




ORIGINAL ARTICLE

Psychologically informed physiotherapy as part of a multidisciplinary rehabilitation program for children and adolescents with functional neurological disorder: Physical and mental health outcomes

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Aim: Children and adolescents with functional neurological disorder (FND) present with physical impairment and mental health comorbidities. Specialist physiotherapy programs for treating FND have been developed over the last two decades. This article reports outcome data from three cohorts of children treated with a multidisciplinary rehabilitation intervention – the Mind–Body Program – in which a psychologically informed physiotherapy intervention, known as the *wellness approach to physiotherapy*, was a key component.

Methods: For three cohorts of children ($n = 57$, $n = 60$ and $n = 25$, respectively) treated in the Mind–Body Program, data about functional impairment and mental health concerns were collected at presentation and at follow-up (4 years, 12 months and 18 months, respectively).

Results: Outcome data show that FND symptoms resolved in 54/57 (95%), 51/60 (85%) and 22/25 (88%) of children in the three cohorts, and that 31/57 (61%), 32/60 (53%) and 13/25 (52%) of children returned to full health and to full-time school attendance. Changes in Global Assessment of Function (GAF) were significant ($t(54) = 21.60$, $P < 0.001$; $t(55) = 9.92$, $P < 0.001$; $t(24) = 6.51$, $P < 0.001$). Outcomes were less favourable for children with chronic FND symptoms at presentation; those whose comorbid mental health disorders or other (comorbid) functional somatic symptoms did not resolve; and those who subsequently developed chronic mental health problems.

Conclusions: Implementation of a multidisciplinary rehabilitation intervention – with psychologically informed physiotherapy as one of the key treatment components – resulted in resolution of FND symptoms and return to health and well-being in the large majority of patients.

Key words: functional neurological disorder; paediatric rehabilitation; psychogenic; physical therapy; physiotherapy; somatoform/somatic.

What is already known on this topic

- 1 Functional neurological disorder (FND) is a neuropsychiatric disorder whose treatment involves multidisciplinary interventions that address dysfunction of the body, dysfunction of the mind, and stress FROM the child's psychosocial context.
- 2 Studies examining the utility of different treatment interventions and outcomes are an area of current research.

What this paper adds

- 1 Physiotherapy for FND activates complex neurophysiological processes that facilitate: the re-emergence of normal movement patterns; physical conditioning; autonomic regulation; stress resistance; analgesic mechanisms; modulation of the gut microbiome; and improvements in comorbid anxiety, depression, and disturbed sleep.
- 2 Multidisciplinary interventions that include psychologically informed physiotherapy are successful in returning the large majority of child and adolescents patients to full health, including full-time school attendance.

Children and adolescents with functional neurological (conversion) disorder (FND) present to hospitals around the world

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because of significant functional impairment. Motor symptoms – motor weakness or loss of function, abnormal movements and dystonia – are the most common neurological symptoms, followed by non-epileptic seizures (NES), sensory symptoms and cognitive symptoms.^{1,2} Presentations are typically complicated by comorbid chronic/complex pain, anxiety and depression, and nonspecific somatic symptoms such as dizziness, fatigue, breathlessness.^{1–3} Because impaired physical function is a core feature of FND, paediatric treatment programs for children and adolescents with FND – henceforth just children – involve a

multidisciplinary approach in which physiotherapy is a fundamental component.^{4–6}

In paediatric practice, the development of specialist physiotherapy for children with FND dates back to the 1960s. Before that time, therapists trained in the psychodynamic tradition conceptualised FND as a disorder arising from conflicts in the mind and treated children using ‘orthodox psychodynamic interventions’.⁷ In 1965, the psychiatrist Stanley Gold (Guy’s Hospital, London) described that inclusion of physiotherapy alongside psychological therapy improved outcomes in children with *functional dystonia*.⁷ In the 1970s, the paediatrician Victor Dubowitz and psychiatrist Lionel Hersov (Hammersmith Hospital, London) included both physiotherapy and psychological therapy in their intervention for *functional motor symptoms*.⁸ By the 1980s *physiotherapy* was being integrated into paediatric treatment interventions for FND in the USA and Australia.^{9,10} In 1994, building on the above, child and adolescent psychiatrist Kenneth Nunn working at The Royal Alexander Children’s Hospital (New South Wales, Australia) founded a multidisciplinary inpatient rehabilitation program for children with FND – now known as the Mind–Body Program. Specialist physiotherapy for children with FND – a psychologically informed physiotherapy intervention, known as the *wellness approach* – was developed as a key component of the treatment intervention.¹¹ In contrast to the standard musculoskeletal approach, psychologically informed physiotherapy for children with FND is embedded in a biopsychosocial framework, and psychological interventions are integrated into, and delivered alongside, the physiotherapy intervention. Psychologically informed physiotherapy prioritises the therapeutic relationship, redirects the focus of attention away from symptoms, utilises playful activities engaging the sick body part indirectly and integrates psychological interventions to manage common challenges. Over time, physiotherapy came to be recognised as a crucial component of contemporary rehabilitation programs for children (and adults) with FND; the goal is to address physical impairment by facilitating the re-emergence of normal movement patterns that help to override the aberrant movement patterns associated with FND.^{5,12–15}

In an effort to understand the emergence and expression of FND symptoms, recent studies using imaging technologies have shed additional light on the complex interaction between psychological factors and the brain regions involved in motor-, sensory and pain- processing. These studies suggest that FND symptoms emerge when stress – physical or emotional – triggers excessive activation of the brain stress systems (regions processing salience, arousal and emotional states), which, in turn, disrupt motor- and sensory-processing regions and amplify pain processing.^{3,16} These research findings reinforce the wisdom of now-established best practice, in which the treatment for FND involves interventions that address both physical and psychological factors concurrently.

A body of work studying the role of exercise in the healing process demonstrates that its impact extends beyond the improvement of impaired physical function. Exercise also builds stress resistance¹⁷; decreases activation of low-grade inflammation mechanisms in chronic pain¹⁸; modulates the health of the gut microbiome (and therefore mental health more generally)¹⁹; improves comorbid anxiety, depression, and disturbed sleep²⁰; and addresses deconditioning secondary to bed rest or to a lack of

exercise in the context of FND symptoms.²¹ Additionally, a recent study of psychological therapies for trauma processing – in particular, eye movement desensitisation and reprocessing and trauma-focused cognitive-behavioural therapy – suggests that successful treatment modulates connectivity changes that involve motor-processing regions in the brain.²²

What the above-described research makes clear is that the treatment of FND – across clinical presentations – requires both psychological interventions that help down-regulate the brain stress systems and physical interventions that address a myriad of factors: physical impairment secondary to motor symptoms; autonomic dysregulation (and functional somatic symptoms) secondary to deconditioning²³; chronic pain; stress resilience; anxiety and depression; memories of past adversity/trauma; sleep quality; and so on. In our own clinical setting – the Mind–Body Program for FND – we have translated this emerging research into clinical practice by integrating a physiotherapy intervention into the treatment of every child presenting with FND symptoms, even when the child’s symptoms did not involve motor symptoms. From this broader mind–body (systemic) perspective, the role of exercise and physiotherapy in treating FND is much broader than the traditional view of physiotherapy as treating ‘specific physical deficits in child and adolescent conversion disorder’ (p. 8)²⁴: exercise and physiotherapy are conceptualised as activating multiple neurophysiological processes that promote health and well-being, not just the treatment of impaired motor function and aberrant movement patterns.

The goal of the current study is to report outcome data from three cohorts of children with FND treated in the Mind–Body Program, in which the *wellness approach to physiotherapy*, a psychologically informed physiotherapy intervention, is a key component. Based in a public, tertiary care hospital, the program provides rehabilitation services to children with the full range of FND symptoms – and comorbidities – that present in clinical practice. A detailed description of the program’s ‘wellness’ physiotherapy component has been published elsewhere.¹¹

Methods

Participants

Three different cohorts of children with FND participated in three separate studies conducted through the Mind–Body Program of The Children’s Hospital at Westmead, Westmead, NSW, Australia. Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text revision (DSM-IV-TR) criteria for FND – and all comorbid mental health diagnoses – were used. In keeping to current DSM-V criteria, participants had documented positive symptoms on neurological examination, a worsening of symptoms with attention and a decrease of symptoms when distracted, and the criterion for antecedent stressor was interpreted broadly to include both psychological and physical stressors – all of which were carefully documented.

1 Cohort 1 included 57 children (41 girls and 16 boys, aged 8.5–18 years (mean = 13.56)) with FND who were treated from 16 August 2006 to 16 August 2010. Children with

Table 1 Clinical characteristics of the three research cohorts of children with functional neurological disorder (FND) on presentation

FND symptoms: Percentage > 1, mean, range	Motor symptoms:		NES:		Sensory symptoms:		Cognitive symptoms:		Pain:	Non-specific FSS:	Mental health disorder:		Stressors:	School loss:	Mal-treatment:	Sexual abuse:	Physical abuse:	Neglect:
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	Mean, range	(%), mean, range	n (%)	n (%)	n (%)	n (%)
Cohort 1 (n = 57) 68%, 2.60, 1–7	38/57 (67)	29/57 (51)	31/57 (54)	14/57 (25)	33/57 (58)	31/57 (54)	41/57 (72)	5.3, 1–10	52/57 (91), 7.2 weeks, 0–52	14/57 (20)	6/57 (11)	9/57 (14)	6/57 (11)					
Cohort 2 (n = 60) 75% 2.68, 1–8	32/60 (53)	60/60 (100)	22/60 (37)	18/60 (30)	41/60 (68)	53/60 (88)	38/60 (69)	4.63, 1–12	48/60 (80), 5.2 weeks, 0–59	17/60 (28)	8/60 (13)	7/60 (12)	7/60 (12)					
Cohort 3 (n = 25) 67%, 2.56, 1–9	20/25 (80)	12/25 (48)	10/25 (40)	7/25 (28)	21/25 (84)	22/25 (88)	20/25 (80)	5.12, 1–11	25/25 (100), 2.57 weeks, 0.12–12.95	9/25 (36)	3/25 (12)	5/20 (20)	1/20 (4)					

FND, functional neurological disorder; FSS, functional somatic symptoms; NES, non-epileptic seizure.

developmental delay were excluded. Outcome data at 4-year follow-up are available for 55 of 57 patients (96%). More information about cohort 1 is available in the published literature.²⁵

2 Cohort 2 included 60 children (42 girls and 18 boys, aged 8–17 years (mean = 13.45)) referred for treatment of NES from April 2011 to March 2016. Outcome data at a minimum 12-month follow-up are available for 56 of 60 patients (93%). More information about cohort 2 is available in the published literature.²⁶

3 Cohort 3 included 25 children with FND who were recruited from consecutive referrals to the Mind–Body Program for an magnetic resonance imaging study from October 2009 to May 2014. Children with developmental delay were excluded. Outcome data at a minimum 18-month follow-up are available for all patients. More information about cohort 3 is available in the published literature.²⁷

All three studies were approved by the institutional ethics committees: Royal Alexandra Hospital for Children Human Research Ethics Committee. Participants or their legal guardians provided written informed consent.

Clinical characteristics across the three cohorts

The clinical characteristics of the three cohorts were similar and are summarised in Table 1. The majority of children (67–75%) had more than one FND symptom. Many also suffered from comorbid pain, non-specific functional symptoms (nausea, fatigue, dizziness and breathlessness) and mental health disorders, with anxiety and depression being the most common (see Table 1).

Measures of physical and emotional impairment

Global impairment in function at presentation (and follow-up) was documented on the Royal Alexandra Hospital for Children Global Assessment of Function (RAHC-GAF) and by school attendance. The RAHC-GAF is the DSM-IV-TR GAF modified to include physical impairment in children suffering from FND, chronic pain, fatigue syndromes or physical illness. The scale has 10 categories (1–10 points each), with possible scores ranging up to 100. Healthy children fall into the upper two brackets ‘superior in all areas (score 91–100)’ or ‘good in all areas (score 81–90)’. Lower values (in each category and in the overall bracket) mark impaired function of increasing severity.

Outcomes were also documented using qualitative pattern descriptors: resolution of FND symptoms; resolution of comorbid mental health disorders; and return to school. Part-time return to school was counted if it reflected a formalised alternate schooling pathway that was designed to enable the child/adolescent to finish her schooling over a longer period of time. The presence or absence of a mental health diagnosis was also documented at follow-up.

The Mind–Body Program treatment intervention

The treatment intervention across the three cohorts was, with some exceptions, delivered via an inpatient admission of 1–3 weeks’ duration – followed by outpatient treatment in which

Table 2 Royal Alexandra Hospital for Children Global Assessment of Function (RAHC-GAF) scores at presentation and at follow-up

RAHC-GAF at presentation: Mean, range	RAHC-GAF at follow-up: Mean, range	t value (df)	P value
Cohort 1 (n = 57 at assessment and 55/57 at 4-year follow-up)			
34.38, 11–51	76.02, 50–95	21.60 (54)	<0.001
Cohort 2 (n = 60 at assessment and 56/60 at minimum of 12 months follow-up) [†]			
41.85, 11–65	66.80, 30–90	9.92 (55)	<0.001
Cohort 3 (n = 25 at assessment and 25/25 at 18-month follow-up)			
37.04, 11–61	65.32, 31–90	6.51 (24)	<0.001

[†]In a previous article reporting outcomes of NES, we excluded one patient with post-prandial events (misdiagnosed NES) from our analysis.²⁹ In this analysis we include her because she also had comorbid functional motor symptoms.

NES, non-epileptic seizure.

the family implemented the program in their local community setting. A handful of patients (3 of 57 (5%) in cohort 1, 4 of 60 (7%) in cohort 2, 1 of 25 (4%) in cohort 3) were treated using an outpatient mind–body intervention. A separate set of patients (18 of 57 (32%) in cohort 1, 10 of 60 (17%) in cohort 2, 5 of 25 (20%) in cohort 3) had admissions longer than 3 weeks or were offered more than one admission. Patients who participated in more than one admission had symptoms – and levels of functional impairment – that did not resolve in the usual 1- to 3-week time frame; see, for example, Khachane *et al.*²⁸ Daily physiotherapy using the wellness approach was a core element of all treatment interventions.

Data analysis

Data analysis involved descriptive statistics, independent sample *t* tests (normally distributed data) and paired sample *t* tests (normally distributed data) for continuous variables (RAHC-GAF). We also examined the data across the three cohorts to see if one of our long-standing clinical impressions was correct – namely, that long-term (global) outcomes were worse for children who were referred for treatment late (at the point that their symptoms were already chronic, defined as >3 months duration) and also for children whose mental health disorders did not resolve, or who developed chronic mental health problems, after their FND has resolved.

Results

Outcomes

Across samples, improvements in global function on the RAHC-GAF were substantial (see Table 2). Half to three-quarters of children – 45 of 57 (78.9%) in cohort 1, 39 of 60 (65%) in cohort 2 and 14 of 25 (56%) in cohort 3 – returned to full health and to full-time school attendance (though a small subset of these patients experienced one or two time-limited recurrences of FND symptoms in the context of new stress) (see Table 3). On the RAHC-GAF a return to full health equated to scores in the upper three brackets: ‘no more than slight problems’ (score 71–80); ‘good in all areas’ (score 81–90); or ‘superior in all areas’ (score 91–100). A small group of children (2–12%) continued to experience chronic FND. More commonly, however, in approximately a quarter of patients (16–32%), the FND symptoms resolved (as with the larger group above), but some form of ill health (defined by scores on the RAHC-GAF or by failure to attend school full time) continued. Explanations included the presence or development of chronic mental health disorders (with anxiety, depression and mood disorders being the most common) or persistence of other (comorbid) functional somatic symptoms (e.g. chronic/complex pain or fatigue) (see Table 3).

Our clinical hunches proved to be partly correct and partly incorrect. Acute versus chronic presentations – illness of ≤3 months’ duration versus >3 months’ duration – were associated with better outcomes only in cohort 2, in which the child’s

Table 3 Health outcomes of children and adolescents in the three functional neurological disorder (FND) cohorts

Full return to health (and school): n (%)	Relapsing course but well in between: n (%)	Chronic FND ± other FSS ± mental health disorder: n (%)	FND resolved but ongoing mental health disorder or other FSS: n (%)	Lost to follow-up: n (%)
Cohort 1 (n = 57 at assessment and 55/57 at 4-year follow-up)				
35 (61)	10 (17.5)	1 (2)	9 (16)	2 (3.5)
Cohort 2 (n = 60 at assessment and 56/60 at a minimum of 12-month follow-up)				
32 (53)	7 (11.7)	5 (8.3)	12 (20)	4 (6.7)
Cohort 3 (n = 25 at assessment and 25/25 at 18-month follow-up)				
13 (52)	1 (4)	3 (12)	8 (32)	—

FND, functional neurological disorder; FSS, functional somatic symptoms.

Table 4 Outcomes in children with acute (≤ 3 months) versus chronic (> 3 months) presentations with functional neurological disorder

RAHC-GAF at follow-up in children with acute presentations: Mean (n), range (SD)	RAHC-GAF at follow-up in children with chronic presentations: Mean (n), range (SD)	t value (df)	P value
Cohort 1 (n = 57 at assessment and 55/57 at 4-year follow-up) 77.56 (n = 34), 50–95 (SD 11.26)	73.52 (n = 21), 51–85 (SD 10.89)	1.31 (53)	0.197
Cohort 2 (n = 60 at assessment and 56/60 at minimum of 12-month follow-up) [†] 70.51 (n = 39), 30–90 (SD 15.69)	58.29 (n = 17), 35–90 (SD 18.03)	2.56 (54)	0.013
Cohort 3 (n = 25 at assessment and 25/25 at 18-month follow-up) 64.30 (n = 10), 35–90 (SD 21.05)	Mean 66.00 (n = 15), 31–85 (SD 18.61)	0.25 (23)	0.834

[†]In a previous article reporting outcomes of NES, we excluded one patient with post-prandial events (misdiagnosed NES) from our analysis.²⁹ In this analysis we include her because she also had comorbid functional motor symptoms.

NES, non-epileptic seizure; RAHC-GAF, Royal Alexandra Hospital for Children Global Assessment of Function; SD, standard deviation.

primary presenting symptom was NES. There was no such association, however, in cohorts 1 and 3 (see Table 4). Our other hypothesis was validated: children whose existing mental health disorders did not resolve and children who developed chronic mental health disorders later – after their FND had resolved – had poorer global functional outcomes across all three samples (see Table 5).

Discussion

Physiotherapy is a fundamental component of multidisciplinary treatment interventions for children presenting with FND. In this article we have described outcomes for three cohorts of children who participated in the Mind–Body Program, which includes specialist, psychologically informed physiotherapy as a key component. Outcomes from the Mind–Body Program were excellent, with half to three-quarters of children returning to full health and to full-time school attendance: the children’s well-being was reflected by RAHC-GAF scores in the upper three brackets. Poor outcomes at follow-up were more common among patients who, at follow-up, suffered from mental health disorders or who continued to experience comorbid, nonspecific functional somatic symptoms (e.g. chronic/complex pain or fatigue).

Our findings pertaining to the adverse effect of chronic mental health disorders on outcome are consistent with previous findings. In a 4-year follow-up of children with FND, Pehlivanurk et al. found that while 35 of 40 (85%) children had recovered

from their FND symptoms, 14 (35%) of 40 met criteria for another mental health disorder known to compromise daily function, with anxiety and depression being the most common.³⁰

Another recurring finding in the broader literature is that children who present for treatment with chronic FND symptoms and poor premorbid adjustment have worse outcomes.^{30,31} We found the same pattern of findings in cohort 2, but not in cohorts 1 and 3, where children with developmental delay had been excluded. This exclusion may have biased cohort 1 and 3 away from those with poor premorbid functioning.^{32–34}

What our study did not measure – and what our present results do not take into account – is the remarkable amount of extra effort involved in treating the typically complex problems of patients presenting with chronic, versus acute, FND. For example, chronicity is associated with serious deconditioning, which requires more work from the physiotherapist and a more comprehensive physiotherapy program, or with longer-standing mental health issues and dysfunctional family interactions that require a more comprehensive mental health intervention. The toll on the treating team related to the effort and complexity of interventions for chronic presentations of FND in children has not previously been measured or even articulated.

The current study has a number of limitations. First, in contrast to adult studies – where presentations are generally chronic – we did not utilise a wait-list control group. Because children typically present with acute presentations, placing a child on a waiting list would prolong the child’s FND symptoms, increase

Table 5 Outcomes in children who met criteria for a mental health disorder at follow-up versus those who did not

RAHC-GAF at follow-up in children not meeting criteria for a mental health disorder: Mean (n), range (SD)	RAHC-GAF at follow-up in children meeting criteria for a mental health disorder: Mean (n), range (SD)	t value (df)	P value
Cohort 1 (n = 57 at assessment and 55/57 at 4-year follow-up) 79.20 (n = 44), 51–95 (SD 9.54)	63.27 (n = 11), 50–80 (SD 7.93)	5.108 (53)	<0.001
Cohort 2 (n = 60 at assessment and 56/60 at minimum of 12-month follow-up) 71.29 (34), 30–90 (SD 15.13)	58.29 (22), 35–90 (SD 18.03)	2.77 (53)	0.008
Cohort 3 (n = 25 at assessment and 25/25 at 18-month follow-up) 79 (n = 15), 60–90 (SD 9.14)	44.80 (n = 10), 31–61 (SD 8.61)	9.372 (23)	<0.001

RAHC-GAF, Royal Alexandra Hospital for Children Global Assessment of Function; SD, standard deviation.

risk of aberrant plasticity-related changes in brain structure and function and in physical deconditioning, delay treatment of comorbid mental health symptoms and serve to further entrench illness-promoting family interactions, thereby decreasing the probability of a complete return to health. Waiting lists in paediatric practice are ethically inappropriate. Second, we did not use separate measures to assess physical function and mental health. Two recent studies evaluating physiotherapy in FND have used the Functional Independence Measure for Children (WeeFIM), an 18-item, clinician-rated measure to assess the child's performance in skills relating to daily function.^{14,15} The WeeFIM could potentially be used alongside the RAHC-GAF to provide more detail about the child's function in the self-care, mobility and cognition domains. The WeeFIM does not provide, however, any way of teasing out the impact of comorbid pain (present in up to two-thirds of our patients) and global impairment of function secondary to comorbid mental health disorders (also present in approximately two-thirds of our patients). Valid and reliable measures – ones that can, in a population of paediatric FND patients, identify both caseness and particular dimensions of mental health – have yet to be identified.^{35,36} Finally, decisions concerning the need for, and allocation of, public health resources would benefit from further research to identify the actual costs, both financial and regarding the wear and tear on professional staff, of interventions for children with different levels of complexity and chronicity.

Conclusions

In summary, this article reports outcome data from the Mind-Body Program for children with FND, where psychologically informed physiotherapy is a core component of the treatment intervention. While outcomes were excellent, with half to three-quarters of children returning to full health and to full-time school attendance, key barriers to a good outcome included chronic FND symptoms at presentation and the presence of a mental health disorder or other (comorbid) functional somatic symptoms at follow-up.

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