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Exercise and physical therapy help restore body and self in clients with severe anorexia nervosa

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Abstract

Exercise in the context of anorexia nervosa is a multifaceted endeavour surrounded by controversy and uncertainty. A broader comprehension of this poorly understood phenomenon is required. Informed by the findings of a body examination of six individuals with anorexia nervosa, as well as exercise science, phenomenology and neurocognition, the purpose of this article is to elaborate on the potential role of exercise and physical therapy in the treatment of anorexia nervosa. The findings of the body assessment include constriction of posture, muscles and pattern of breathing. These bodily restraints are not necessarily merely associated with high levels of exercise, they may also reflect psychological strain accompanying the illness. The restricted breathing in particular is assumed to be associated with difficult thoughts and suppressed feelings. Based on the results of the body examination, as well as medical and psychological considerations accompanying the illness, it is suggested that interventions should focus on improving postural stability and restoring related muscular function. Integral to engaging in these activities, the potential to integrate proprioceptive information in this process may generate a more coherent experience of the body, as well as of the self, in these clients. Accordingly, constrictions of the body may have a vital role in constraining the experience of the self. As such, addressing bodily restraints in these clients may facilitate the experience of being the subject causing and controlling the movements. This is in marked contrast to clients' previous exercise experiences, which were associated with compulsion, rigidity and the absence of coherence and control.

BACKGROUND

Exercise in the context of anorexia nervosa is a multifaceted endeavour giving rise to a range of controversies and debates, especially in the case of extensive and rigorous exercise routines, which are seen frequently in these individuals. Compulsive exercise[1] in clients with anorexia nervosa is anticipated to have negative implications for the process of recovery; it has been associated with increased psychological comorbidity (Taranis and Meyer, 2011; Beumont and Touyz, 2003), intensified medical complications (Mehler and Brown, 2015; Miller et al.,

2005), prolonged hospitalization (Solenberger, 2001), modest clinical results (Casper and Jabine, 1996), and increased prospect of relapse after recovery (Strober et al., 1997; Carter et al., 2004). Such exercise has further been assumed to interfere negatively with personal relationships and the social world (Fox and Diab, 2015; Kolnes, 2016). On the other hand, some would argue that exercise may also entail benefits for these clients. For instance, exercise can be an important strategy for regulation and management of feelings, and for avoiding conflict with significant others (Bratland-Sanda et al., 2011; Moola et al., 2015; Kolnes and Rodriguez-Morales, 2016). Exercising may also function as a means of distraction or of escaping intense bodily distress accompanying high levels of psychological strain and difficult feelings (e.g., tension or pain in the chest or stomach) (Kolnes and Rodriguez-Morales, 2016). In addition, it has been shown that exercise has the potential to embody significant value for participants' identity, self-understanding and belonging, notably for those who have been engaged in organized sport during their childhood or adolescence (Jenkins and Ogden, 2012; Kolnes and Rodriguez-Morales, 2016). Concerns over maintaining a sense of control and a strong ambivalence about treatment and recovery have been suggested to be essential triggering dimensions accompanying clients' engagement in such exercise routines (Kolnes, 2016). However, being wedged in an ongoing cycle of compulsive exercise and restrictive eating may keep the individual tangled up in ambivalence, thus preventing her or him from exploring feelings and core beliefs about self and behaviour that preserve such ambivalence (Geller, 2006), and from finding alternative ways of dealing with problematic feelings and confirming the self.

Current approaches for dealing with problematic exercise during hospital treatment seem to be characterized by exercise restriction and control, and patients' engagement in physical activities is habitually considered to compromise treatment goals (Moola et al., 2015). Restricting activity entirely while in a treatment situation involving increased psychological distress may, however, produce intensified ambivalence and resistance towards change in these

clients (Kolnes and Rodriguez-Morales, 2016). Thus, a full restriction approach can be counter-productive due to its potential for weakening the sense of autonomy and control provided by exercise engagement in these clients (Moola et al., 2013). Prohibiting patients from exercise has been shown to produce further tension between staff and patients (Beumont et al., 1994).

Researchers and clinicians have reasonable concerns that excessive and compulsive engagement in exercise in individuals with anorexia nervosa embodies a hazard for already medically vulnerable clients, due to their continuing underweight and its consequences for bodily functions and structures. Despite prevailing concerns about the risks accompanying moderate and high levels of physical activity, various aspects of exercise in this context are poorly understood. There is confusion among clinicians and staff about what can be considered 'physical activity' and what represents 'eating disorder psychopathology' (Moola et al., 2015). Apart from considerations around weight issues and body mass index (BMI), the conception of the client´s "readiness" to take part in exercise is unclear (Davies et al., 2008). Yet, focusing solely on weight criteria before implementing exercise might turn out to be unproductive, as it may contribute to maintaining emphasis on weight and the association of exercise primarily with weight concerns.

Clearly, in order to expand on the conceptualization of exercise in this context and move beyond control and restriction, a broader understanding is required of whether and how certain forms of physical activity, as well as physical therapy, might have benefits for recuperation, not merely of the physical body, but also of the self. After all, it can be assumed that the self is inherently bodily (Legrand, 2011) and that bodily restraints might also constrain the experience and recognition of the self. Provided that activities are modified and tailored to the individuals´ characteristics and needs, such exercise might, in fact, have a restorative dimension, in contrast to the more risky excessive and compulsive exercise routines commonly undertaken by these clients. Informed by the findings of a body assessment of individuals with anorexia nervosa, as well as sport and exercise science, phenomenology and neurocognition, the purpose of this

article is to elaborate on these subjects and to offer an alternative frame of reference for comprehending and managing exercise in this particular context. First, work on exercise and physical therapy interventions, as well as some medical problems of relevance to exercise in clients with anorexia nervosa, will be reviewed.

Exercise and physical therapy interventions for patients with anorexia nervosa

While high levels of exercise in general are at odds with being severely underweight, this does not imply that any form of exercise is deemed unsafe in this context. A modest body of literature illustrates beneficial aspects of some forms of physical activity and how these can be employed therapeutically and in a manner complementary to other therapies in the management of anorexia nervosa. Work covering both exercise- and physical therapy interventions will be reviewed, given their complementary roles in managing physical activity and recovery in clinical settings, although physiotherapists typically have broader expertise regarding identification, examination and evaluation of functional impairments related to the body.

Exercise interventions

Assuming patients adhere to their meal plans and treatment programmes, and interventions are of moderate intensity and carefully implemented, exercise interventions appear to have positive effects for medically stable patients, such as increased psychological well-being, reduced anxiety and increased compliance to treatment (Thien et al., 2000; Szabo and Green, 2002; Chantler et al., 2006). A three months graded low impact exercise protocol performed three times weekly improved patients' quality of life, but had moderate impact on measure outcomes such as body mass index and percent body fat (Thien et al., 2000). An eight week light resistance training targeting all major muscle groups and performed twice a week for one hour showed positive effects on the muscular strength of hospitalized individuals with anorexia nervosa (Chantler et al., 2006). Additionally, as shown by Szabo and Green (2002), the training

was combined with increased nutritional consumption and improved body composition and psychological well-being in the patients. Moreover, a supervised exercise training at anaerobic threshold level, performed five times weekly for thirty minutes during the recovering phase produced beneficial changes in exercise capacity as well as a reduction in emotional stress in adolescent patients with anorexia nervosa when retested one year after the initial exercise test (Tokumura et al., 2003). In less than four weeks, residential participants taking part in a multidimensional exercise programme (including some combination of Pilates, yoga, stretching, partner exercises, strength training, aerobic and balance activities) four times per week for one hour, and who were also given the opportunity to reflect on the experience before, during and after each session, reported reduced disordered thoughts, feelings and behaviours about exercise (Calogero and Pedrotty, 2004). An individualized yoga treatment programme for patients with eating disorders across diagnosis, revealed a short term reduction in clients´ preoccupation with food and in anxiety indicators (Carei et al., 2010). Worth noting is that such supervised exercise interventions seem to have no adverse effects on weight gain in these clients (e.g., Calogero and Pedrotty, 2004; Tokumura et al., 2003; Touyz et al., 1993; Thien et al., 2000). The literature emphasizes that structured exercise interventions should be undertaken once adequate food and weight restoration has been achieved, and only by patients who are in a process of recovery (e.g., Chantler et al., 2006). Thus, the interventions do not appear to be appropriate for very low weight individuals, or clients in earlier phases of the recovery process struggling with abstaining from their exercise routines.

Physical therapy interventions

Physiotherapy as an approach in treatment programmes for anorexia nervosa is not yet well characterized. In general, individual physical therapy interventions are based on a history taking and the findings from a body examination, or they can be adapted according to the particular needs of a group of clients. However, work based on body assessment and specific

bodily concerns in the context of anorexia nervosa is sparse (Fisher and Schenkman, 2012; Hechler et al., 2005). Nevertheless, changing the way in which patients with anorexia nervosa experience their bodies is assumed to be an important indication for physiotherapy, and interventions aimed at modifying body awareness and bodily experiences have been proposed (Vandereycken et al., 1987; Beumont et al., 1994; Probst et al., 2013; Probst et al., 1995). One paper has discussed the potential of body awareness therapies in terms of increasing body contact, initiating novel ways of sensing and interpreting bodily signals, as well as improving emotional awareness through the body (Kolnes, 2012). In her exploration of techniques that may increase the perception of the body and relaxation in individuals with anorexia nervosa, Davison (1988) emphasizes the importance of establishing a trusting relationship with the client, and of tailoring the interventions to the specific needs of the individual. With the purpose of influencing the body experience an excessive exercise in patients with anorexia, interventions with the aim of rebuilding a realistic body awareness and curbing “hyperactivity”, including massage therapies and exercises with the aim of changing breathing, posture and the ability to relax, have been reviewed by Probst and colleagues (Probst et al., 2013; Probst et al., 1995). Given the wide arrays of qualifications of physiotherapists in, for example, facilitating the experience and awareness of the body, Probst et al. (2013) contend that physiotherapy should be an integrated part of the overall treatment of anorexia nervosa. Based on physiotherapeutic examinations of a severely deconditioned patient with anorexia nervosa who was unable to perform daily tasks (e.g., walking and sit-to-stand without assistance), Fisher and Schenkman (2012) outlined a programme of diverse physical therapy interventions during a nine-week hospitalization. A vital aspect of the treatment was the adapting of interventions to the patient's physical potential in close collaboration with the multidisciplinary team at the unit, notably the specialist physician, nursing and dietary staff. Along with medical stabilization, the main focus of the physical therapy was promoting functional independence in daily living

activities through the restoration of the body (e.g., stretching short muscles, gait training, light resistance training, endurance and postural stability training) (Fisher and Schenkman, 2012).

MEDICAL CONCERNS OF PARTICULAR RELEVANCE TO EXERCISE

Owing to nutritional deprivation and weight loss, anorexia nervosa is inherently associated with a number of medical comorbidities affecting nearly all bodily organs, functions and structures, including a profound whole body metabolic disturbance (McLoughlin et al., 1998). Risk factors for developing medical complications in anorexia nervosa are primarily associated with degree of weight loss and duration of illness (Mehler and Brown, 2015; Miller et al., 2005). With the exception of bone loss, nearly all complications seem reversible with weight gain and nutritional rehabilitation. While others have provided overviews of potential medical problems in restricting anorexia nervosa (e.g., Mehler and Brown, 2015), for the purposes of this paper, physical complications of particular relevance to exercise in the context of anorexia will be considered. These include complications associated with the cardiovascular and pulmonary systems, bone metabolism, and musculature. These systems are mutually interrelated and carefully coordinated by the nervous system in order to maintain bodily homeostasis. As such they need to be seen as part of a whole.

Cardiovascular system. Bradycardia (slow heart rate) and hypotension (low blood pressure) represent the most common cardiovascular findings in these patients, with bradycardia seen in up to 95% of patients (Yahalom et al., 2013). Structural changes, such as effusion of the pericardium, decreased left ventricular size, and left ventricular dysfunction, are fairly frequent in these clients (Kastner et al., 2012). Due to a general loss of muscle mass caused by malnutrition, and given that the heart is also a muscle, it appears plausible that the size of the heart will decrease to some extent in patients with enduring anorexia nervosa.

Bone metabolism. Osteopenia or osteoporosis has been found in approximately 80% of patients diagnosed with anorexia nervosa (Grinspoon et al., 2000; Miller et al., 2005). The long

term risk of a fracture in these women is three times higher than in the general population (Lucas et al., 1999). Low bone mass in anorexia is associated with decreased bone formation and increased bone resorption resulting from hormonal adaptations aimed at reducing energy expenditure during phases of low energy intake (Fazeli and Klibanski, 2014). Consequently, the structure of the bone is impaired and bone strength is reduced. While the optimal treatment for bone loss in these patients is currently unclear, the safest and most effective strategy to improve bone health in anorexia nervosa is considered to be normalization of weight and restoration of menses (Mehler and MacKenzie, 2009; Misra et al., 2015). In contrast with other medical complications of anorexia nervosa, bone mineral loss does not seem to be fully reversible, even with restoration of a normal weight and return of menstrual function (Mehler et al., 2015). Regarding the effect of continuous high levels of exercise on joints, it seems plausible that such activity can cause strain injuries in weight-bearing joints of the lower limbs (i.e., hip, knee and ankle).

Neuromuscular system. Continuing malnourishment results in weakness and deconditioning of the peripheral nerves and skeletal muscles (Mehler and Brown, 2015; McLoughlin et al., 1998). Structural changes in muscles (i.e., loss of contractile elements) and accumulaton of muscle glycogen, possibly due to a defect in anaerobic glycolysis, have been found in these patients (McLoughlin et al., 1998). The result of strict protein-energy malnutrition on the musculo-skeletal system is a metabolic myopathy, which has a negative impact on muscle function and strength and subsequently affects neuromuscular control and stability. Muscle myopathy is, however, reversible with an apropriate re-feeding program (McLoughlin et al., 1998). Nutritional restriction accompanied by weight loss and high levels of exercise leads to further reduction of glycogen stores in the liver and disruption of gluconeogenesis, which may result in malfunction of glucose metabolism and a reduced ability to maintain safe glucose levels in the blood (Gaudiani et al., 2012). This affects all bodily organs, including muscles as well as the brain and the nervous system (Kutas and Federmeier, 1998).

Pulmonary system. Despite its vital role in physical processes respiration and breathing has to date received surprisingly little attention in accounts of medical vulnerabilities in individuals with anorexia nervosa. Yet, functional changes in the respiratory system have been reported in these clients, such as reduced lung capacity and a higher residual volume (Gardini Gardenghi et al., 2009), and a reduction in diffusion capacity, which seems to worsen with the duration of the illness (Coxson et al., 2004). As with other skeletal muscles, the respiratory muscles – and in particular the diaphragm – are likely to be affected by malnutrition. The diaphragm appears to decrease proportionally to body weight in poorly nourished patients, impairing its function and strength (Murciano et al., 1994; Arora and Rochester, 1982). A mild to moderate decrease in isometric strength of inspiratory and expiratory muscles has been detected from early phases of the illness (Gardini Gardenghi et al., 2009). The diaphragm is of particular clinical interest given its major role in respiration and in the maintenance of free and normal ventilation.[2] As importantly, respiration plays a key role in posture and spinal stabilization. In conjunction with the abdominal muscles (i.e., transversus abdominis) and pelvic floor muscles, the diaphragm makes a vital contribution to core stability and posture (Smith et al., 2006; Hodges et al., 2007). In the case of dysfunctional respiration, the postural activation of these muscles is weakened, subsequently compromising the breathing pattern and stability of the spine (Hodges et al., 2001). This may possibly increase the potential for injury in exposed spinal structures, in particular during rigorous exercise and in the case of osteopenia or osteoporosis. Finally, breathing is also regulated by the autonomic nervous system, which commonly is affected by psychological states. Emotional stress associated with anxiety and mental distress, features frequently observed in persons with anorexia nervosa, may affect respiration in multiple ways, for example by altering respiratory rate and expiratory time (Wilhelm et al., 2001; Masaoka and Homma, 1997; Masaoka and Homma, 2001). Given the vital role of respiration in physical processes and its role in maintaining physiological homeostasis, alterations in this system can have diverse effects on bodily functioning, including changes in the circulatory, muscular and

nervous systems. Accordingly, the brain and its cognitive, interoceptive[3] and exteroceptive[4] processing might also be affected.

PRESENT STUDY

Instead of basing the management of exercise solely on the patient's ability to follow the treatment plan, medical stability, weight concerns and body mass index (BMI), the use of a physical examination and evaluation that provide valuable information complementary to other medical assessments, may also contribute to the overall recovery process. Tailoring exercise and physical therapy interventions to the needs of the individual may prove favourable for clients' motivation with respect to bodily recovery, as well as recovery in general. With few exceptions (e.g., Fisher and Schenkman, 2012; Kolnes, 2012; Probst et al., 2013; Scott and Van Blyderveen, 2014), the literature does not address exercise or physical therapy interventions based on findings from body examinations that may uncover bodily restraints and bodily tension in clients. The lack of such assessments may reduce the prospect of developing interventions that meet the needs of the individual patient, both in terms of his or her physical and psychological status. For instance, if a client complaining about continuous neck- and headache has restricted breathing, attempts to facilitate a deeper breathing pattern in order to unload the stress on muscles connected with the neck could well be relevant (Kapreli et al., 2008; Perri and Halford, 2004). As will be further elaborated upon in the method section, breathing might be restricted as a result of the person holding back difficult feelings. Thus, deeper breathing may not only reduce the load on respiratory muscles associated with the neck, but is also likely to enable access and attention to problematic feelings.

This paper has multiple aims. Firstly, in order to explore in more detail bodily constraints in individuals with anorexia nervosa, the results of a physiotherapeutic body examination of six women with anorexia nervosa will be presented. Secondly, based on these findings as well as related medical concerns and psychological features, body-oriented interventions tailored to

addressing bodily restraints will be considered. Thirdly, how these endeavours may engender new experiences of the body, enabling bodily agency and the experience of the body as one´s own, will be discussed. The overall intention is to identify the functionality of the body and bodily restraints accompanying the manifestation of enduring anorexia nervosa, and how these may be used to guide exercise and physical therapy interventions aimed at rejuvenating not only the physical body as such, but also the experience of the body as a unified place of one's own, a place to find oneself. It is anticipated that recovery can be approached in a way that resonates with both the body and the self.

Method

In accordance with phenomenological and philosophical beliefs that the body offers a continuing structure and possibility for our being and our consciousness of the world (Sartre, 1943/1956) and that the individual connects to the surrounding world through the body (Merleau-Ponty, 1945/1962), the Norwegian psychomotor physiotherapy (NPMP) offers a valuable frame of reference for addressing the body in individuals with anorexia nervosa. The approach is grounded in the understanding that the body is a functionally integrated entity, and that lived experiences and feelings are embedded in and expressed through the body (Bunkan and Thornquist, 1990). The basic idea is that body and psyche are indivisible, and that unresolved and problematic feelings are contained in, and expressed through the body. The approach is not specifically aimed at treating particular diagnoses or bodily symptoms. Rather, by the use of massage, grounding and balancing exercises, it aims to achieve a general readjustment of bodily restriction, flexibility and stability, as well as an altering of the person’s physical and emotional habitual reactions (Bunkan, 2001).

For the purpose of identifying and assessing bodily constraints in clients with anorexia nervosa, a slightly modified body examination established within the paradigm of NPMP has been employed. The intention is not to search for detailed impairments caused by medical

conditions or injuries affecting the musculoskeletal system as such, but to consider findings in relation to each other and how they influence the functionality of the whole body, and indeed the person. The body examination typically follows a comphrehensive history taking and involves assessment of four main dimensions; *posture, respiration, muscle tension and texture,* and *functioning* (including flexibility and ability to relax) (Bunkan and Thornquist, 1990). Changes in the breathing pattern, and emotional and autonomic reactions emerging during the examination are recorded. The observation of respiration is fundamental, as it is assumed that there is a dynamic interaction between breathing and psychological states (Boiten, 1994; Homma and Masaoka, 2008; Masaoka and Homma, 1997). For instance, constrained breathing, along with muscular tension, is believed to be a way of avoiding or suppressing problematic feelings (e.g., fear and anxiety). A continuing pattern of restricted breathing is often associated with rigidity in bodily expressions, functions, movements, and also with poor mental awareness (Ekerholt and Bergland, 2008). When the breathing pattern changes, Bunkan and Thornquist (1990) have described how changes in posture and movement pattern seem to occur spontaneously, and how patients tend to become more in touch with their feelings. Such changes may also prompt a release of tension in mimic muscles and the ability to express oneself verbally. Altogether, the inspection provides insights into restriction and tension as well as flexibility and stability of the whole body. It also gives some indication of the person's potential for change. To sum up the findings, it can be useful to visualize the level of divergence in a resource continuum (see figure 1, appendix).

The body examination conducted in this study followed in depth interviews, lasted between twenty and thirty minutes and was conducted in a quiet room at the unit or at the author´s work place. To ascertain validity of the findings, trial assessments of two women with anorexia nervosa were conducted separately by the author and a trained colleague specialist in NPMP. The findings were subsequently analysed and discussed, revealing only minor differences in the considerations.

Participants

Six women undergoing in- or outpatient treatment for their anorexia nervosa at services providing residential and day treatment for eating disorders in Norway, were examined. The participants were recruited to take part in a broader study employing qualitative interviews with the aim of exploring experiences and making sense of their engagement in compulsive exercise; two papers from this study have recently been published (Kolnes and Rodriguez-Morales, 2016; Kolnes, 2016). After the interview, the women were assessed using the body examination derived from NPMP, which is described in detail in the method section. The participants were over the age of 18; they had a clinical diagnosis of anorexia nervosa restricting subtype and were considered compulsive exercisers. Their diagnosis was provided by their consultant psychiatrist or psychologist using ICD 10 (World Health, 2004). Compulsive exercise was for the purpose of recruitment defined as 'moderate to vigorous exercise for more than six hours per week for a minimum of one month before hospitalisation' (Davis et al., 1997). This definition takes into consideration that exercise for more than six hours weekly may have harmful effects (e.g., overuse injuries, stress fractures) for individuals with anorexia nervosa who are severely underweight (Grinspoon et al., 2000; Mehler and Brown, 2015). Four participants were involved in organized and competitive sports in their teens, prior to the onset of the illness. Only women were included, since no men were admitted to the services during the recruitment phase meeting the inclusion criteria. The participants were between 23 and 50 years old, they had had an eating disorder for between 4 and 23 years, and attended treatment for between 6 months and 5 years. Their body mass index (BMI) was between 15.2 and 19.2 at the time of the examination, while lowest BMI had been between 12.6 and 14.5. The study received ethical approval from the Regional Ethics Committee of Southern Norway and the hospital units involved granted administrative consent. Participants were given printed information about the research; they were informed of the possibility of

withdrawing from the interview and body examination at any time. Informed consent was collected from all women. To protect participants' anonymity and confidentiality, identifying features were altered and names replaced by numbers in the results section (i.e., P=participant; P1, P2, P3, P4, P5, P6).

Results - body examination

*Posture (P)***:** The inspection of posture revealed minor (P2, P3, P4 and P5) to moderate restraint (P1 and P6) in the participants. The main features were de-alignments in the position of the trunk, such as increased extension of the lower back and anteriorly tilted pelvis, protracted and elevated shoulders, a forward position of the head and increased extension of the neck. In addition, the participants´ standing position appeared stiff and rigid.

Muscle (M): The examination of muscles showed moderate (P3, P4, P5, P6) to substantial restriction (P1, P2). Muscles showing increased tension in most participants were muscles in the upper body commonly associated with the function of breathing (e.g., scalenes, sternomastoid, upper trapezius, intercostal), as well as muscles related to the upper neck and the jaws. Muscles in the calves, the gluteal region and the lower back were also affected. Palpation disclosed a general soreness in all muscles and irregular muscle consistency, particularly in the gluteal region. All muscles were in general lacking in fullness.

*Function (F)***:** This part of the examination included an evaluation of bodily functioning in terms of flexibility and ability to relax. One way of examining flexibility was by checking the ability to let go in passive movements of the over- and under extremities. With the exception of one participant who had minor functional restraints (P5), flexibility and ability to relax were moderately restricted in the remaining participants (P1, P2, P3, P4, P6). Notably, the inspection of the shoulders revealed reduced flexibility and articular range of motion in the

standing position and when supine. Reduced flexibility of the neck and a decreased ability to perform independent movements of the pelvis and the extremities were also revealed in some participants. The findings suggest that the subjects' capacity for relaxation is limited.

Respiration (R): The assessment of respiration demonstrated a distinctly constricted and upper-chest pattern of breathing in all participants, indicating a substantial restriction of respiration. Movements generally connected with breathing were barely observable, either during the inhalation or the exhalation phase. The examination of the flexibility of the thorax revealed thoracic stiffness and high resistance. In addition, "respiration responses", which imply that breathing is affected by certain grips or movements performed by the examiner, and which are assumed to give some indication as to whether or not the breathing pattern is changeable, were weak in all individuals.

The level of divergence in each participant´s body is presented in table 1 (appendix), while an overview of findings in all participants is summarized in a resource continuum (figure 1, appendix).

INTERPRETATION AND IMPLICATIONS OF BODY EXAMINATION FINDINGS

In sum, the results of the body examination indicate minor to moderate divergences in posture, and moderate restriction in function, muscle tension and texture. Respiration stands out as the dimension that is most obviously affected in all participants, with evidence of a constricted breathing pattern, upper-chest breathing, increased tension in muscles associated with breathing (i.e., accessory muscles), as well as a high thoracic resistance. Accordingly, the majority of restraints are situated in the upper part of the body. Although moderate, the postural de-alignments and stiffness are also of significance, given their relatedness to maintaining a stable and balanced body.

One highly plausible interpretation of these findings is that they are the result of high levels of exercising; such symptoms will worsen in clients who engage in continuous cycles of rigorous and excessive exercise regardless of its negative implications for their health, relational and social life. However, seen together, and in light of the view that we capture the lived world through our bodies (e.g., Merleau-Ponty, 1945/1962), it could also be suggested that the bodily restraints (i.e., constrained breathing, increased muscular tension and postural instability) relate to a strong psychological defence and continued embodied control with respect to difficult feelings, thoughts and unresolved conflicts or experiences. Such an understanding would be consistent with the psychological features that habitually accompany anorexia nervosa (e.g., anxiety, depression, OCD symptoms). It also resonates with the assumption that the manifestation of impaired neuromuscular and proprioceptive[5] control not only affects the subjective experience of the body, but also of the self, as the self is inherently bodily (Øien et al., 2007; Legrand, 2006). Notably, the withheld breath might indicate that problematic thoughts and feelings are contained within the body, instead of being attended to, or mentalized. This state may feed a feeling of being overwhelmed by the body, and might be counterproductive regarding the individual's capability not only to connect with her body, but also to bring "the non-mental into the realm of the mental" (Allen, 2008: p. 105). Indeed, identifying and exploring embodied feelings and distress in clients with anorexia nervosa may offer the individual some sense of connecting with his or her feelings, and, as important, of how to make sense of these (Kolnes and Rodriguez-Morales, 2016). As such, and as opposed to the assumed difficulties clients with anorexia nervosa may have in perceiving and interpreting stimuli arising in their bodies (Bruch, 1962), it may be hypothesized that free respiration and a flexible, balanced body may enhance the ability to recognize the body as one´s own and the capacity to mentalize emotion, in terms of being aware of feelings and their meanings.

In line with the understanding that the body is functionally integrated (Bunkan, 2001) and the notion that the function and efficiency of breathing is connected with postural stability and balance (Chaitow et al., 2014; Hodges et al., 2002), the findings vividly illustrate that divergence in one bodily function or structure engenders changes in others. For instance, a restricted breathing pattern combined with upper-chest breathing, as observed in all participants, frequently seems to be accompanied by an over-activation of respiratory muscles. Thus, these muscles, already weakened by malnourishment (Gardini Gardenghi et al., 2009), are inclined to compensate for the lack of abdominal breathing and the associated downward movement of the diaphragm, as well as the lateral movement and rise of the ribs. Instead, they become involved in lifting and stabilizing the upper part of the thorax, along with elevating the shoulders to allow for expansion of the trunk in the vertical direction. Consequently, the respiratory muscles become increasingly tense, as confirmed by the observation that the participants´ shoulders are moderately hunched upwards and pulled forward. This position of the shoulders is likely to produce a forward head posture and hyperextension in the neck in order for the person to be able to look ahead, subsequently generating neck pain and headache. The notion that poor breathing is often accompanied by a forward head posture, de-alignment, dysfunction, and subsequently neck pain is supported by clinical research (Perri and Halford, 2004; Kapreli et al., 2008).

Furthermore, a continued constrained breathing is likely to influence the position of the chest, thus producing increased stiffness and reduced mobility and stability of the thorax. The high thoracic resistance revealed during the body examinations emphasizes this point. For normal breathing to occur, thoracic structures are required to be compliant, elastic and functional (Chaitow et al., 2014). Restrictions of any kind may reduce the ability of the rib cage to adapt in response to the breathing cycle, and compensatory changes are likely to occur (Chaitow et al., 2014). The inhibited breathing pattern demonstrated in the participants, combined with other bodily findings such as postural de-alignments and muscular tension, not

only compromise postural control, but affect the flexibility and stability of the whole body. Consequently, in order to maintain a stable position, the individual has to compensate by increased activation of the muscles that keep her in the upright position. Given that de-alignments in the upper part of the body are mutually related to the lower part and considering the impact of this on the configuration and stability of the whole body, a dysfunctional breathing pattern is a significant clinical feature in this context.

Relevant interventions

Firstly, given the findings in the body examination of de-alignments and stiffness, as well as the general reduction of muscle function and strength accompanying the illness, it is proposed that the focus of early interventions should be on mediations considered to improve dynamic postural stability. A well balanced body, implying that bodily axes are approximately normal and muscular strength sufficient to resist the forces affecting the balance, is considered imperative to nearly all movements, whilst a lack of stableness may limit these movements (Brodal, 2010). Given the multiple implications of constrained breathing for postural stability, it is likely that modifying postural de-alignments and improving stability will also affect the breathing, albeit in an indirect way. Increasing postural stability might entail a stabilizing dimension that can be valuable for the body as well as for the self (Ekerholt and Bergland, 2008; Sviland et al., 2012).

Secondly, owing to the results of the body assessment and also to the effects of malnourishment on the strength and functioning of the muscular system, it is suggested that attempts are made to enhance the recovery of the neuromuscular system in general, and in particular of muscles considered to have a stabilizing function. Since common practices in strength training may not be appropriate given the changes in the neuromuscular system found in individuals with severe underweight, such training must be modified to meet the needs of

these clients. Thirdly, dimensions of relevance to aerobic training and bone health in clients with anorexia nervosa will be briefly addressed.

Postural stability

Increasing dynamic postural stability commonly involves a normalization of bodily axes in order to arrive at a more balanced and flexible position. In this context, a balanced posture reflects a position in which little muscular effort is required to maintain that position, and where the segments of the body are balanced against each other in a way that allows for both stability and flexibility (Bunkan and Thornquist, 1990). Ideally, movements can spread through the stable body without restraints (e.g., stiff chest, withheld respiration), signifying changeability. In order to arrive at a stable posture and counteract de-alignment in the upper body, it is imperative to start with the foundations, that is with the legs and the feet, to create a solid platform for the body. How a person stands on his or her feet is regarded as a vital premise for good balance. To explicitly address the breathing pattern and dealignments in the upper body would not be as meaningful at this point, if the person does not stand firmly on his or her feet; if they are not grounded, so to speak (Kolnes, 2012).

While an optimal posture hardly ever exists, a balanced posture is commonly achieved by compensating proprioceptive mechanisms that provide maximum postural stability within the existing fundamentals of the individual (Chaitow et al., 2014). Even small changes in bodily axis can produce shifts in the centre of gravity and restructuring mechanisms may occur automatically. Rather than targeting posture directly (Bunkan and Thornquist, 1990), it is important for each person to explore and recognize what they perceive to be a balanced and good position for them exclusively. A steady position may promote spontaneous changes in posture, and standing can become more relaxed. Since modest muscular effort is required to maintain a steady posture, it may be further assumed that when the body is more balanced, the breathing will gradually and spontaneously become less restrained and muscular tension will

decrease. Clinical experience show that deeper breathing typically occurs during a transition process into a balanced posture from a rigid, inflexible posture. As such, the breathing is approached indirectly, allowing it to be successively released in accordance with the individual`s readiness.

In this specific context, undertaking posture and balance exercises in the upright position seems particularly appropriate. As well as promoting control and stability in weight-bearing joints of the lower limbs, such practices may also enable stability of the spine, all of which will help to support the body in the upright position. The interactions between the quadriceps muscles, the dorsal flexors of the ankle and the proximal joints of the toes are particularly important in this work, due to their role in providing stability in the standing position (Bunkan and Thornquist, 1990). In addition, owing to clinical practice, reducing tension in the sole of the foot (e.g., by rolling the sole on a stimuli ball) frequently seems to increase contact between the foot and the ground, and generate a feeling of being more explicitly gounded.

Various therapies that focus on enhancing bodily awareness may be valuable in this work. Such approaches commonly have the aim of facilitating body awareness and of integrating the body in the total experience of the self by stabilizing posture and balance, and promoting movement, breathing and mental awareness (e.g., Roxendal, 1990; Gyllensten et al., 2003). Exercises designed to improve neuromuscular control and dynamic balance in the standing position are also relevant. An array of activities with the aim of increasing proprioception can be found in the literature on neuromuscular training associated with rehabilitation as well as injury prevention in the lower limbs (e.g., Holm et al., 2004). These include a whole range of measures, such as balancing exercises on uneven bases, with suggestions for gradual advancement. Progression may be determined by the person’s ability to perform the task with free respiration, although given that the clients' breathing pattern in this study is considerably constricted, it may be appropriate to remind them to observe their breath, to make sure they are not withholding it during the practices. Such practices can easily be managed in a way that

demands low levels of energy, and may therefore be introduced to the majority of underweight individuals who are medically stable.

In order for a change in habitual patterns of bodily tension and rigidity to occur, and to allow individuals to make adjustments at their own pace, it is essential to provide each person with enough time to explore where she might have constrictions or blockades. Discriminating between bodily experiences may further the ability of the patient to experience the body in a more differentiated way (Davison, 1988), and facilitate a sense of coherence between bodily perception and movement. It is also critical that the atmosphere between the therapist and client is supportive and acknowledging. Pushing clients to progress more quickly than they are ready for might result in the practices becoming too provocative for them and they might pull away. Recognizing how they are standing on their feet, hunch their shoulders or hold their breath during the undertaking of balance exercises, as well as in their daily living, may help clients become more familiar with their bodily reactions and why they need these in social encounters and daily life situations. The opportunity for the clients to discuss and share feelings and thoughts about their experiences concerning the body during or after practices, has been shown to be valuable (Calogero and Pedrotty, 2004).

Mirror exercises have been suggested as a way of improving mental representations of the body and body size issues (e.g., Probst et al., 2013). Despite the role of visual systems in maintaining postural stability, due to the potential for distracting clients from recognizing what goes on within the body, and to avoid visual comparing and judging, the use of a mirror may not be suitable during the early phase of this process. In this particular context where the clients have an extraordinarily complicated relation to their bodies, the sensing of the body through vision might be more worthwhile when the person has become more accustomed to the awareness of his or her body. This reflection is, however, mostly based on the author´s clinical experiences from working with patients with severe anorexia nervosa, and is of course open to debate.

Restoration of muscle and exercise techniques

Given the consequences of malnutrition and the associated effects on skeletal muscle function and strength, it is highly debatable as to whether the muscles of clients with anorexia nervosa would respond positively to high intensity resistance training (Chantler et al., 2006). While del Valle et al. (2010) found only modest improvements in a three-month intervention study on functional capacity and muscular strength in very young individuals (12 – 16 yrs) with anorexia nervosa, Chantler et al. (2006) demonstrated that a light resistance training programme, accompanied by monitored re-nutrition, had a positive impact on muscle strength in hospitalized patients with anorexia nervosa (aged 15 – 36 yrs). Furthermore, improvements in muscular strength have shown to have positive effects on body composition and psychological well-being (Szabo and Green, 2002), as well as on the ability to perform daily living activities and on overall health and welfare (Chantler et al., 2006). It may also be of some relevance that strength training combined with balance training can reduce the risk of fractures in patients whose postural stability is negatively affected by their anorexia (Pedersen and Saltin, 2015).

The finding in the present study that the participants were impaired in performing independent movements of the pelvis and the extremities suggests a lack of control and stability of the trunk. This observation is significant, as it relates to movements of the whole body, both in the upward and downward direction. To improve functionality associated with the torso and pelvis, as well as the recuperation of weak and undernourished muscles in these areas, it is important to focus on the strengthening of muscles associated with the stability of the spine, as these are considered essential for maintaining an upright and stable position (Hodges et al., 2002). The strengthening of muscles of the lower limbs can to some extent be implemented during the previously discussed posture and balance exercises. To improve the functionality, control and stability of the trunk, activation of deep local muscles in conjunction

with global muscles should be promoted (Kavcic et al., 2004). Due to its effects on trunk muscle activation, strength, and balance improvements, sling exercise therapy may be a clinically valuable approach in terms of optimizing posture and strengthening the stabilizing muscles of the trunk in these clients. The approach offers a whole range of progressively advancing stages of difficulty for each exercise, in accordance with levels of coping in the individual client (e.g., Gaedtke and Morat, 2015). The intervention further shows positive effects on trunk stability, posture and back pain in osteoporosis patients (Schröder et al., 2014). Such training demands extreme focus and concentration as well as the ability to be present in the here and now in order to perform the exercises. Thus, increasing stability of the trunk may also be reassuring for the individual and induce a feeling of being more in touch with one's body. Improving the stability of the trunk is also important in terms of preparing the individual for strength training.

A key factor for successful strength training at any level of fitness, age and clinical health, is an appropriate programme design and progression (Kraemer and Ratamess, 2004). In the case of novice healthy adults, recommendations for an initial phase of strength training include 8–12 repetitions maximum (RM), repeated for one to three sets, and performed two to three days per week (Kraemer et al., 2002). When the individual can perform the existing workload for one to two repeats over the desired number, Kraemer et al. (2002) suggest a progression involving a two to ten percent increase in workload. As mentioned above, general procedures for exercise progression for adults in good physical shape, particularly in the case of strength training, need to be modified in order to accommodate the physical limitations and clinical status of clients with anorexia nervosa. Owing to potential weakening of bones and muscular structures, and decreased neuromuscular control, the use of maximal strength testing to estimate training loads is risky in this context. Rather than focusing on training based on maximal load, a modified approach may be preferable, in which efforts are tailored to individuals with the aim of strengthening their bodies so that they become accustomed to

further physical strain. Such training might, for instance, involve smaller loads and a higher number of repetitions (e.g., 12–15 repeats of three sets) to allow muscles to recover from undernourishment and to successively adapt to the training. Such training should ideally be performed two to three times per week in order to have an impact on muscles (Kraemer et al., 2002). In general, large muscle groups should be targeted, and stationary equipment may be used in combination with free weights and other equipment.

When performing this type of training, it is imperative that clients are capable of keeping their bodies in a well-balanced position. Thus, at this stage, the focus should also be on the acquiring of proper exercise techniques and awareness of breathing during the exercises. Importantly, it is attentiveness to one´s breathing, as opposed to the control of breathing, which is crucial in this context, since breathing is often already too restrained in these clients. Acquiring appropriate training techniques requires close and continuous supervision by skilled training counsellors or physical therapists. Progression may be considered based on an evaluation of how each individual responds to the training, as well as the process of weight gain. This means of improving overall health and of preparing the body for later training may be carefully introduced in combination with increased energy consumption during weight recovery. Depending on earlier training experience, it may be assumed that muscle mass will constitute an increased part of the overall weight gain if one takes part in a supervised and modified strength training programme, as opposed to no such training. When clients have stabilized their weight within the normal spectrum, and is psychologically apt to adhere to such training, general guidelines for strength training for beginners may be cautiously introduced. It is worth mentioning that for those with little experience of resistance training, the prospects for improvement in strength are relatively good, compared to those who are already highly trained (Kraemer et al., 2002). This may well prove motivating for clients. Overall, however, more research is required into the properties of strength training, and how it may be utilized in a beneficial way in this context.

Concerns about aerobic training and bone health

Not surprisingly, reports on aerobic capacity in individuals with anorexia nervosa are limited. One exception is the study of Tokumura et al. (2003), which comprised a thirty minute supervised aerobic training programme five times a week. The authors observed beneficial changes in exercise capacity and emotional stress in the participants, and no adverse effects on weight recovery were identified (Tokumura et al., 2003). Nevertheless, it appears important to avoid exposing the heart to too high a load too hastily, providing the heart with sufficient time to adjust to the increased demands accompanying increased physical efforts. Aerobic training should therefore, if considered safe, be introduced slowly to individuals who have been undernourished, and should initially be of low intensity and involve slow progression (e.g., walking). Exercise must also be considered in accordance with the normalisation of weight and restoration of menses, as intense aerobic training can hinder the progress of these crucial processes. In addition, general guiding principles on aerobic training do not take into account the medical concerns and bodily restraints (e.g., impaired neuromuscular functioning and constrained breathing pattern) identified in clients with severe anorexia nervosa. It is crucial to address these features before introducing aerobic training, such as jogging and running, in order to prepare the body for the physical loads associated with such training and to prevent further harms. The focus on enhancing bodily stability and strength, as well as recognition of the body, may represent a significant contrast to previous training for those who used to engage in highly energetic and compulsive exercising.

The impact of exercise on bone quality is more complex in these patients than in any other population, as it is sensitive both to the type of mechanical loading and the stage of illness during which the exercise is performed (Waugh et al., 2011). While a combination of diverse and regular moderate to high–impact weight-bearing activities seems to improve bone structure and strength in normal weight individuals (Nikander et al., 2010), large amounts of moderate

loading exercise seem to be negatively associated with bone mineral density in individuals with anorexia nervosa (Waugh et al., 2011). It may be hypothesized that the lowering of energy availability instigated by excessive exercise can cause disruption of metabolic hormones and increase the severity of the illness, thus inducing further bone loss. While excessive walking may increase the risk of low bone mass *when ill,* high bone loading activities are suggested to generate bone increase in patients *having recovered* from the illness (Waugh et al., 2011). Owing to the potential for reduced bone mass in this population, one should bear in mind that to improve bone health, aerobic training should ideally involve weight-bearing activities in combination with strength training due to their roles in preserving and imposing load on bones (Pedersen and Saltin, 2015; Torstveit et al., 2008). As such, cycling, for example, might not be an ideal activity for patients at risk of osteoporosis, or who have recently recovered from such risk, due to its uncertain impact on bone mineral density (Mojock et al., 2016).

DISCUSSION

With respect to the main findings of the body examination, changes were detected in posture, bodily flexibility, muscle tension, and, notably, in respiration. Interventions focusing on establishing a solid platform from the bottom up, by improving posture and restoration of muscle function associated with bodily stability, were proposed. The suggested interventions may counteract muscular weakness and deconditioning by facilitating structural and metabolic recuperation, as well as muscle function and growth during treatment. Muscular strength, in combination with endurance, are in general assumed to improve quality of life and self-efficacy in populations with health issues (Hautala et al., 2016). It could also be anticipated that a balanced stable body, as opposed to a rigid, stiff and disorganized body, is capable of enduring increased physical and psychological strain (Ekerholt et al., 2014; Davison, 1988). Thus, the ability to tolerate tranquillity and the sense of being present here and now may be improved, as may concentration and mental awareness (Sviland et al., 2012; Ekerholt et al.,

2014) and the ability to elaborate and transform experiences into more organized mental phenomena and structures (Lecours and Bouchard, 1997).

This study differs from foregoing work, in that it links physical therapy interventions directly to data derived from an examination focusing on the whole body. Thus, the notions put forward in this paper resonate with previous work regarding proposals that physical rejuvenation should enhance recognition of the body and improve the connection between the mind and the body, in contrast to the contemporary focus on purely cognitive treatments (Calogero and Pedrotty, 2004; Kolnes, 2012; Moola et al., 2013). These ideas also meet with the thoughts of Nicholls and Gibson (2010), in their claim that the prevalent reductionist biomedical way of approaching the body needs to be updated. They argue that it is time for physiotherapy to engage in a broader theoretical model going beyond the margins of conventional practice, inferring a more inclusive way of viewing illness that involves an embodied view emphasizing the whole person. Instead of offering short bouts of treatment, in which patients are passive recipients of procedures designed to temporarily lessen symptoms, the patients should be offered a process of care approaching the whole person (Nicholls and Gibson, 2010).

Thus, what does it mean to approach the whole person in processes of bodily recovery? In addition to its more obvious correspondance with the field of postural and neuromuscular control training, the notion of facilitating body recognition and self awareness in these clients through physical interventions or actions (i.e., postural training, but also restoration of muscle needed for bodily stability) speaks to work on neurocognitive processes focusing on action recognition, sense of agency and sense of ownership. It has been argued that the experience of having some sense of control of one´s bodily actions or movements may facilitate a sense of agency and sense of ownership of the body (Tsakiris, 2011). While *sense of ownership* may be associated with pre-reflective experiences of being the subject of the movement, *sense of agency* connects with the pre-reflective experience of causing the movement, implying some

sense of control of the movement (Tsakiris et al., 2007). It is anticipated that sense of agency facilitates and modulates ownership of the body, both at a functional and experiential level (Tsakiris et al., 2007). The integration of efferent and afferent information alongside internal models of the body (e.g., visual and tactile) is considered to have a modulatory role on the experience of the body as one´s own, as separate from other objects (Tsakiris, 2011). Of particular relevance in this context is the observation that a coherent experience of the body is subject to sense of agency and the integration of multisensory information in *action contexts* (Tsakiris et al., 2007; Legrand, 2011). One early "philosopher of the body", Maine de Biran, contended that the experience of self resides in the indvidual's capability of acting, and that the feeling of one´s own coincides with the feeling of an active force connected to active movements (i.e., by muscular voluntary movements) or agency (cited in Legrand, 2011: p 210). As such, Maine de Biran views the sense of self as constituting a sense of being the subject of effort (Legrand, 2011). Accordingly, it can be theorized that while postural training, along with other physical activities in which natural postural alignment is fundamental (e.g., dance, tai-chi, and similar activities), has the potential to improve bodily stability, the process inherent in these forms of action of integrating afferent with efferent information may generate a more coherent experience of the body as well as of the self. In contrast to the more fragmented, or disorganized, experience of the body in individuals with anorexia nervosa that is sustained by escape into compulsive exercising (Kolnes, 2012), as well as confusions around bodily sensations which prevent action in accordance with bodily agency (Legrand, 2013), the potential to experience the body as more coherent and integrated through activities involving integration of efferent and afferent information may represent a critical dimension for the experience of a more united self. Engaging in a way of acting that involves a sense of having intentionally caused (sense of being the subject of) a movement and a feeling of having some control of that movement (sense of agency), as opposed to being controlled or driven by the activity, might need to be re-learned in these clients. In essence, such a process differs

qualitatively from the rigourous and compulsive exercise in which clients with restrictive anorexia nervosa frequently engage (Bewell-Weiss and Carter, 2010; Dalle Grave et al., 2008; Davis et al., 1999; Kolnes, 2016).

Given its profound affiliation with changes in postural stability and muscular tension, breathing is anticipated to be affected indirectly by the suggested mediations. Breathing is likely to gradually become more spontaneous and deeper as a consequence of a more balanced and stable body. Accordingly, awareness of thoughts and feelings may increase, as may the capacity to identify, modulate and express one`s feelings, and to make sense of these. Owing to its vital role in maintaining feelings in the body, and in preventing feelings from reaching the mind, or being mentalized, it is crucial that the breathing pattern is not ignored during the recovery process. Notably, since continued constrained breathing and muscular tension interconnect with the functioning of the whole body, and since the self is inherently bodily and connected to the experience of the body as coherent (Legrand, 2011), it may be theorized that bodily constrictions have a vital role in constraining the experience of a coherent self.

Lastly, in considering exercise and physical therapy interventions in this context, it is vital that the measures are tailored to each individual according to the person´s bodily and psychological resources. Earlier experience in training and sport, and individual preferences may also help guide the selection of interventions. As importantly, the clients' capability of engaging in a process of bodily and emotional change should also be considered. Releasing bodily constraints may engender changes in both physical and psychological patterns of defence, including the emotions (Davison, 1988). Some clients may need to experience increased coherence in their consciousness of perceptions and action in order for them to tolerate changes in the pattern of breathing and to allow their anxiety and defences to diminish. Affecting the breathing pattern indirectly appears essential, in view of the observation that a more direct focus has been noted to have adverse effects, including the furthering of anxiety and depression (Sviland et al., 2012; Bunkan, 1991).

It is essential that the suggested implementations are guided by professionals with expertise regarding physical and psychological features of anorexia nervosa, and skills in designing and tailoring health beneficial physical training programmes to the individual, such as physical therapists or exercise counsellors. These professionals are generally also skilled as regards basic principles of progression in clinical populations, as well as in counselling clients about healthy levels of exercise at any given time in the process of recovery. It is imperative that physical therapy and exercise interventions should be offered in combination with other therapies (e.g., cognitive behavioural or motivational therapies), alongside closely supervised nutritional and weight management, and that the different parts of treatment are closely coordinated and pull in the same direction.

CONCLUSION

In order to facilitate recovery from bodily restrictions in clients with anorexia nervosa who exercise compulsively, implementation of some carefully selected physical interventions is presented and discussed. In order to address the identified restrictions in breathing, muscles and posture, it is suggested that activities should involve dimensions that increase postural stability, due to the role of such practices in facilitating a change in proprioceptive awareness of the entire body and its indirect effect on the pattern of breathing. Increased proprioceptive awareness connects with the sense of experiencing the body as one´s own and of having a sense of control over one´s body and bodily actions, as well as the goals these are aimed at realizing. These approaches may help clients become more attuned to their bodies and are likely to facilitate new experiences of the body and motion, as opposed to the rigidity connected with previous exercising that was frequently driven by emotion regulation and compulsions. As importantly, the process of integrating afferent with efferent information may not only generate a more coherent experience of the body, but also a more coherent experience of the self. To experience the body as an integrated place of one's own, and "a place from where to start to walk through

one's life, to walk with and towards others might precisely be a dimension that the person with anorexia is lacking" (Legrand, 2016).

Informed by sport science and cognitive neuroscience, concerns about recognition of movements and body awareness as well as restoring the body and the self in clients with anorexia nervosa should be subject for continuing debate and research within the field of the eating disorders. Future research should further investigate the role of physical activities and practices in the process of integrating proprioceptive information and for producing a coherent experience of the body and the self, in healthy individuals as well as in clinical populations like clients with anorexia nervosa.

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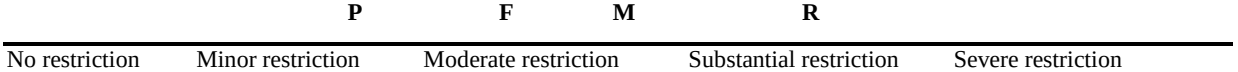
Declaration of interest
The author reports no declaration are of interest.

Appendix

Table 1: Body examination findings showing divergence for each of the participants

Participant (P)	Posture (P)	Muscle (M)	Function (F)	Respiration (R)
P1	Moderate	Substantial	Minor	Substantial
P2	Minor	Substantial	Moderate	Substantial
P3	Minor	Moderate	Moderate	Substantial
P4	Minor	Moderate	Moderate	Substantial
P5	Minor	Moderate	Moderate	Substantial
P6	Moderate	Moderate	Moderate	Substantial

Figure 1: Summary of the level of restriction revealed by the body examination



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[1] There is currently no agreement regarding what constitutes excessive versus compulsive exercise in this area, though the most consistent support appears to be for the term compulsive exercise, as this captures adherence to strict and recurring exercise routines maintained in spite of negative consequences (Taranis L, Touyz S and Meyer C. (2011) Disordered eating and exercise: development and preliminary validation of the compulsive exercise test (CET). *Eur Eat Disord Rev* 19: 256-268.). High levels of exercise may also be understood as a continuum characterized by increased prioritizing of exercise over other activities in parallel with increased exercise tolerance, which may progress into compulsive exercise (Le Grange D and Eisler I. (1993) The link beween anorexia nervosa and excessive exercise: A review. *Eating Disorders Review* 1: 100-119.).

[2] During inhalation when breathing is quiet and steady, the diaphragm descends into the abdominal cavity, increasing the vertical and transverse dimensions of the thorax. During exhalation, it relaxes and returns to its upward position, and the chest wall and abdomen return to their starting positions.

[3] Sensitivity to stimuli originating inside the body.

[4] Sensitivity to stimuli originating outside the body, e.g. by auditory, haptic, olfactory, visual and gustatory sensory receptors.

[5] Proprioception may be understood as a neuromuscular process which involves afferent input and efferent signals that allow the body to maintain stability and orientation during both static and dynamic activities (Laskowski ER, Newcomer-Aney K and Smith J. (1997) Refining rehabilitation with proprioception training: expediting return to play. *Phys Sportsmed* 25: 89-104.)