
**INTERNATIONAL PHYSIOTHERAPY PRACTICE IN INFANTS WITH
CYSTIC FIBROSIS SURVEY RESULTS 1998 – 2000**

**Endorsed by the International Physiotherapy Group / Cystic Fibrosis (IPG/CF)
Grant support: European Respiratory Society Taskforce Project**

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Filip Van Ginderdeuren

Acknowledgements

The IPG/CF for supporting the project and distributing the questionnaire to the contact physiotherapists in the 40 IPG/CF member countries in 1998 - 2000.

All the country contact physiotherapists in IPG/CF member countries in 1998-2000 who distributed, completed and returned questionnaires for collation and analysis.

Grateful thanks for the editorial comments and suggestions made by Professor Maximilian Zach from the Klinische Abteilung für Pädiatrische Pulmonologie und Allergologie, Univ.-Kinderklinik, Medizinische Universität, Graz, Austria, and Professor Andrew Bush from the Royal Brompton Hospital during the preparation of the survey results.

Melissa George, Kate McQueen and Annie Dummett are acknowledged for assistance with data entry from the completed surveys.

Survey summary:

Background: Physiotherapy has traditionally commenced at diagnosis in infants with cystic fibrosis (CF). The aim of the survey was to determine physiotherapy practice in IPG/CF member countries.

Method: A structured questionnaire was developed by a group of experienced international physiotherapists, members of the IPG/CF. The questionnaire was piloted, revised and mailed internationally. Questions were asked about the demographics of participating CF centres, the physiotherapy organization, experience and practice, the use of newborn screening, the timing of the introduction of physiotherapy, education of carers and infection control practice.

Results: A total of 166 completed questionnaires were returned from 27 countries. CF centre size and therapists' experience ranged widely. Newborn screening occurred at 43% of centres that completed surveys, physiotherapy was commenced at diagnosis in 77% of centres with newborn screening and 86% of those without screening. Family members were taught by the centre physiotherapist and provided daily physiotherapy at 93% of centres. Patient segregation based on respiratory organisms was widely practiced. Twelve different physiotherapy techniques were prescribed.

Conclusions: The results of the survey found a wide variation in physiotherapy practice.

INTRODUCTION

Cystic fibrosis (CF) is characterized by viscous pulmonary secretions, impaired muco-ciliary clearance, obstruction of small airways, fibrosis and ultimately respiratory failure [1,2]. Improved survival has been attributed to better nutritional status, intensive treatment with antibiotics and physiotherapy [3]. Without newborn screening, a diagnosis of CF is usually made with the onset of respiratory symptoms, failure to thrive, steatorrhea or a presentation of meconium ileus in the neonate [4]. Physiotherapy has traditionally been introduced at the time of diagnosis [5]. In a study of fetal lungs during the second trimester of pregnancy, accumulation of mucin in the tracheobronchial glands in the infants with CF was observed compared to controls, but other changes were lacking [6]. It is not clear whether inflammation, infection or excessive mucus constitutes the initial pulmonary insult. Clinically asymptomatic infants with CF have demonstrated early airway inflammation, infection and pathogens on broncho-alveolar lavage in the first weeks of life [7,8]. These early changes are linked to reduced mucociliary clearance and obstruction in CF [9]. Physiotherapy has for decades been widely accepted as an integral part of the regular treatment of patients with CF [5]. The main aim of physiotherapy is to compensate physically for the impaired mucociliary clearance with the objective of retarding the development of lung disease as much as possible and to preserve lung function and physical function [10]. The widespread introduction of newborn screening worldwide for CF in the past two decades has led to an early diagnosis of CF, often in the first few months of life, when many infants are clinically asymptomatic.

Physiotherapists meeting at international conferences noted that despite the widespread use of physiotherapy in infants with CF, little was known about its worldwide use. There are no internationally accepted guidelines for physiotherapists treating infants with CF. We hypothesized that differences exist in a number of aspects of the physiotherapy management of infants with CF internationally, with different outcomes in different regions, and that there is a need for evidence based practice. The aims were to determine: (1) the demographics of the organization of physiotherapy and the experience of therapists treating infants in CF centres; (2) the use of newborn screening; (3) education of the providers of daily physiotherapy; (4) infection control practice in inpatient and outpatient settings, and, (5) the timing of the introduction of daily physiotherapy after diagnosis, the different techniques prescribed, and the use of adjunctive inhalation therapy

MATERIAL AND METHODS

Questionnaire

A structured information gathering questionnaire was developed and reviewed by a panel of internationally recognized physiotherapists treating infants with CF. It was endorsed by the International Physiotherapy Group for Cystic Fibrosis (IPG/CF). The questionnaire was piloted at six paediatric CF centres in Australia followed by final amendments which consisted of re-phrasing questions that were unclear. Worldwide distribution occurred via the International Physiotherapy Group for Cystic Fibrosis (IPG/CF) who distributed the questionnaire to the country contact physiotherapist in each of the 40 member countries between 1998 and 2000. Contact persons in turn distributed

the questionnaire to national CF centres for completion. The complete questionnaire is available upon request from the following email addresses: b.button@alfred.org.au or brendab@unimelb.edu.au. The questionnaire addressed the following topics: CF centre demographics, therapists' experience, newborn screening, training of caregivers, timing of the introduction of physiotherapy, infection control practice, the different techniques and adjunctive inhalation therapy prescribed.

Asymptomatic infants were defined as having a clear chest radiograph, no added sounds on auscultation, a dry sounding cough on stimulation, no increase in frequency of cough, a normal breathing pattern and respiratory rate (expected in an infant of a similar age without CF). Symptomatic infants were defined as having one or more of the following: changes on chest radiograph, added sounds on auscultation, moist sounding cough or cry, increased frequency of cough, abnormal breathing pattern and increased rate of breathing.

RESULTS

Analysis of Data

Completed questionnaires were returned in 1999 and 2000 from 27 of the 40 (67.5%) member countries. A total of 166 completed questionnaires were analyzed. The pilot centres completed the final questionnaire for inclusion in these results. North America, South America, The United Kingdom, Western Europe, Eastern Europe, Northern and Southern Europe and Australasia were represented in the completed questionnaires (see Table 1).

Size of CF centres

CF centres ranged in size from a few patients to 750 patients (see Figure 1). The majority of centres had between 40 and 200 patients. A few centres had between 350 and 750 patients. The number of infants treated at individual centres varied widely. The mean number of infants attending CF centres surveyed was 14.3 ± 16 (range 1 – 113). Eighty-five percent of centres treated up to 25 infants. A further 10% of centres had between 25 and 50 infants, while 4% of centres had between 50 and 75 infants, 0.7% of centres had 75-100 infants and 0.7% had 100-125 infants (see Figure 1).

Physiotherapists' experience treating infants with CF

The mean experience of the 161 responders was 12.5 ± 8 (range 0.5 – 39.5) years. The majority of therapists had 5 to 15 years of respiratory physiotherapy experience treating patients with CF. However, 24 therapists had 0.5 to 5 years experience (see Figure 2).

Newborn screening

Of the 144 responder centres surveyed 43% carried out newborn screening while 57% did not provide the service at the time of the survey.

Timing of introduction of daily physiotherapy

At centres with newborn screening, physiotherapy was commenced at the time of diagnosis at 77% of centres. Similarly, at centres without newborn screening, physiotherapy was commenced at the time of diagnosis at 86% of centres.

Education of the provider of daily physiotherapy for infants with CF

The CF physiotherapist was the primary educator at 93% of centres with initial education occurring in the inpatient and outpatient settings in equal proportions. Parents, grandparents, or guardians provided daily physiotherapy at 93% of centres.

Hospital or community therapists and trained therapy assistants provided treatment at a few centres while trained lay persons provided daily physiotherapy at 16% of responder centres. Others who occasionally provided physiotherapy included extended family members, family friends, babysitters, kindergarten assistants, older siblings, day care providers or community / home care nurses.

Patient segregation and infection control procedures

During hospital admissions patient segregation based on respiratory organisms was carried out at 85% of the responder centres (116 centres) while 15% of centres did not practice segregation (21 centres). In the setting of the Outpatient Clinic, a total of 68% of centres segregated patients based on pulmonary organisms (95 centres) while 32% (44 centres) did not segregate outpatients.

Inhalation therapy used as an adjunct to physiotherapy in clinically asymptomatic versus symptomatic infants

Inhalation therapy in general was used frequently or always at 74% of centres surveyed. Hypertonic saline and propylene glycol were the least frequently used inhalations. Fewer than a third of centres used bronchodilator agents or isotonic saline with clinically asymptomatic infants. Bronchodilator and antibiotic inhalations were the most frequently prescribed inhalations for symptomatic infants. RhDNase was used in less than 10% of centres with clinically asymptomatic infants in contrast to about a third of centres with symptomatic infants (see Table 2).

Physiotherapy Techniques

The different physiotherapy and cough stimulating techniques used are summarized in Table 3.

Postural drainage and modified postural drainage were used frequently or always in similar proportions (55% and 47% respectively) at responder centres; manual techniques (percussion or clapping) at 35%, vibration at 52%, mechanical vibration at 9%, positioning to improve ventilation at 58%, assisted autogenic drainage (the adaptation of autogenic drainage in infants: the physiotherapist manually increases the expiratory flow velocity and prolongs expiration towards residual volume) at 19%, the French technique of manually increasing expiratory flow with thoracic compression combined with cough stimulation at 17%, the German technique of contact breathing with the infant altering respiration in response to the physiotherapist's hands at 15%, the Swedish technique of physical activity interspersed with assisted autogenic drainage maneuvers at 19%, and positive expiratory pressure therapy (PEP) at 14% (see Table 3).

Use of cough stimulation

Cough stimulation techniques were used at 31% of centres. The different types of cough stimulation used were nasopharyngeal or oropharyngeal suction, stimulation of the back of the tongue, and tracheal pressure (see Table 3).

There were different reasons why some physiotherapists used cough stimulating techniques. These included stimulation of a cough during assessment of the infant's respiratory status, intermittently during and/or at the end of a treatment session. Some

therapists used cough stimulation only in clinically symptomatic infants while other used them regardless of the infants' respiratory status (see Table 3).

Physiotherapy Dosage

The number of different positions recommended per treatment session

The majority of centres used four or six positions per treatment with four being the most frequently used number for clinically asymptomatic and symptomatic infants. The range in number of positions used per treatment was between 1 and 12. Those using traditional postural drainage were the ones most likely to use 12 positions per treatment. For a graphic summary of the number of positions used by the responder centres with asymptomatic and symptomatic infants see Figure 3.

Total time per treatment session (including inhalation therapy) recommended

The most frequently prescribed physiotherapy treatment time regardless of symptoms was 26-30 minutes (inclusive of inhalation therapy). Extremely short or long treatments were seldom used.

Number of treatments per day – asymptomatic versus symptomatic infants

Once daily was most frequently prescribed for clinically asymptomatic infants while two to three times daily for symptomatic infants. It was rare for physiotherapy to be prescribed more than three times daily.

Recommended timing of physiotherapy treatments in relation to infant meals

In this open ended question some replied with more than one answer, for example, "before meals or at least 1 to 2 hours after meals". The majority (106 of 166) recommended physiotherapy before meals. If treatment was undertaken after meals, the minority (14 of 166) recommended waiting less than an hour, while the majority recommended at least an hour with some proposing treatment one to two hours after meals (51 of 166). A further minority suggested at least two hours after feeds (17 of 166) (see Figure 4).

Therapists opinions regarding common infant behaviors during physiotherapy

Approximately one third of physiotherapists frequently or always allowed infants to suck on a pacifier during treatment, one third never or rarely allowed non-nutritive sucking and a third occasionally used a pacifier. Some therapists had no opinion on the topic. Nearly half of therapists allowed infants to fall asleep during treatment, while others thought treatment would not be as effective if infants slept through treatment. The majority of therapists ceased treating infants who became extremely upset during treatment, while a small proportion said they would continue regardless of the infant's apparent distress. For detailed results of therapist's opinions and recommendations related to different infant behaviors during treatment see Table 4.

Management of gastro-oesophageal reflux (GOR) in relation to physiotherapy

Clinical observation and history taking of signs such as vomiting, regurgitation and re-swallowing, pain and irritability during physiotherapy possibly associated with GOR were always or frequently carried out at 88% of 154 responder centres. Modified positioning during physiotherapy (avoiding head down tilt) was used always or frequently at 75% of centres surveyed.

DISCUSSION

Data from two-thirds of IPG/CF member countries relating to the diagnosis and physiotherapy treatment of infants with CF was collected and analyzed. The results of this questionnaire demonstrated widely varying practices between centres in many aspects of physiotherapy. The demographic information relating to size of centres suggests that this survey captured a broad picture of the physiotherapy treatment of infants with CF worldwide and can therefore be accepted as representative of worldwide practice at the beginning of the 21st century. The experience of physiotherapists treating infants with CF ranged from a few months to 4 decades. This evidence supports the need for treatment guidelines for physiotherapists commencing work with patients with CF for the first time.

There are no randomized controlled trials to provide an evidence base for the early introduction of daily physiotherapy in clinically asymptomatic infants diagnosed with newborn screening. Some physiotherapists argue against the early introduction of daily physiotherapy in the absence of symptoms, conversely, many experienced physiotherapists working in internationally recognized CF centres reason for the early introduction of physiotherapy. Their justification comes from studies using broncho-alveolar lavage (BAL), in young infants diagnosed with newborn screening, where early inflammation and infection, often with pathogens, are identified in clinically asymptomatic infants [7,8]. Furthermore, these physiotherapists believe that infants tolerate treatment better when it is introduced early in infancy and becomes part of the daily routine of the infant and family. They speculate that this may in turn enhance participation and adherence to treatment in the longer term [11].

The study by Sutton and colleagues demonstrated the usefulness of inhaled saline to increase the effectiveness of sputum clearance [12]. Nebulized saline may hydrate the thick viscous secretions sometimes found in the lungs of clinically asymptomatic infants with CF, which in turn may improve muco-ciliary clearance. No long-term clinical trials have been carried out to investigate the effectiveness of regular use of nebulized saline, broncho-dilators or DNase in infants with CF and the risk of increased infection from contaminated equipment. This is an area requiring research.

Respiratory symptoms are usually characterized by a combination of clinical observation and assessment including breathing pattern, respiratory rate, sound of coughing or crying, chest sounds on auscultation, oximetry and chest radiograph. When respiratory paediatricians used these criteria to determine whether a patient was asymptomatic or not, the infants with apparently normal respiratory status were found to have diminished airway function using full and partial forced expiratory manoeuvres [13]. Infants responded positively to bronchodilators and physiotherapy [14]. The absence of respiratory symptoms on clinical examination and radiology was found to underestimate the degree of lung disease [15]. Infant pulmonary function tests have not yet been standardised and there is no normative data. It was concluded that it is not possible to assess a patient as being asymptomatic based on clinical examination alone [15]. High

resolution computed tomographic scans and broncho-alveolar lavages (invasive and expensive techniques) offer more sensitive complementary information and a more accurate description of the respiratory state in infants with CF [7,8]. Even though the onset and intensity of lung disease is highly variable, most begin to develop a progressive pulmonary obstruction during early childhood [7,9]. Some physiotherapists experienced in treating infants with CF believe that the early introduction of physiotherapy at the time of diagnosis may delay the progression of lung disease as physiotherapy is the only physical means of compensating for decreased muco-ciliary clearance, one of the hallmarks of CF [11].

Newborn screening has been available for more than two decades and has become standard practice in many regions. Until the introduction of newborn screening, diagnosis was usually made because of respiratory symptoms at varying ages from months to years. Connett and colleagues evaluated the outcomes of the early commencement of CF treatment, including physiotherapy, following newborn screening compared to delayed diagnosis in 73 patients with homozygous Delta F508 over ten years. At ten years, patients with delayed diagnosis required significantly more antibiotics and inhaled steroids to maintain their health and had more radiological changes [16].

There has been a tendency to extrapolate physiotherapy techniques used in mature patients with chronic cough and sputum production to developmentally immature infants, many of whom are clinically asymptomatic [17]. The horizontal alignment of the cartilaginous ribs result in mechanically less efficient intercostal muscles and a flatter diaphragm, and consequent wider sterno-costal angle reducing the effectiveness of the anti-reflux barrier [18]. Infants ingest frequent liquid feeds and spend much of their time in recumbent positions. Poor truncal tone causes infants to adopt a slumped sitting position increasing intra-abdominal pressure. All of these factors predispose the infant to gastro-oesophageal reflux [19].

Postural drainage with head down tilted positions is widely used internationally (see Table 3). The evidence for use of postural drainage comes from studies in mature patients with chronic sputum expectoration and until relatively recently has not been studied in infants. Postural drainage with head down tilted positions of 30° has been shown to provoke increased episodes of gastro-oesophageal reflux in very young infants of 2 months diagnosed with CF using newborn screening and some positions have been found to be more reflux provoking than others, in particular prone head down [20]. A study in older infants using lesser angles of head down tilt and different positions to the previous study [20] including the avoidance of the prone head down position did not demonstrate an increase in reflux [21]. A five-year study of twenty neonates randomized to standard physiotherapy or modified physiotherapy has shown that the modified physiotherapy group had significantly better lung function and fewer radiographic changes at six years of age [22]. Orenstein, in a recent editorial recommended that modified physiotherapy positions, avoiding head down tilt, should be used with asymptomatic infants with CF [23].

The aim of Autogenic Drainage (AD) developed by Jean Chevallier in Belgium in the 1970s is to achieve an optimal expiratory airflow progressively through all generations of bronchi without causing dynamic airway collapse [24]. Assisted Autogenic Drainage (AAD) sometimes described as passive AD is the adaptation of AD to infants and young children not yet mature enough to carry out this technique independently. AAD carried out by the physiotherapist supporting the infant in upright sitting on an exercise ball and utilizing bouncing was not found to provoke episodes of gastro-oesophageal reflux [25].

A study of the effect of the French Technique of manually increasing expiratory flow with thoracic compression combined with pharyngeal suction to stimulate cough on gastro-oesophageal reflux was undertaken in 1991 [26]. Treatment in the supine horizontal position was associated with increased gastro-oesophageal reflux compared to 30° head up. Furthermore, oropharyngeal suction was associated with significantly more gastro-oesophageal reflux than naso-pharyngeal suction. It was concluded that treatment should be carried out in the 30° head up tilted position and that oropharyngeal suction should be avoided [26].

The Swedish Technique was developed after a long term study from 1981-1983 which demonstrated that the effects of physical activity/exercise combined with the forced expiration technique (FET) was equally as effective as postural drainage, percussion and the FET and much preferred by infants, young children and their families [27]. Since 1983 postural drainage and percussion have not been used in Sweden with any patients regardless of age. For infants, toddlers and young children the physical handling / activity is interspersed with gentle therapist assisted thoracic compressions towards residual volume during expirations [11]. Recently published data demonstrates that this treatment philosophy has resulted in better than average long term outcomes [11].

Positive expiratory pressure (PEP) therapy was developed in Denmark in the early 1980s and was found to be at least as effective as postural drainage [28]. Since 1984 PEP in upright sitting has been the only technique used in Denmark where better than average outcomes have been reported using aggressive anti-biotic therapy and PEP physiotherapy [29]. PEP therapy has also been used in infants in Italy for a number of years. PEP was found to be as effective as postural drainage in a 12 month study of infants with CF, and the treatment of choice for parents and infants [30].

The majority of therapists recommended that physiotherapy ideally be carried out before meals. If that was not possible then at least one hour after meals / feeds. A number of therapists believed that at least 2 hours should pass before physiotherapy is undertaken. Delayed gastric emptying is known to occur in CF [31]. In a study comparing the effects of standard postural drainage (SPT) and modified postural drainage (MPT) on gastro-oesophageal reflux, infants had significantly more episodes of reflux during SPT than MPT even though treatment was carried out at least two hours after feeds [17].

Concern has been raised that if infants engage in non-nutritive sucking during physiotherapy, particularly in head down tilted positions, that gastro-oesophageal reflux may be further increased. In a recent study [20] postural drainage (with head down tilt)

was associated with gastro-oesophageal reflux, crying and lower oxygen saturation during treatment. Non-nutritive sucking was associated with a significant reduction in reflux episodes during postural drainage. Oxygen saturation during postural drainage was significantly lower during crying than other arousal states and non-nutritive sucking was associated with a significant increase in oxygen saturation. It was concluded that the use of non-nutritive sucking and infants falling asleep during treatment probably does no harm [20].

It is not possible to undertake double blinded placebo controlled trials with cardio-respiratory physiotherapy techniques. The number of patients at different centres is often not large enough for adequate power to detect a change when comparing two techniques. This survey has highlighted the need for well-designed research studies that may need to be extended to single blind multi-centre trials for adequate power.

The results of this survey show that newborn screening is becoming more widespread with the majority of centres introducing physiotherapy at the time of diagnosis often in the first 4-8 weeks of life. As postulated, wide variations in physiotherapy organization and practice were found, little of which is underpinned with scientific evidence. Regional tradition and cultural influences are strong factors in the selection of physiotherapy techniques for use with infants with CF. There is an urgent need for further research into the treatment of infants with CF so that practice is based on scientific evidence and best outcomes are achieved.

TABLE 1 – Countries included in the survey and number of completed regional surveys

Country	Number of completed surveys
Argentina	5
Australia	8
Austria	7
Belgium	5
Brazil	3
Canada	9
Costa Rica	1
Czech Republic	1
Denmark	2
Estonia	1
Finland	5
France	14
Germany	6
Ireland	4
Italy	11
Macedonia	1
Netherlands	4
New Zealand	1
Norway	4
Poland	4
Portugal	1
Romania	1
Slovakia	4
Sweden	3
Switzerland	3
United Kingdom	11
United States	47

TABLE 2: Inhalation therapy use as an adjunct to physiotherapy in asymptomatic versus symptomatic infants

Inhaled agent	Asymptomatic			Symptomatic		
	F/A	Occ.	N/R	F/A	Occ.	N/R
Bronchodilator	27[41]	23[34]	50 [76]	73 [115]	23[36]	4 [5]
Isotonic saline	27[40]	14[21]	59 [91]	38 [56]	14[20]	48 [69]
Hypertonic saline	2[2]	4[6]	94 [137]	5 [8]	9[12]	86[121]
DNase	9[13]	14[21]	77 [115]	30 [45]	30 [45]	40 [60]
Anti-inflammatory	7[10]	19[29]	74 [110]	37[55]	38[58]	25 [38]
Antibiotics	16[23]	14[22]	70 [103]	50 [74]	29[44]	21 [32]
Propylene glycol	0 [0]	1[1]	99 [138]	2 [2]	4[5]	94[118]

Abbreviations: F/A= Frequently / Always; Occ.= Occasionally; N/R = Never / Rarely.

The whole numbers refer to the % of centres. The numbers between square brackets [] refer to the number of centres that answered the question.

TABLE 3: Airway clearance techniques and cough stimulating techniques used with infants with cystic fibrosis internationally

Technique	Frequently/ Always	Occasionally	Never / rarely
Postural drainage	55% [90]	14% [23]	31% [51]
Modified postural drainage	47% [75]	26% [42]	27% [44]
Clapping / percussion	35% [55]	12% [19]	53% [83]
Manual vibration	52% [84]	18% [30]	30% [50]
Mechanical vibration	9% [15]	12% [19]	79% [126]
Positioning to ↑ Ventilation	58% [89]	18% [28]	24% [36]
Autogenic drainage (passive)	19% [30]	12% [19]	69% [111]
French Technique	17% [2]	9% [14]	74% [114]
German Technique	15% [2]	7% [10]	78% [115]
Swedish Technique	19% [26]	8% [11]	73% [98]
PEP therapy	14% [2]	5% [7]	81% [136]
Cough Stimulation	31% [44]	28% [40]	41% [60]
- tracheal pressure	13% [20]	20% [32]	67% [110]
- oropharyngeal stimulation	4% [7]	15% [23]	81% [126]
- oropharyngeal suction	7% [11]	20% [32]	73% [115]
- nasopharyngeal suction	9% [15]	25% [39]	66% [105]

Postural drainage included head down tilted positions while *modified postural drainage* avoided head down tilt. *Autogenic drainage (passive)* consisted of gradually moving secretions towards the upper airways with therapist assisted expirations towards residual volume generating the highest expiratory airflow without causing dynamic airway collapse.

The *French technique* consisted of acceleration of expiratory flow using thoracic compression combined with cough stimulation using tracheal pressure.

The *German technique* consisted of contact breathing stimulated by the sensation of the therapist's hands.

The *Swedish Technique* consisted of physical activities in different positions to alter the breathing pattern combined with gentle assisted expirations towards residual volume to enhance airway clearance.

TABLE 4: Therapists opinions and recommendations relating to infant behaviours (non-nutritive sucking on a pacifier, falling asleep and infant distress) during physiotherapy treatment.

Therapists' opinions	Frequently/ Always	Occasionally	Never/ rarely
The use of pacifiers			
Helps settle	36% [54]	32% [49]	32% [47]
Try not to use	33% [46]	12% [17]	55% [79]
No opinion	14% [15]	8% [8]	78% [81]
Infants falling asleep / upset			
Allow infants to fall asleep	41% [59]	25% [37]	34% [49]
Try to keep awake	37% [51]	9% [13]	54% [75]
Keep treating: mildly upset	73% [113]	15% [23]	12% [17]
Cease session: distressed	72% [110]	16% [25]	12% [18]
No opinion	9% [9]	6% [6]	85% [88]

Figure 1: Number of patients at CF centres

Mean = 132 patients

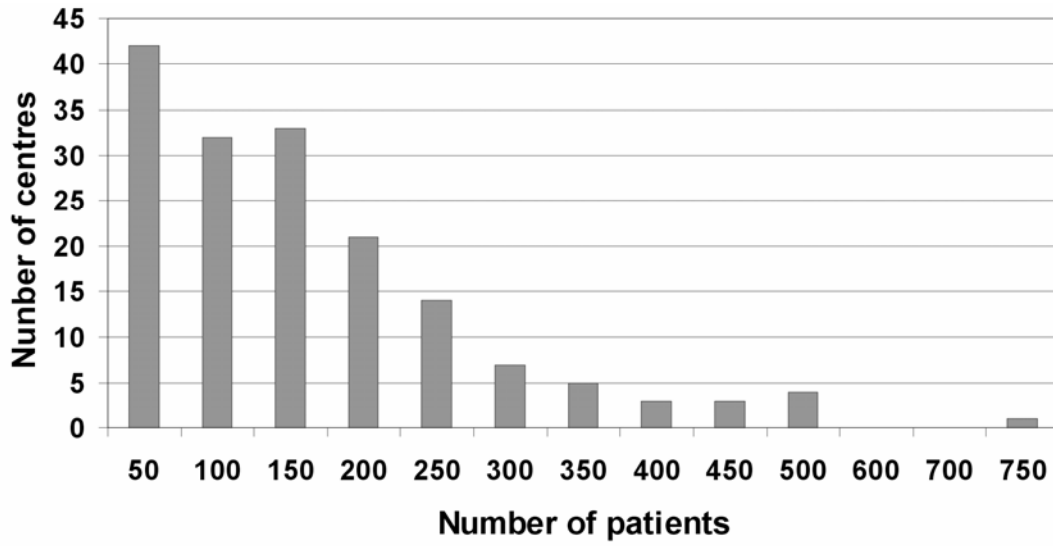


Figure 2: Therapists' years of experience in CF practice

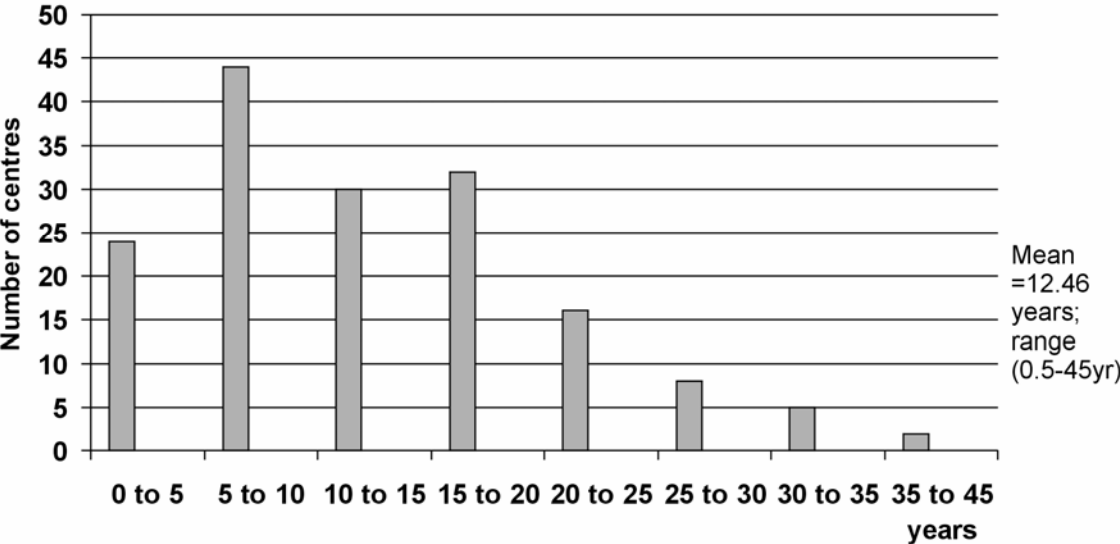


Figure 3: Number of positions per treatment

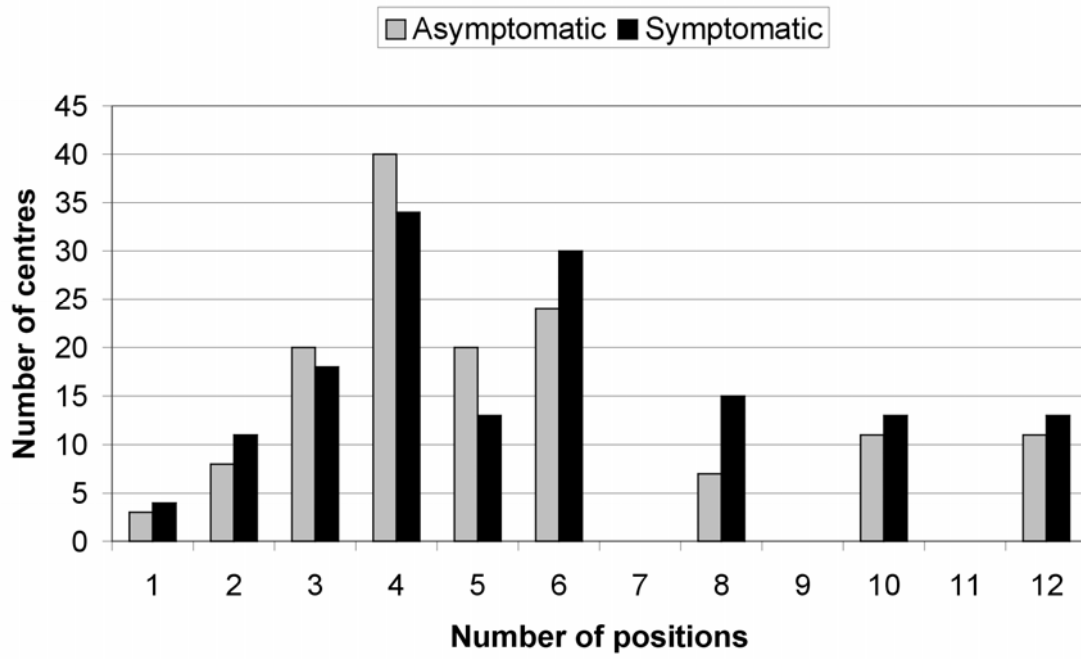
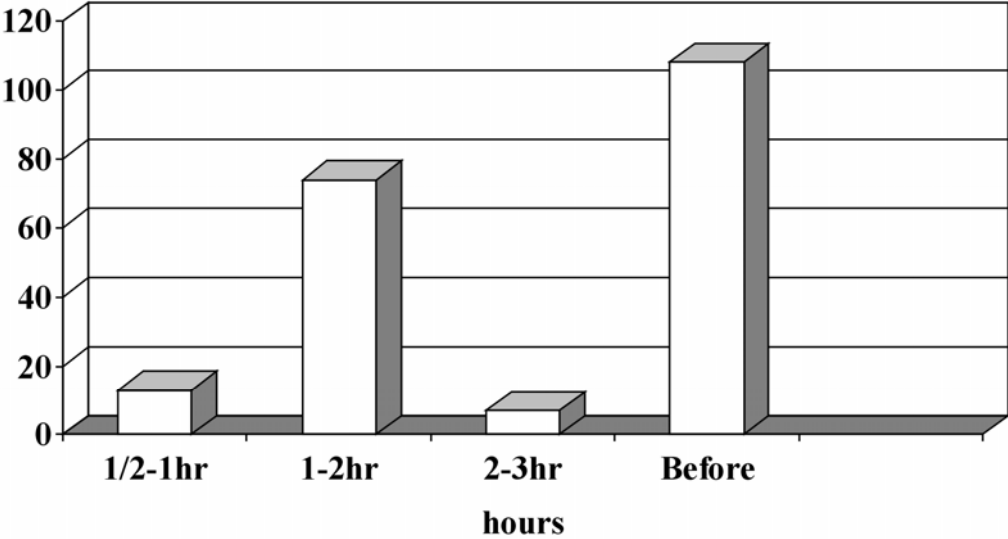


Figure 4: Timing of treatment in relation to meals - hours



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