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Safety Issues in Functional Capacity Evaluation: Findings From a Trial of a New Approach for Evaluating Clients With Chronic Back Pain

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Although safety is recognized as a critical issue in functional capacity evaluations (FCEs), it has rarely been investigated. This paper reports on the findings of a study which examined safety aspects of a new approach to FCE. Fourteen rehabilitation clients with chronic back pain participated in the study. Aspects examined included the pre-FCE screening procedures, the monitoring of performance and safety during the FCE, and the end of FCE measures and follow-up procedures. Support was found for the screening procedures of the approach, particularly blood pressure measurement, and for the combined approach to monitoring of the person's performance from biomechanical, physiological and psychophysical perspectives. Issues for FCE safety in general are identified and discussed, including the importance of screening procedures to determine readiness for FCEs and the issue of load handling in FCEs, especially in relation to clients with chronic back pain.

KEY WORDS: functional capacity evaluation; safety; chronic back pain; occupational rehabilitation.

INTRODUCTION

Functional capacity evaluations (FCEs) are a commonly used tool in occupational rehabilitation practice (1,2) which evaluate an injured worker's capacity to perform the sorts of physical activities that may be required in a job. Because the person undergoing the FCE usually has an injury or ongoing disability and because the person is required to exert some effort to perform the items of the FCE, there are a number of issues concerning safety of FCEs (3). Procedures need to be in place before, during and after the FCE to attend to the safety of the person undergoing the FCE.

Before the FCE, there needs to be adequate screening procedures to detect any precautions or contraindicated conditions for the FCE (4–8). During the FCE, there needs to be adequate procedures for monitoring the safety of the person, particularly during the

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performance of the items that involve manual handling (3,9). The procedures need to be safe for the population being evaluated. The procedure needs to be sufficiently physically exerting, or specific enough, to measure the person's capacity for performance of the task as may be required in the workplace while not causing a significant aggravation of the person's injury or condition, either during or after the FCE. After the FCE, a follow-up of the person within a couple of days allows the therapist to check the longer term effect of the physical exertion of the FCE which can also be useful for making recommendations for the person's return to work.

The importance of safety in FCEs has been recognized in the literature, including recent reviews (4,10), with some nominating it as the most important criterion or attribute for FCEs and similar work-related assessments (3,5,11–14). The importance of safety in practice was confirmed by a recent survey of practitioners which asked them to rate the necessity of attributes of work-related assessments, including FCEs (11). The attribute given the highest rating of necessity was safety. Despite this perceived importance of safety in the literature and in practice, this criterion or attribute has undergone little investigation. Most attention has been given to the properties of reliability and validity of FCEs and other work-related assessments (11).

A study by Matheson *et al.* (15) examined the safety of the EPIC Lift Capacity (ELC) Test by recording the effects of administration of the test on samples of healthy participants and a sample of participants who had musculoskeletal impairments. Safety for the test was based on no reports of injuries from the test sessions and no reports of new symptoms or need for medical attention. This study also reported on the heart rate effects of the test. Four of the participants from the sample of people with musculoskeletal impairments ceased participation in one or more of the tests because of the heart rate limits imposed in the test (85% of predicted maximum heart rate), while one of the healthy participants ceased due to reaching this limit. Screening and monitoring of cardiac function before and during FCEs has been recommended, as individuals undergoing FCE may be considerably deconditioned (16) and the lifting components in particular can be highly demanding for the cardiovascular system (17,18).

Heart rate and blood pressure measurement during FCEs monitors one aspect of the person's performance and safety in the FCE, that is the demand the FCE places on the cardiovascular system. The therapist can consider many other aspects of the person's performance in monitoring the person's safety during the FCE (3). These aspects can be classified under three main areas, physiological (e.g. heart rate and blood pressure), biomechanical (e.g. signs of muscle fatigue or weakness) and psychophysical (e.g. pain or fear of (re)-injury) (3). This paper reports on the findings of an examination of these aspects using a new approach to FCE with rehabilitation clients with chronic back pain. This approach is called the Gibson Approach to FCE or GAPP FCE.

As with many existing approaches (7), the GAPP FCE evaluates the client's performance on some of the physical demands from the Dictionary of Occupational Titles (19). See Table I. The GAPP FCE aims to integrate evaluation of the biomechanical, physiological and psychophysical aspects of performance of these physical demands (20). Such an integrated approach to the models of determining the end-point of the FCE has been recommended by others (21). The GAPP FCE also incorporates an evaluation of key psychosocial factors that can influence FCE performance, especially for persons with chronic back pain, such as self-efficacy (20,22,23).

The research and development of the GAPP FCE has followed standard processes of test development, including expert review (24), pilot testing (20), preliminary examination

Table I. The DOT Physical Demands and Subitems evaluated in the GAPP FCE

	Items evaluated in the GAPP FCE
1.	Sitting[a]
2.	Standing[a]
3.	Walking[a]
4.	Lifting (waist to waist)[a]
5.	Lifting (floor to waist)[a]
6.	Lifting (above waist)
7.	Carrying (bilateral)[a]
8.	Carrying (unilateral)
9.	Pushing and pulling
10.	Climbing (stairs)[a]
11.	Balancing (beam)
12.	Stooping (sustained semisquatting)[a]
13.	Kneeling (repetitively)[a]
14.	Kneeling (sustained)
15.	Crouching (repetitively)[a]
16.	Crouching (sustained)[a]
17.	Crawling
18.	Reaching (overhead)[a]
19.	Handling
20.	Fingering

[a]Recommended core physical demands for people with chronic back pain.

of its interrater reliability (20) and examination of its item validity (25). In the expert review of the GAPP FCE (24), all except one expert responded positively to a question about the safety of the GAPP FCE procedures. This expert qualified her response by stating that the procedures appeared safe if used in conjunction with adequate training.

This study examined aspects of each stage of the GAPP FCE process, including the biomechanical, physiological and psychophysical responses recorded by the administering therapist, either before, during, or on completion of the FCE to provide an indication of any safety issues in the procedures of the GAPP FCE. The results of the performance of a small sample of clients are used to illustrate some of the safety issues that can arise with FCE and that need further consideration in practice and research.

METHOD

Participants

The participants were 14 rehabilitation clients with chronic back pain (>3 months) who were consecutively referred for FCE to five occupational therapists trained in the GAPP FCE. These clients and therapists were participating in a larger study of the properties of the GAPP FCE including examination of its interrater reliability and predictive validity.

Materials

The GAPP FCE materials include an Evaluation Booklet and a User's manual. The Evaluation Booklet contains the battery of recommended pre- and postevaluation

questionnaires and the standard procedures and scoresheets for evaluation of the physical demands which are listed in Table I. The scoresheets classify possible observations and responses into three models of evaluation, that is, biomechanical, physiological and psychophysical. The GAPP FCE advocates use of the three models in combination to guide the observation of the person's performance and the cessation of the evaluation of the performance of the physical demands. The aim is that the evaluation is ceased because of observation of indicators of biomechanical effort. However, if physiological or psychophysical indicators occur, such as high heart rate or reports of pain, the therapist is encouraged to attend to these and weigh up the person's overall performance, putting the client's safety first. On completion of the performance of the physical demand, the therapist rates any difficulty with the performance using a scale of activity limitation, based on the scale of activity limitation used in the World Health Organization's ICIDH-2, the draft International Classification of Functioning, Disability and Health (26).

The User's manual describes procedures for each of the eight steps of the GAPP FCE process. These steps include preparation for the FCE, collection of background information, physical screening, evaluation of perceived functional capacity and other psychosocial variables, physical demands performance testing, post-FCE measures, scoring and rating and using the results.

The User's manual includes a section on safety issues, such as medical precautions and contraindications for FCE, heart rate and blood-pressure monitoring, screening for impairments, manual-handling technique and duty of care. The section on preparation for the FCE includes procedures for establishing medical stability and readiness for the FCE, including a proforma for obtaining medical clearance to undergo the FCE. As an additional precaution for establishing readiness for the FCE, the client is asked to complete a Physical Activity Readiness Questionnaire (PAR-Q) (27). The PAR-Q is recommended by the American College of Sports Medicine's (ACSM) Guidelines for Exercise Testing and Prescription (28) "to identify . . . adults for whom physical activity might be inappropriate . . . " (28, p. 13). The PAR-Q is widely used for screening for exercise testing (29) and has been used for screening in lifting studies (17) and work evaluation (30).

Resting heart rate is measured with a continuous heart rate monitor attached on commencement of the evaluation. Blood pressure is measured using an automatic blood pressure monitor, which provides gross measurement intended only for screening purposes. Pain scales are used to obtain a thorough picture of the person's presenting pain, including the 11-point Box Scale (31,32), a measure of pain intensity. This scale ranges from 0 (*no pain*) to 10 (*pain as bad as it can be*). Pain scales are also used during the FCE, only if pain is reported, and routinely on completion of the FCE. This measurement provides a profile of the person's pain before, during and after the FCE.

Further description of the materials is provided in Gibson *et al.* (20). Gibson *et al.* also reported the findings to date of properties of the approach, including preliminary interrater reliability of the approach with the same cohort of clients and therapists reported on in this study of safety issues. Reasonable support was found for the interrater reliability of the main overall ratings of return to work (RTW) based on administration of the GAPP FCE, especially between two occupational therapists experienced in FCE. However, these findings were with a small sample size; larger scale examination is required of these overall ratings and the interrater reliability of ratings made at the individual item level.

Examination of aspects of the content validity of the approach has generally provided support for the approach. This examination included an expert review of the technical quality

and representativeness of the approach (24) and a study of the item validity of the procedures for evaluation of the physical demands from the DOT that are evaluated in the GAPP FCE (25). One of the strengths of the approach identified by the expert review reported in Gibson and Strong (24) was how it incorporated evaluation of the biomechanical, physiological and psychophysical aspects of the person's performance of the physical demands.

Procedure

The clients were required to receive written medical clearance to undergo the FCE. The clients underwent the GAPP FCE screening procedures including completion of the PAR-Q (27) and measurement of resting heart rate and blood pressure after 30 min of sitting. The GAPP FCE guidelines recommend that the therapist should consider consultation with a medical practitioner before proceeding with the evaluation if the person's resting blood pressure measures greater than 140/90, which is the level above which is classified as hypertension by prevailing standards (33,34). The clients then completed the battery of recommended questionnaires as part of the evaluation of the first physical demand of Sitting.

After completion of the screening procedure, the clients underwent the standard GAPP FCE procedure for the Functional Physical Demands Testing component, attempting as many of the core physical demands (see Table I) as possible and any additional physical demands as determined by the administering therapist. The FCEs took an average of 3 h ($M = 3.18$, SD $= .47$), with a range of 2.5 h to 3 h and 50 min.

During the performance of the physical demands the therapists recorded their observations and the client's responses using the standard scoresheets. Pain was rated on the 11-point Box scale (31,32) only if the person reported pain or discomfort. Heart rate was noted at designated periods during evaluation of each physical demand. The standard procedure requires that the person's heart rate is noted at least at the end of the performance of each physical demand or each "set" with the physical demands involving manual handling. Blood pressure was measured before and on completion of the FCE and intermittently during the FCE, at the discretion of the administering therapist. The therapist also rated the performance in terms of the severity of any activity limitation. For the items involving manual handling, additional ratings were made for each load level, including the safety of the person's manual-handling technique.

On completion of performance of the required physical demands, the therapists took the required end of FCE measurements including heart rate, blood pressure and pain intensity. The therapist also rated the overall safety of the person's manual-handling technique. The clients were asked to fill in a follow-up diary for 2 days after completion of the FCE and return it in a reply-paid envelope.

Analysis

The safety of the approach was examined by inspection of the results from the following components of the FCE.

(a) The screening procedure, particularly the resting heart rate and blood pressure measurements,
(b) The Functional Physical Demands Testing, including whether and how the administering therapist monitored heart rate and blood pressure during the FCE, the

Table II. Characteristics of Participants

	Mean	SD	Range
Age (years)	38.4	12.8	21–57
Duration of chronic back pain (years)	4.3	6.5	.3–22
Pain intensity (0–10) (in general)	3.4	2.1	0–7
Pain intensity (0–10) (start of FCE)	2.3	1.4	0–4

responses recorded by the administering therapists on the scoresheets during the performance of the physical demands, particularly the reasons the evaluation of the physical demands or end-points ceased, the maximum heart rate and blood pressure values and pain intensity scores, the load ranges handled in the items requiring manual handling, and the ratings of activity limitation by the administering therapist,

(c) The end of FCE measurements, including the end pain intensity scores, heart rate and blood pressure values and the therapists' ratings of the safety of the clients' manual-handling technique,

(d) The follow-up component, including the clients' responses on the follow-up diary, including any reports of injuries or new symptoms or need for medical attention, as per Matheson *et al.*'s study (15).

RESULTS

Participants

The trial involved seven men and seven women. The statistics for age, duration of back pain and general and pre-FCE pain intensity are presented in Table II. Half of the sample were still working at the time of the FCE and had not had time off work. Sixty-four percent were still employed (64%), that is, had jobs to which they could return. Of the clients who were not working ($n = 7$) all but one had been off work for less than a year. Two clients were involved in litigation and half of the sample was receiving workers compensation.

Screening

The values for heart rate and blood pressure recordings taken before the FCEs were reviewed as an indication of the need for such physiological screening before FCE. A number of clients had readings of high resting blood pressure before commencement of the FCE, as recorded with an automatic blood pressure monitor. One client had a resting blood pressure recording of 182/102, well above the safety limit of 140/90. The administering therapist attempted to consult with the person's treating medical practitioner before proceeding and when unable to do so, did not proceed with evaluation of the manual handling or other cardiovascularly demanding physical demands (such as Climbing Stairs). Evaluation of this person's performance of these demands occurred on a later occasion after the person had commenced treatment for hypertension and further medical clearance had been obtained. Another five clients had readings close to the 140/90 guidelines and were managed by the

therapists by retaking the blood pressure after further sedentary activity and by regular monitoring, when the readings had lowered.

Apart from these instances, there were no reports of other precautions or contraindications for the clients to participate in the FCEs, based on the results of the screening procedure, including the PAR-Q.

Functional Physical Demands Testing

The types of end-points recorded by the administering therapists on the scoresheets for the functional physical demands component were examined, to provide an indication of the safety of the administration of the evaluation (Table III). Table III shows the number of clients who reached end-points for each of the core physical demands evaluated in the trial, and the number of clients who reached each type of end-point, either biomechanical, physiological, and psychophysical. This provides an indication of the reasons the therapists noted for ceasing the evaluation of the particular physical demands. These end-points provide an indication of the level of the safety and difficulty of the items for clients with CBP, in that the end-points may not necessarily be achieved if the person completes the physical demand according to the criteria, such as in the required time or distance. These end-points therefore also provide an indication of the safety and suitability of the criteria for evaluating clients with CBP.

The highest recording of end-points occurred for Lifting Waist to Waist, followed by other manual handling items of Lifting Floor to Waist and Bilateral Carrying. Table III shows that where the clients reached end-points of performance, this was primarily because of biomechanical reasons. On closer examination of the specific types of biomechanical end-points recorded, observation of an increased lumbar lordosis was one of the most common reasons for ceasing a physical demand (occurring on four occasions for Lifting Waist to Waist). In the items not involving manual handling, an inability to complete the procedure occurred once for Sitting, once for Standing, once for Walking, once for Crouching Repetitively and four times for Stooping or Sustained Semisquatting, the latter being the last item in the recommended order of testing.

Table III. End-points Recorded by the Administering Therapist for Each Core Physical Demand

Physical demand	No. of clients that reached end-points (*n*)	Type of end-points[a]		
		Biomechanical	Physiological	Psychophysical
Lifting (waist To waist)	10 (14)	7	2	2
Lifting (floor–waist)	6 (12)	2		2
Carrying bilateral	5 (11)	2		3
Stooping (sustained semisquatting)	4 (14)	3		2
Sitting	2 (14)	2		2
Standing	2 (14)	2		2
Walking	2 (14)	2		
Crouching repetitively	2 (14)	2		
Reaching overhead	1 (14)	1		1
Kneeling repetitively	1 (12)			1
Crouching sustained	1 (12)	1		
Climbing stairs	1 (13)	1		

[a] Some had combinations of types of end-points.

During two of the 14 evaluations, high blood pressure was the reason for ceasing evaluation of the particular physical demand and was therefore recorded as an end-point. This occurred during Lifting Waist to Waist for both clients. The concomitant heart rates for these two blood pressure recordings were examined, in terms of the guideline of achieving 85% of maximum for age heart rate. [The GAPP FCE recommends that heart rate alone is not used as an absolute end-point, as it can be highly variable (28).] For one client the concomitant heart rate for the high blood pressure recordings was well below 85% of his maximum heart rate for age while for the other client the concomitant heart rate was just above 85% of his maximum heart rate for age. (This was the only recorded occasion of a client reaching more than 85% of his or her maximum for age heart rate.)

The most physiologically demanding physical demand appeared to be Climbing Stairs, with seven of the 13 recorded maximum heart rates occurring during evaluation of this item. The next most demanding item was Lifting Floor to Waist with three occasions of maximum heart rate recorded.

The average maximum pain score for all 14 clients over all the physical demands, measured by the 11-point Box scale which ranges from 0 to 10, was 5.5 (SD = 2.3). The maximum pain scores ranged from 2 to 9. These maximum pain scores occurred across a range of items, with the most frequent item being Stooping (Sustained Semisquatting) for three of the clients. The highest maximum pain score was reported by one client at the commencement of the evaluation of Lifting Waist to Waist, lifting the empty crate of 3.6 kg.

In the 14 FCEs, there were three reports of symptomatic responses to the physical demands (such as tingling, radiating, sharp or burning pain) that needed to be considered with caution. These reports occurred with Kneeling Repetitively, Carrying Bilateral and Sustained Semisquatting. "Voluntary cessation," where the client asked to stop or did not want to proceed, was noted as an end-point 12 times over all the physical demands (including subitems and sets) evaluated for 14 clients. That is, the evaluation of the physical demand did not proceed or was not completed on 12 occasions because the client said he or she did not want to proceed. However, these 12 occasions occurred with four of the 14 clients, including five times with one client. Four of these 12 occasions were with Lifting Floor to Waist and occurred when the therapist wanted to proceed to evaluation of higher load handling.

The loads handled in the items of Lifting Waist to Waist, Lifting Floor to Waist and Carrying Bilateral were inspected as another indicator of the safety of the manual handling items in the FCEs (Table IV). The amount of load used in the GAPP FCE is at the discretion of the administering therapist, with some guidelines and precautions provided in the User's manual about considerations for the starting load used and the subsequent incremental increases in load. The scoresheets also provide guidance in terms of end-points for evaluation of load handling or observation of unsafe manual-handling technique. The loads handled

Table IV. Loads handled (kg) in the Trial

	Set (*M*)							
Physical demand	1	2	3	4	5	6	Min	Max
Lifting waist to waist	6	9.9	14.5	17.4	21.3	22.7	3.6[a]	30
Lifting floor to waist	7.1	11.5	14.8	16.9	15.4		3.6[a]	23.6
Carrying bilateral	6.4	11.7	15.3	19.2	17.5		3.6[a]	27.5

[a]Empty crate = 3.6 kg.

ranged from a minimum of 3.6 kg (the weight of the crate used in the study) for all the manual handling subitems to a maximum of 30 kg, which was handled in the subitem of Lifting Waist to Waist. The maximum mean load handled was 22.7 kg for the subitem of Lifting Waist to Waist.

The items requiring manual handling had the highest ratings of activity limitation. Of the items not requiring manual handling, Stooping (Sustained Semisquatting) had the highest mean rating of activity limitation on the 5-point scale ($M = 2.8$, SD = .98), followed by Kneeling Repetitively ($M = 2.0$, SD = .6).

End of FCE Measures

The mean pain intensity score for the end of the FCEs was 4.25 (SD = 2.3, $n = 12$). There was an overall trend for an increase in pain during the evaluation, followed by a reduction by the end of the FCE, with the end pain remaining higher than the pain reported on commencement of the FCE. Two of the clients reported a higher level of pain on completion of the FCE than was reported during the evaluation, one had the same level of pain as the maximum recorded during the evaluation and the remaining recorded levels decreased.

A similar trend was noted with heart rate, with an increase to mostly submaximal levels then a reduction by the end of the FCE. However with heart rate there was a greater trend towards resting heart rate levels than with the pain levels on completion of the FCE. Blood pressure measurements showed a different trend on completion of the FCE. The blood pressure levels increased during the evaluation as with pain and heart rate. However, on completion of the FCE the majority of blood pressure levels were less than the resting blood pressure measurements.

The therapists were asked to make a global rating of the safety of the clients' manual-handling technique. All but one of these ratings ($n = 10$) was that the technique was safe. This participant's manual handling capacity was evaluated with only very light load levels, that is, the empty crate and only for the Waist to Waist item.

Follow-up Measures

Another indication of the safety of the procedure was provided by examination of the responses to the diary that clients were asked to complete in the 2 days following their FCE. Specifically, the diaries were examined for any reports of injuries from the FCEs or new symptoms or need for medical attention, as per Matheson *et al.*'s study (15). Of the 10 returned pain diaries, one client reported a major aggravation of pain after the FCE such that he consulted his doctor for stronger medication. (This client had reported high levels of pain before commencement of the FCE and displayed difficulty with performance of the lightest physical demands during the FCE). There were no reports of the need for other medical interventions or of new injury or reinjury after the FCEs.

DISCUSSION

The trial of the GAPP FCE provided support for the attention to safety in the GAPP FCE procedures, especially in terms of its requirements for screening and monitoring of

heart rate and blood pressure. Without such measurement, at least one FCE would have proceeded without awareness of possible undiagnosed hypertension. The trial provided evidence of the value of physiological screening before the FCE, including blood pressure measurement, and the need for medical clearance to undertake the FCE.

The pressure for expediency from referrers for therapists to arrange and administer an FCE as soon as possible after referral, may discourage therapists from obtaining adequate medical clearance and client consent for the evaluation. Recent surveys of Australian therapists who conduct work-related assessments, including FCEs, confirmed that time is a constraint on ideal practice and can be a barrier to thorough assessments (35,36). The therapist is required to balance time constraints with adequate screening for serious contraindications. Nadler *et al.* (37) cautioned referring medical practitioners and administering therapists about the risk of conducting FCEs with people with undiagnosed cardiac and(or pulmonary problems and of re-injury from lifting tasks for people with back pain. These authors recommended that treating medical practitioners need to take responsibility for identifying any contraindications and that the administering professional take responsibility for obtaining informed consent before the FCE.

Similarly, the authors of a study on the metabolic and cardiorespiratory effects of continuous box lifting called for thorough screening before such activity in clinical settings with people with low back pain in case of undiagnosed cardiovascular disease (17). Their study involved participants with excellent levels of cardiovascular fitness who found such activity using a squat style to be highly physiologically demanding. They recommended that such screening include completion of medical history and health status questionnaires, medical clearance and baseline measurement of heart rate and blood pressure. They also recommended heart rate and blood pressure monitoring during lifting or immediately at the end of lifting tasks.

Recent evidence has found that the cardiovascular fitness of patients with chronic low back pain may not be as poor as theorized (38). While some studies have confirmed a lower cardiovascular fitness in patients with chronic back pain, others have found it comparable to healthy controls especially if the patients are actively working (38). This evidence may be reassuring for conducting FCEs with individuals with chronic back pain, especially if they are still working. However, as our study shows, there is still the need for vigilance to screen for individual cases with unknown cardiovascular disease before undertaking the physiologically demanding items of the FCE.

There are clear guidelines available that can be used for such screening before the FCE (31,32). However this is not the case for guidelines on what are appropriate and safe heart rate and blood pressure responses during or after the physiologically demanding items of an FCE. Indeed, a independent review of the physiological aspects of the GAPP FCE procedures (39) noted the limited literature available to better inform the procedures for evaluating physiological aspects of performance of the physical demands in FCE and the need for further research of this area.

The trial provided reassurance about the procedures for evaluating the physical demands in that symptomatic responses that needed caution to proceed were only reported on three occasions and there was only one case of a reported major aggravation of pain in the days after the FCE. The trend towards increased pain levels during the FCE followed by a reduction on completion of the FCE was also reassuring. However, the fact that the majority of the clients' pain levels remain elevated from the pre-FCE levels supports the

need to follow-up the clients in the days after the FCE to check that the pain returns to usual levels. This follow-up also provides valuable information about the cumulative effect of the evaluation in terms of the effect of physical activity on the person's pain, which in turn is important in considering return to work recommendations.

The examination of the end-points of performance noted by the therapists as reasons for ceasing the evaluation of the physical demands provides evidence that the therapists used the three models of evaluation in combination for guiding the evaluation, as recommended by the GAPP FCE. The findings showed that the biomechanical model was strongly used by therapists but that when the client reported symptoms of concern or asked to cease the evaluation (psychophysical end-points), or where physiological signs of concern were noted, the therapist considered these end-points as reasons for ceasing the evaluation. This evidence supports the safety as well as utility of the approach.

The safety of the approach was supported by the small number of absolute end-points noted over the 14 FCE's and the indication from the end-points that the therapists ceased evaluation of the physical demand on noting demonstration of unsafe biomechanical indicators, such as an increased lumbar lordosis. Interestingly, a recent review of the evidence for different techniques for low level lifting questions the evidence for many of the biomechanical indicators traditionally thought of as unsafe (40), such as not maintaining a normal standing lordosis during lifting. This raises the safety issue for FCEs about the style of manual-handling technique used by the person and what the therapist or the approach operationally defines as safe (41). With the increasing evidence against recommending one particular manual-handling technique (40,42) and the recommendation for accommodation of individual lifting styles depending on the person's diagnosis for people with back pain (43), there is a need for flexibility in these definitions and the application of broad principles of safe manual handling (40,44). The GAPP FCE advocates general principles of safe lifting. However these will need to be regularly reviewed and updated according to the latest evidence.

The examination of the loads used by therapists to evaluate the physical demands that required manual handling in the final trial provided another indication of the safety of these demands. The therapists appeared to have followed the recommendation in the GAPP FCE User's manual to commence the evaluation of the manual handling items with either an empty crate or small loads. The data showed that the loads used for evaluation ranged from the weight of the empty crate (3.6 kg) up to a maximum of 30 kg for one client in Lifting Waist to Waist with a maximum mean of 22.7 kg for the subitem of Lifting Waist to Waist (Table IV). In the item of Lifting Floor to Waist, the maximum load used was 23.6 kg and the highest mean load level was 16.9 kg.

In a study of the test-retest reliability of a 2-day FCE protocol, Reneman *et al.* (45) noted that some of the load levels evaluated in that study using patients with CBP were well above the weight limit of 23 kg recommended by the US National Institute for Occupational Safety and Health (NIOSH) (46). The loads used by the therapists in the GAPP FCE trial were on average below the 23-kg level, particularly for the item of Lifting Floor to Waist. The highest loads handled were for the items of Carrying and Lifting Waist to Waist, which require more a transfer of the load across the same height rather than a lift of the load between different heights. However, the fact remains that some of the loads used by the therapists in the trial to evaluate the physical demands of lifting and carrying were higher than prevailing guidelines recommend (44,47). Therapists may argue that testing in a controlled setting with an ideal container, under their supervision and in relation to the specific capacity of the

individual being evaluated, as occurs in the FCE, is different to the recommendations they would make for workers on their RTW. However, there remains the risk of further or other injury in the testing situation (10) and the question of whether such heavy load handling should be performed even in a so called supervised and controlled setting.

There were also two cases in the trial where one of the therapists recommended a physical level of RTW of Heavy with Restrictions, which would involve handling loads greater than 23 kg. Again, this is endorsing the person returning to work handling loads above recommended guidelines. A different classification of the "heaviness" of load handling in jobs, such as that reported by Andrews *et al.* (48), may be a useful alternative for use in FCE ratings for RTW. This classification system is more conservative than that provided by the DOT.

The use of this system may also be supported by the evidence, albeit limited, that workers with a history of back pain may aggravate their condition if they lift heavy loads (49). Apart from using guidelines on load handling for all workers (44,46,47,50), there is a paucity of guidelines on the physical demands and level of work that workers with a history of back pain can safely tolerate. Most back pain guidelines recommend caution in returning the person with a history of back pain to heavy manual handling demands at work (51). However, there is evidence that restrictions on RTW can limit the likelihood of RTW or full duties (52). More research on workers with back pain is needed to see what jobs and physical demands workers with back pain can tolerate safely.

The findings of a concurrent study of the item validity of the physical demands from the DOT as evaluated in the GAPP FCE contributes further information on the issue of the evaluation of load handling in FCEs (25). As well as examining the item-objective congruence and relevance of the items in the GAPP FCE, this study included asking a group of Australian-based occupational therapists to rate the difficulty and safety of the items, including the difficulty and safety of evaluating levels of loads, based on the physical levels of work defined in the DOT. The majority of the therapists had concerns with the safety of evaluating clients with chronic back pain handling medium to heavy loads, that is, 17 kg and above, as defined for the study. The majority of therapists rated the evaluation of the handling of heavy loads (defined as 24–45 kg) unsafe for the items of Lifting Above Waist and Unilateral Carrying and highly difficult to unsafe for the items of Lifting Waist to Waist, Lifting Floor to Waist and Bilateral Carrying. Evaluation of the handling of loads greater than 45 kg in all the Lifting and Carrying subitems were rated as completely difficult or unsafe by a significant proportion of the participants.

In the item validation study, of the physical demands not requiring manual handling, Stooping (or Sustained Semisquatting as evaluated in the GAPP FCE) was the demand rated the most difficult. The therapists gave support to inclusion of the item overall but it was rated by the majority of therapists as moderately to highly difficult for people with chronic back pain. Although not rated as unsafe by the majority of therapists, it is interesting that in the trial of the GAPP FCE with clients with chronic back pain, the item of Stooping (Sustained Semisquatting) had the most end-points of the items not involving manual handling. In this item, four clients reached an end-point. Stooping (Sustained Semisquatting) also had the highest number of maximum pain recordings and the highest rating of severity of activity limitation. However, a consideration in this is that this item was recommended to be evaluated at the end of the core demands, so the clients would have experienced the cumulative effect of the whole evaluation to that point.

The physical demand of Stooping has also been found to be highly difficult for clients with chronic back pain in a report of such a population undertaking another FCE battery on the basis of the physical demands of the DOT (53). Another test of Stooping has been found to be the most difficult for healthy volunteers in a battery including overhead reach and kneel reach tests (54). However, these batteries tested Stooping in a more traditional posture of forward flexion of the spine rather than in a semisquatting posture with flexed hips and knees, as recommended in the GAPP FCE. It is acknowledged that a sustained semisquatting posture may be as equally demanding because of the muscular effort required to sustain the hip and knee flexion.

Reneman *et al.* (55,56) have raised the issue of the need for better guidelines for the criteria used in FCE items to evaluate performance. Given the evidence from the trial of the GAPP FCE, the item validation study and the other evidence discussed above about stooping tests, further consideration and future research is warranted of the evaluation of Stooping in the GAPP FCE and FCEs in general, at least for people with chronic back pain. Studies on recommended maximum holding times for static standing postures from the ergonomic literature (57), as cited by Reneman *et al.* (55,56), may provide some guidance for such consideration and research.

Despite the small sample size of this trial, a number of issues have been identified for further attention and future research in the GAPP FCE. These issues may be relevant to FCE practice in general, in addition to the GAPP FCE in particular. This trial has shown the importance of including screening procedures to determine readiness for the FCE, especially from a cardiovascular point of view. However, it has also raised the need for improved guidelines and procedures for evaluating such readiness and for physiological monitoring before, during and after the FCE. This trial has raised safety issues about load handling in FCEs, especially for people with back pain and in relation to prevailing standards. The issues raised also relate to the need for sound and thorough training for therapists administering FCEs.

The findings of this study are limited by the fact that the developers of the approach have conducted and reported the research, thereby potentially biasing the results. However, there have been few studies to date addressing these aspects of FCE. Given the limited research on safety issues in FCE to date, this research on the GAPP FCE makes a contribution to this aspect of practice and provides a base for ongoing investigation of safety issues.

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