floor muscle training should carry the weight, with an inflammatory panel collected as a secondary, hypothesis-generating measure.

Paediatric conditions

Cerebral palsy has the richest biochemical dataset in paediatric acupuncture, and it is the only one in which a panel has been measured against a sham procedure. In a randomised trial of 90 children with spastic cerebral palsy, twelve weeks of scalp acupuncture added to conventional rehabilitation lowered serum NSE, GFAP, MBP, UCH-L1, IL-33 and TNF-α and produced greater gains in gross motor function and daily living than sham scalp acupuncture, with parallel changes in corticospinal diffusion tensor metrics [22]. Serum BDNF, NGF, GDNF and IGF-1 have been reported to rise with adjunctive needling in smaller, open-label studies, but the sham-controlled trial above measured injury proteins rather than neurotrophins, so the neurotrophic half of the mechanism remains the weaker one. The critical gap is the missing link between the two levels: almost no study reports the correlation between marker change and functional gain, which is precisely the quantity that would establish a marker as a surrogate rather than an epiphenomenon.

In autism spectrum disorder the biochemical signal is weaker and less consistent. Plasma BDNF fell, and severity and language scores improved, after twelve sessions of low-level laser acupuncture in a small randomised study, while miR-320 discriminated children with autism from typically developing children [23]; but a marker that separates cases from controls is a diagnostic marker, not a monitoring one, and other studies report BDNF rising rather than falling. Serotonin has been measured in several small trials with inconsistent direction, and the neuropeptides oxytocin and arginine vasopressin have been proposed as predictors of response to acupoint stimulation on the basis of preliminary data. Biomarkers in autism should therefore be treated as exploratory secondary outcomes and should not be used to justify clinical decisions.

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Nocturnal enuresis has the cleanest mechanistic target, because the vasopressin axis is directly relevant to nocturnal polyuria: in a study of 25 children, nocturnal plasma antidiuretic hormone was low before treatment and rose afterwards, whereas daytime values and serum osmolality were unchanged [24]. Antidiuretic hormone is pre-analytically fragile and has a short half-life, so copeptin is the more practical surrogate and urinary aquaporin-2 offers a non-invasive alternative that is particularly attractive in children. For chemotherapy-induced nausea, the relevant transmitters are serotonin and dopamine, both of which fell in adults receiving transcutaneous electroacupuncture at PC6 and PC5 compared with sham [25]; the paediatric evidence in this setting remains clinical rather than biochemical. Whatever panel is chosen, the paediatric envelope is set by phlebotomy volume and distress rather than by assay availability: total sampling should stay within recognised limits for body weight, be combined with clinically indicated draws, and be justified to the ethics committee as a secondary objective with a stated stopping rule.

A minimal panel, and how to report it

The proposal that follows is deliberately modest. For gynaecological rehabilitation, four analytes - PGF2α, PGE2, hs-CRP and, where the question is neuroendocrine, β-endorphin - sampled at a fixed cycle day before and at the end of a course are affordable, interpretable and sufficient to test whether needling engages the prostanoid and inflammatory axes. For paediatric rehabilitation, BDNF, NGF, NSE and GFAP, or BDNF, GFAP and UCH-L1 in the youngest children, cover neurotrophic support and neural injury with a single small draw. For PCOS and nocturnal enuresis the panel is hormonal and should ride on the existing clinical assay rather than on a research kit.

Reporting should follow the same discipline as the clinical outcomes: a pre-specified primary analyte, a responder definition fixed in advance, change scores with 95% confidence intervals rather than p values alone, the standardised response mean, and an explicit correlation between marker change and functional change. Where a marker is intended to guide practice rather than to explain mechanism, the diagnostic-test framework should be applied in full, with discrimination, calibration and the effect on management reported [19]. Used in this way, a biochemistry table is not decoration: it is a testable bridge between the needle and the rehabilitation goal.

From Evidence to Rehabilitation Practice

Table 2 summarises the principal findings and their certainty, and (Table 1) sets out the candidate plasma and serum markers that could be used to monitor them. Five practice implications follow. First, define the functional target before the first session. Useful baseline measures include a numeric pain scale, the International Consultation on Incontinence Questionnaire, a one-hour pad test, the Gross Motor Function Measure, the Yale Global Tic Severity Scale and a bladder diary. Repeating these at fixed intervals keeps acupuncture accountable to function rather than to sensation.

Table 1: Rehabilitation-relevant evidence for acupuncture in gynaecological and paediatric conditions.

Condition	Best Available Evidence	Principal Finding	Certainty
Primary dysmenorrhoea	SR/MA, 60 RCTs [1]	Reduced pain intensity versus no treatment	Low to moderate
Endometriosis-related pain	SR/MA, 6 RCTs, 371 women [2]	>20% reduction in pelvic pain severity	Low
Female stress urinary incontinence	SR/MA [3]	Electroacupuncture better than placebo; add-on to PFMT better than PFMT alone	Moderate
Postpartum stress urinary incontinence	SR/MA [4]	Add-on to pelvic floor rehabilitation superior to training alone	Low to moderate
Menopausal hot flushes	Cochrane review, 16 trials [5]	No difference versus sham; benefit versus no treatment; inferior to hormone therapy	Low
Postpartum depression	SR/MA [6]	Higher response rate versus control	Low
Polycystic ovary syndrome	Cochrane review, 8 RCTs [7]	More regular cycles; ovulation and live birth not established	Low
Cerebral palsy	SR/MA, 20 RCTs, 1797 children [9]	GMFM gain of 5.93 points with adjunctive needling	Low to moderate
Autism spectrum disorder	Cochrane review, 10 trials [10]	No difference in core features versus sham	Moderate (for null core effect)
Tourette syndrome	SR/MA, 26 studies [12]	Higher effective rate, fewer adverse reactions	Low
Nocturnal enuresis	SR/MA [13]	Favourable pooled effect, heterogeneous trials	Low
Chemotherapy-induced nausea	SR/MA [14,15]	Reduced intensity and episodes	Moderate

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Table 2: Candidate plasma and serum biomarkers for monitoring acupuncture response in gynaecological and paediatric rehabilitation.

Condition	Biological Axis	Candidate Analyte (Matrix)	Direction Reported with Acupuncture	Certainty and Principal Caveat
Primary dysmenorrhoea	Prostanoid axis	PGF2α, PGE2, TXB2, 6-keto-PGF1α; PGF2α/PGE2 and TXB2/6-keto-PGF1α ratios (plasma)	No acute change after a single session of electroacupuncture at SP6 despite immediate pain relief [20]; lower PGF2α and higher PGE2 after three monthly courses in non-blinded trials	Low; sampling point (cycle day, needle-to-draw interval) explains much of the discordance
Primary dysmenorrhoea	Endogenous opioid system	β-endorphin (plasma)	Rises after acupuncture or acupoint stimulation in most small trials; seldom measured against sham	Low; short half-life and stress sensitivity limit reproducibility
Dysmenorrhoea; endometriosis	Systemic inflammation	IL-6, TNF-α, hs-CRP (serum)	Reductions reported with adjunctive needling; confounded by NSAID and hormonal therapy	Very low to low; direction consistent but designs weak
Endometriosis	Oxidative stress	Malondialdehyde, superoxide dismutase, glutathione peroxidase (serum)	Lower malondialdehyde and higher superoxide dismutase after acupuncture in small trials	Very low; no correlation with pain or function reported
Polycystic ovary syndrome	Gonadotrophin axis	LH, FSH, LH:FSH ratio (serum)	Ratio falls with both true and sham acupuncture, without any between-arm difference in ovulation rate [21]	Moderate for change, low for specificity; the analyte is not acupuncture-specific
Polycystic ovary syndrome	Androgen excess and insulin resistance	Total and free testosterone, SHBG, free androgen index, fasting insulin, HOMA-IR (serum)	Lower fasting insulin and free testosterone track a higher ovulation rate within the true-acupuncture arm only [21]	Low; the most promising responder signal in the gynaecological literature, but unreplicated
Polycystic ovary syndrome	Ovarian reserve	Anti-Müllerian hormone (serum)	Insufficient data; no trial powered for this endpoint	Insufficient
Menopausal hot flushes	Gonadal axis	FSH, estradiol (serum)	No consistent change; no advantage of acupuncture over sham for flush frequency [5]	Low; hormonal change cannot serve as a surrogate of symptom response
Stress urinary incontinence (including postpartum)	Connective tissue turnover and inflammation	No validated circulating marker; exploratory: TGF-β1, collagen I/III turnover peptides (serum)	Not established	Insufficient; pad test and condition-specific quality of life remain the anchors
Cerebral palsy	Neurotrophic support	BDNF, NGF, GDNF, IGF-1 (serum)	Reported higher with adjunctive needling in small open-label studies; the sham-controlled trial measured injury proteins rather than neurotrophins [23]	Very low; no sham-controlled neurotrophin data
Cerebral palsy	Neuronal and glial injury	NSE, GFAP, MBP, UCH-L1 (serum)	Lower after 12 weeks of scalp acupuncture than after sham scalp acupuncture, alongside higher GMFM-88 scores [23]	Low to moderate; the only paediatric panel we identified that was measured against a sham procedure
Cerebral palsy	Neuroinflammation	IL-33, TNF-α, IL-6 (serum)	Lower with adjunctive needling [23]	Low; no marker-function correlation reported
Autism spectrum disorder	Neurotrophin and microRNA	BDNF (plasma), miR-320	BDNF falls and severity improves after laser acupuncture [24]; miR-320 discriminates autism from typical development, i.e. a diagnostic rather than a monitoring marker	Low; direction of BDNF change inconsistent across studies
Autism spectrum disorder	Monoamine and neuropeptide	5-HT, oxytocin, arginine vasopressin (plasma)	5-HT measured with inconsistent direction; oxytocin and arginine vasopressin proposed as response predictors on preliminary data	Very low; hypothesis-generating only
Tic disorders	Dopaminergic tone	Dopamine, homovanillic acid, prolactin (serum)	Sparse; prolactin used as an indirect index of central dopamine tone	Insufficient; no acupuncture trial with a dopaminergic panel identified
Nocturnal enuresis	Vasopressin axis	Nocturnal antidiuretic hormone (plasma), copeptin (serum), aquaporin-2 (urine)	Nocturnal antidiuretic hormone low at baseline and rose after acupuncture in 25 children, daytime values unchanged [25]	Low; antidiuretic hormone is pre-analytically fragile, copeptin preferred
Chemotherapy-induced nausea	Emetic neurotransmission	5-HT, dopamine, substance P (plasma)	5-HT and dopamine fall with transcutaneous electroacupuncture at PC6/PC5 versus sham in adults [22]; Paediatric data are clinical only	Low to moderate; adult evidence extrapolated to children

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Second, treat needling as a priming intervention. Sessions are commonly scheduled once or twice weekly for 8 to 12 sessions, with active therapy placed in the hours that follow needling when soreness and tone are lowest. This sequencing is a pragmatic inference from mechanism rather than a validated protocol, and it should be documented so that it can be tested. Third, integrate rather than isolate. The strongest signals in this review come from add-on designs, in which needling was compared with the same rehabilitation programme plus sham or plus nothing [5,6,11]. Departments should therefore resist the temptation to create parallel acupuncture clinics detached from therapy planning.

Fourth, report transparently. Adherence to the STRICTA recommendations, registration of pragmatic trials, and collection of participation-level outcomes would substantially improve the usefulness of future studies. Fifth, collect a small biochemistry panel alongside the functional outcomes. Table 1 identifies what is worth measuring and, equally, what is not yet worth measuring. The panel should be fixed before the first session, sampled at a standardised point in the cycle or the day, reported as change with confidence intervals, and correlated with the functional endpoint. A marker that does not track function should be dropped from the next protocol rather than reported as a mechanism.

Limitations and Research Agenda

This review is narrative and selective; it was not prospectively registered, did not use duplicate independent screening, and did not perform formal risk-of-bias or GRADE appraisal for each included study. Certainty judgements in (Table 2) are therefore indicative. Four limitations recur across the primary literature. Most trials have been conducted in a single country and published in Chinese, raising questions about external validity and selective reporting. Blinding of practitioners is impossible and blinding of participants is imperfect, so expectancy effects cannot be excluded. Co-interventions, especially rehabilitation training, are often poorly described, which makes it impossible to determine whether needling added value or merely added contact time. Follow-up rarely extends beyond three months, so durability is unknown, and outcomes are usually symptom scores rather than activity and participation measures.

Biomarker evidence carries limitations of its own. Assays are rarely standardised across centres: the same analyte may be measured in serum or in plasma, at different cycle days, with different kits and different limits of detection, and inter-kit variability for BDNF and for the prostanoids is large relative to the effects reported. Almost all studies present within-group change rather than a between-group comparison against sham, so a fall in PGF2α or a rise in BDNF cannot be attributed to needling rather than to time, co-intervention or expectancy. Samples are small and the analytes are usually secondary or exploratory outcomes that were never adjusted for multiplicity. Finally, the diagnostic-test framework that would establish a marker's discrimination, calibration and effect on management has, to our knowledge, not been applied to any candidate marker of acupuncture response; the certainty ratings in (Table 1) should be read in that light. Priority studies would include pragmatic trials of needling embedded in protocolised rehabilitation, factorial designs that separate needling from co-intervention intensity, assessment of whether needling improves adherence to PFMT and to home exercise, and economic evaluation in paediatric and postpartum services where the alternative is long-term pharmacotherapy.

Conclusion

Within PM&R, acupuncture is best understood as a modulator of the conditions that limit participation: pain, tone, pelvic floor dysfunction, nausea and sleep disruption. The evidence is strongest where needling is added to an established rehabilitation programme, as in stress urinary incontinence and cerebral palsy, and weakest where it is offered as a substitute for behavioural or developmental intervention. For gynaecological and paediatric patients, the pragmatic position is neither advocacy nor dismissal: use acupuncture as a time-limited, function-oriented adjunct, measure what matters, and stop it when function does not improve. Biochemistry should follow function rather than replace it: a fall in PGF2α or a rise in BDNF is informative only when it travels with a measured gain in activity, and a marker that changes while the patient does not should be treated as a hypothesis rather than as a result.

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