

A narrative synthesis investigating the use and value of social support to promote physical activity
among individuals with Schizophrenia.

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Abstract and key words

Purpose. To review and synthesize the literature detailing the use of social support to facilitate physical activity participation in individuals with schizophrenia

Method. A systematic review of major electronic databases was conducted to identify literature regarding the use of social support to promote physical activity among people with schizophrenia. A narrative synthesis was undertaken in 4 stages, including; development of a theory; developing a preliminary synthesis; exploring relationships; and assessing the robustness of the synthesis.

Results. From a total of 110 studies, 23 met the inclusion criteria including 883 individuals with schizophrenia. Informational support was the most documented form of social support, followed by emotional, esteem and tangible. Providers included research personnel, healthcare professionals, family members and peers. Details of the content of the different dimensions of functional support are given. Social support appears to have an important role to help individuals with schizophrenia initiate, comply and adhere with exercise interventions. Social support may have an indirect benefit on weight maintenance. However, due to the limitations of the selected literature it was difficult ascertain what the (in)direct benefit of social support are on health outcomes.

Conclusions. Social support appears to play a pivotal role in initiating physical activity as well as ensuring compliance and adherence to physical activity. Future research is required to investigate the optimal type and mode of delivery of social support on health outcomes.

Key words: *schizophrenia, social support, physical activity, physical activity, exercise, synthesis*

1.Introduction

There is widespread acknowledgement of the importance of physical activity to the physical [1,2] and psychological [3,4] health of individuals with schizophrenia. However, a challenge remains as to how to engage individuals in physical activity despite complex barriers (physical, environmental, situational and psychosocial) to participation [4-6]. Social isolation, reported in around half of individuals with schizophrenia [7], combined with a lack of motivation has been identified as a significant barrier to participation in physical activity [1,8]. Further, decreased social interaction is a key barrier to participation [4,9]. However, physical activity which is accompanied by positive social interactions and relationships can improve challenge ambivalence to participation [5] and can also aid adherence, enjoyment and motivation [6,10-14]. Thus, social support has been identified as having an integral role in promoting physical activity initiation and adherence in people with schizophrenia. [4,6,14].

If individuals are going to successfully initiate and adhere to a physical activity intervention, positive interactions utilising different types of social support are required [15]. Emerging research recognises the need to consider the types of social support that are used to influence physical activity in individuals with schizophrenia, from the perspective of the health care professional [6,14] and the patient [10,16,17]. For instance, staff that support individuals are required to be knowledgeable about the physical activity, be encouraging and providing esteem support to overcome motivational barriers [18-20]. However, there is still considerable uncertainty regarding the optimal type and mode of delivery of social support [6,14,15,21].

Given the potential for social support to improve physical activity uptake and adherence among individuals with schizophrenia and also the lack of clarity around the optimal type and method of delivery, a review of the literature is needed to inform clinical practice. A narrative synthesis was adopted since it provides a useful way of collating information to synthesize findings and enables new interpretations of findings [22-24]. This type of review is able to bring together evidence from

studies that are heterogeneous [25] and is useful as it enables researchers to utilise different synthesis tools (e.g., translation of information from different studies, idea webbing and conceptual mapping, see[23]) and techniques which answer questions which traditionally can't be answered using a systematic approach [25].

Aim and Objectives

The aim of the current research is to provide a critical consideration of the role, value and use of social support as a part of physical activity interventions for individuals with schizophrenia.

2.Methods

A narrative synthesis review was conducted following recognised criteria [23]. The process is conducted in 4 stages: (1) developing a theory; (2) developing a preliminary synthesis; (3) exploring relationships; and (4) assessing the robustness of the synthesis.

2.1 Developing a Theory

Social support is considered a vital condition for therapeutic change in psychiatry [26] as such it was hypothesised by the author that it has a direct and significant impact on the outcomes of physical activity interventions. Previous literature [15,27] defines social support as having four fundamental dimensions of functional social support and one dimension of structural support (group membership and belonging). The functional domains include (a) emotional support; defined by a feeling of being cared for and an ability to go to others for security and comfort at stressful times. (b) Informational support; defined by the provision of guidance and advice which enables an individual to have solutions to problems they perceive. (c) Tangible support; which is defined by the assistance and resources provided to an individual at times of stress e.g., financial assistance. (d) Esteem support; which is defined by the bolstering an individual sense of self-esteem and competence and expressing a belief that an individual is capable of coping with a stressful situation. This support is aided by the provision of positive feedback about an individual ability or skills to perform a task. These forms of

support can be effective in enabling individuals with schizophrenia to engage in physical activity [6,14,28].

2.2 Developing a Preliminary Synthesis

A systematic search of the literature was conducted to identify and evaluate literature that has considered social support and physical activity intervention studies. We focused on physical activity interventions in order to study the interaction between physical activity and the reported outcome measures. We assessed the consistency with which the different domains of support were used, who the provider of support was and whether social support could be attributed to direct or indirect benefits identified from outcome measures assessed by each study. For the purpose of this study we define physical activity as any bodily movement undertaken by the skeletal muscles which results in energy expenditure [29].

2.3 Information sources and search strategy

Electronic searching was conducted, from database inception to August 2013, using Cochrane Library, AMED, CINAHL, EBSCO, EMBASE, Medline, PEDro, PubMed, PsychINFO, SPORTSdiscus, Science Citation Index and Social Science Citation Index; ZETOC databases; selected Internet sites (e.g. Chartered Society of Physiotherapy) and Indexes (Turning Research into Practice, Health Services/Technology Assessment). Each search strategy combined key terms for the population and the topics of physical activity and social support of interest [30], key terms included; PHYSICAL ACTIVITY, SCHIZOPHRENIA, PSYCHIATRIC, EXERCISE, SOCIAL SUPPORT, SOCIAL CAPITAL, GROUP, and SPORT. Hand searches were made on the reference lists of articles including recent review articles [1,3,31] related to physical activity and schizophrenia.

2.4 Eligibility criteria (inclusion and exclusion criteria) for the review

Eligibility criteria was arranged around the acronym SPIDER [32] and included:

(S) Sample- individuals with a diagnosis of schizophrenia or schizophrenia spectrum disorders from a structured clinical assessment (DSM-V, ICD-10).

(P) Phenomenon of interest-studies must make reference to at least one of the four dimensions of social support or the one structural dimension of social support [6,14,15,27].

(D) Design –a mixture of design methods were included, including (randomised control trials, quasi-experimental trials, pre-experimental trials, case control trials, cohort studies and case studies.

(E) Evaluation-all outcome methods were included as well as subjective interpretation of data relating to social support from the authors of studies.

(R) Research-types included explanatory studies if they considered the concept of social support within their physical activity intervention and descriptive or exploratory studies if they considered the role, value, or use of social support as a part of physical activity.

We only considered articles written in English. Studies before 1968 were excluded.

2.5 Study selection process

The primary author screened articles by title, and abstract. Full text was retrieved when it was decided (by the primary and corresponding author) that the article could not be indubitably excluded based on its title and abstract. The full text was obtained and eligibility criteria applied.

2.6 Critical appraisal

Two methods for critical appraisal were undertaken. Case studies (n=4) were appraised using a set of screening questions [33] and risk of bias was utilised to assess trials (n=19) [34].

2.7 Synthesis

The synthesis was undertaken in four stages. Stage one involved the identification of demographics (for instance, age, gender, weight) and the social support and physical activity intervention

processes using a pre-determined data extraction form. Stage two involved identifying the provider of social support, using vote counting (see supplementary Table 1) to document the frequency of different groups (mostly groups healthcare professionals e.g., physiotherapists). Stage three identified the domains of functional support utilised in each study. The primary synthesis (See supplementary Table 2) documented each type of support as presented by each study. A secondary synthesis (undertaken by the corresponding author) used a content analysis to bring this information together. In the final stage, the corresponding author undertook a primary synthesis using tubulisation (Supplementary Table 3) this recorded how and if social support was attributed to beneficial effects from the study. This included columns which summarised the implication and proposed mechanisms, a column which utilised existing reviews [1,4,28,35-37] to support the implication and mechanisms statement. A final column identifies the likelihood (three strength statements: possible, likely, very likely) of creating statistically and clinically meaningful changes for an individual, score was decided upon by three authors [AS, PG, BS] and was weighted by current evidence combined with existing review evidence. A secondary synthesis using content analysis was then used to present the consistency across studies of the attributions made.

3. Results

3.1 Search output and stage 1 considering the summary of included studies.

From a total of 110 studies, 80 were excluded since they did not meet the inclusion criteria. A total of 883 participants were represented across the 23 studies [11,12,38-58]. The full search process can be considered within the PRISMA flow diagram (Figure 1).

INSERT FIGURE 1 HERE

The included studies used a range of study designs including randomised control trials (RCT's, n=10), single group pre-post (n=1), prospective non-blind pilot study (n=1), single group prospective (n=3), experimental (n=1), quasi-experimental (n=2), cohort (n=1) single group feasibility (n=1) and case studies (n=3). Information regarding the demographics of study participants was variable and often lacking. For instance, 12 studies did not provide details regarding gender, the remaining divided into male (n=552), female (n=319). The age of participants ranged from 18-64 years, when reported the average age of most studies (n= 12) participant was between 30-50 years. The main intervention settings included of outpatients facilities (n=9) and inpatients facilities (n=9). Interventions lasted from one week to twelve months with treatment sessions ranging from once to 3 x per week with one study having 3 x exercise sessions plus 1 x session around healthy behaviours education [55]. Full details of the study demographics and design are provided in Table 1.

INSERT TABLE 1 AROUND HERE

3.2 critical appraisal

3.2.1 Critical appraisal of trials

All except three trials [50,52,53] rated high for selection bias-allocation concealment. Types of bias were identified as selection bias-random sequence generation, (n=7); selection bias-allocation concealment, (n=16); detection/performance bias (n=13); attrition bias, (n=7); reporting bias, (n=3) and other bias, (n=14). Eleven out of nineteen trials [11,12,40-42,49,52,54,55,57,58] contained at

least four out of a possible 6 types of bias. For details, see Table 2. Fourteen studies [11,12,39-42,49-52,54,55,57,58] rated high for detection bias as no blinding of participants or study personnel was undertaken. Attrition bias, associated with participant dropouts, was a risk in seven studies [11,41,42,49,55,57,58].

3.2.2 Critical Appraisal of case studies

The researcher's perspective was not taken into account across any of the case studies. One study [45] did not have a clearly described method of data collection, which could introduce reporting bias. No details were given regarding the methods of data analysis or quality control measures across any of the case studies, it is difficult to accurately assess whether the data is likely to be valid and reliable which decreases external validity and rigour.

INSERT TABLE 2 AROUND HERE

3.3. Synthesis

The final three stages of the synthesis are presented below:

3.3.1 Stage two-Provider of Social Support within each study

The main providers of social support identified were healthcare professionals (n = 13) as well as research staff (n=13) and exercise or fitness specialists (n=7). A full breakdown of staff can be identified within supplementary Table 1.

Stage Three-Identifying Types of Social Support Utilised by each Intervention

Informational support was identified as the most consistently utilised type of support across all interventions (n=22/23). Emotional support (n=20/23) was the second most utilised, followed by esteem support (n=15/23) and tangible support (n=11/23). The full detailed description of the content of each type of support is provided in Table 4 (the content where at least 3 studies support a sub-theme/code is identified below). Details by study can be seen in supplementary Table 2.

The content of emotional support included; (a) supervision and generalised support for individuals during sessions (n=5), (b) the use of family members to support individuals (n=4), (c) care giving for individuals such as providing a friendly atmosphere or asking individuals how they felt.

The content of informational support included: (a) technical instructions of how exercise, flexibility should be performed and how injury or discomfort limited (n=5). One study also considered breathing and relaxation techniques, (b) sessions on topics around an individual's diet (n=9), this included healthy eating, food shopping reading labels, preparing food and food sampling, (c) sessions on topics around an individual's physical activity (n=8), this included information about the importance of physical activity, how to use instruments (e.g., pedometers), and how to choose suitable physical activity, (d) sessions on how to undertake a healthier lifestyle or improving health were given (n=8), identifying how to modify lifestyle, how to prevent relapse, how to cope with withdrawal symptoms, how to manage anxiety and the importance of sleeping, (e) informational support in the form of assessments included; fitness (n=5), weight and diet (n=3), perceived exertion during exercise (n=3), goal setting and exercise planning (n=4), (f) informational sheets or booklets which covered the educational guidance within the sessions were provided frequently (n=10). (g) phone calls to identify when session took place or when to attached a pedometer were made (n=3), (h) finally, enhanced consideration to consent was given (n=3).

The content of esteem support within studies included: (a) verbal encouragement for individuals (n=5), (b) reinforcement of positive and negative behaviour (n=8), (c) having peer role models that could encourage others (n=3), (d) interaction which assisted behaviour change outside the physical activity (n=9), this included different motivational techniques like motivational interviewing to encourage adherence and achieve goals.

The content of tangible support most frequently identified (n=3) included using privileges to enhance weight loss for instance meal or food privileges or tokens which could be used to purchase gift items. In older studies work privileges were also identified.

Stage four-Outcome Measures and Results attributed to Social Support

The attribution of the benefits of social support from physical activity interventions for individuals with schizophrenia is identified fully in supplementary Table 3 and summarised in Table 5. Overall the indirect health benefits of social support were difficult to ascertain. However, providing esteem support, emotional support and verbal reinforcement (n=8), general social support (n=4) and peer /group social support (n=5) appeared to facilitate individuals compliance and attendance of programmes.

INSERT TABLE 3, 4 & 5 AROUND HERE

4. Discussion

Twenty-three studies were analysed in this synthesis to determine the type and use of social support used to facilitate physical activity in individuals with schizophrenia. The most frequent provider of support was the research staff or exercise instructors. The current findings were able to detail how the utilisation of different functional and structural domains of social support act to help individuals overcome the barriers which influence physical activity initiation, adherence, as well as compliance to programmes. Indeed, previous literature has suggested that support given during a familiarisation phase [12] or pre-intervention phase [44] can allow patients to feel that they are known and valued, trusted and feel cared for. This may help them overcome the psychosocial barriers to attendance[53]. Further to this a novel finding identified the possibility of an indirect influence of social support on the success of maintaining and losing weight (the most frequently reported outcome).

Informational support was identified as the most utilised and this correlates with previous literature to some extent [6]. This type of support can be readily implemented in clinical practice as it may require less expertise to deliver it, as it relies on the participant to read and be informed by the information. It is also the easiest domain of support to document within research. These findings may explain why it was the most documented/utilised type. Further research is required to

determine how informational support should be disseminated and constructed in order to maximise the effects.

Esteem support is highlighted in several studies [6,14,28] as the most valuable from the perspective of both staff and patients. Past literature has identified the importance of individualised verbal encouragement[44] and reinforcement[45,47] likely enhances an individuals perceived ability to continue with their efforts and not give up, it may be especially important due to a-motivation, the current results go some way to support this, especially when considering the value on adherence, attendance and compliance. This makes sense, when one considers that individuals with schizophrenia lack an internal locus of control, therefore find it difficult to make and maintain change as they rely on the actions of others, or environmental or situational events to enable this [20].However, emotional and esteem support may require greater time for contact with individuals, a higher level of knowledge and training from the provider, especially when working with individuals who have complex needs [10,16]. Further to this there is less understanding of how emotional and esteem support work e.g., what should be said, how it should be said. Importantly, peer support and group settings appeared to be of value for adherence and compliance of physical activity. One reason for this could be that isolation from living alone acts as a barrier to attendance e.g., in one study [41] individuals who lived alone attended significantly ($p = 0.32$) fewer sessions than those who lived with others.

The current review suggests that individuals with schizophrenia will benefit greatly from friendships that develop alongside the physical activity that is undertaken. Such friendships provide access to positive identities [4] and acts as a positive form of social control [37], which , in turn help to increase an individual's confidence for further participation in physical activity [59] and that the cohesion that is developed with others during physical activity can encourage interest and aid on-going commitment to physical activity [60]. Further to this, evidence has identified that friendships

with peers developed within the physical activity setting are associated with a reduction in psychiatric symptoms [1,18,19].

The current review suggests that it is very likely that social support can have an indirect benefit on efforts to maintain weight or even enhance weight loss when it was measured across studies. This finding, as in other studies [52], should be considered tentatively as requires direct measurement.

Past literature has identified that individuals with schizophrenia who are overweight should have a target weight loss of between 5% and 10% [61] and that a in body weight of 5% will have a clinically meaningful reduction in morbidity for individuals [62]. Importantly past reviews have suggested that this is a challenging target [2,31,61,63]. However, evidence from this review implicates that the utilisation of different forms of functional and structural social support with 'very likely' chance of having an effect on outcomes (see Table 4 and 4.4.2) has the potential to allow individuals to reach and surpass this target.

4.2 Implications

The current results have identified the value of emotional, esteem, and peer support on the initiation compliance and adherence of exercise in individuals with schizophrenia as well as the indirect benefit of esteem and informational support on weight maintenance and loss. Given this, the current implications have drawn on the most common forms of these dimensions of functional and structural support to provide clinical recommendations from this review (please note that further evaluative research is required to test these implications):

4.2.1 Recommendations to support the initiation, compliance and adherence to physical activity

Attention should be given to the individuals needs on a personal level. Within intervention settings, a friendly and welcoming atmosphere is required where individuals feel accepted and cared for. Individuals should receive frequent encouragement about progress and encouraging statements to

keep going when undertaking an intervention. Encouragement for compliance to the recommended exercise level or intensity should be given but not forced and any amount of maintenance or progress valued. Positive behaviour should be reinforced. Pre-intervention contact and support will likely enhance the potential for initiation and adherence. Additionally peer support should be considered within interventions for its value in helping individuals change their lives and increase their sense of belonging and life satisfaction[64]. The use of peer support or having a training partner can enhance the experience of exercise through individuals knowing and supporting one another [11,12,40,43], as well as reducing the feelings of being uncomfortable in the physical activity setting or the consequence of not having anyone to go with [65].

It may be useful for clinicians' to consider the trans-theoretical model of behaviour change [66] when using social support to promote behaviour change. Importantly, it may be at different stages of the behaviour change model certain types of support are more effective or useful. The use of counselling techniques or motivational interviewing techniques [67] should be used to assist initiation and adherence, and the importance of establishing rapport, trust and a relationship should be consistent and used to enhance the effects of esteem and emotional support. Groups where positive reinforcement and interactions can be obtained by peers are important and will likely aid initiation, compliance and adherence of exercise. These types of support should be used within the exercise session as well as outside the exercise session.

4.2.2 Recommendations for the use of social support to aid the maintenance of weight or reduction of weight

Social support must be considered for interventions if psychological barriers including cognitive biases are to be prevented and physical activity is going to be initiated. Before maintenance of physical activity is established individuals can experience feeling isolated and vulnerable and not feel comfortable to attend sessions without social support. Individuals will significantly benefit from having others (health care professionals, positive peer role models, family or carers) to go with and

encourage them to participate. Positive behaviour should be reinforced when it would likely help the individual achieve weight maintenance or weight loss. Providing individuals with information about diet and physical activity and the value of it is important as it, techniques to encourage behaviour change to occur such as motivational interviewing and exercise counselling. This finding can be supported in future studies by a mediator analysis.

4.3 Limitations

4.3.1 Methodological Limitations

Several types of bias have been identified which could have influenced results therefore findings must be interpreted with caution. Limited number of randomised control trials (n=10) may increase risk of a selection bias within the results [68] and thus may influence the interpretation of findings associated with understanding the benefit of social support on outcome variables. Further to this, allocation concealment is crucial in the randomisation process to increase internal validity and decrease the risk of bias. The lack of blinding throughout the studies could potentially compromise the validity of the findings and any conclusions made as it may have introduced participant or performance bias [69]. None of the studies (n=7) that had an attrition bias performed intention-to-treat analysis, leading to missing outcome data which makes interpretation of the results more difficult and undermines the validity of the conclusions reached [70].

Although strategies such as the use of data extraction tables were implemented to minimise bias, the primary and corresponding author performed all aspects of the review non-blinded, therefore researcher bias may have been introduced. Including quantitative and qualitative studies may introduce bias to the findings due to the latter having a less rigorous design approach, therefore allowing for collection of biased results. Language bias may also have been introduced due to

exclusion of non-English articles, excluding potentially relevant literature. Due to a current lack of research in this area to date, the sample size of included literature was small (n=23).

4.3.2 Bias's within the data

The population of the sample shows a higher ratio of males to females than the general population of individuals with schizophrenia (1.7 compared to 1.4) [71]. This may reduce external validity and therefore generalizability [72]. External validity may be further reduced due to lack of indication of participants' ethnicity. Evidence suggests the potential presence of over or misdiagnosis of psychotic symptoms in African American inpatients [73]. Affective disorder symptoms can be misinterpreted as psychosis, which may introduce sampling bias. However, in the studies reviewed, there were equal numbers of inpatient and outpatient settings (n=9).

Few studies report on the symptom profile or the degree of symptoms experienced by the participants selected for inclusion. There is evidence that the presence of negative symptoms is the most significant correlate with physical inactivity [1] and as such clinicians may wish to target this symptom profile in interventions for patients with schizophrenia designed to increase physical activity. The lack of specific information on symptom profiles of the samples in the studies in this review limits the extent to which we can comment on the generalisability of findings to this particular population. The lack of information on the degree of symptoms experienced by participants also makes it difficult to ascertain generalisability. Although participants throughout studies are reportedly medicated for their symptoms, few report on dosage and adherence to medication. In addition, none of the studies report on whether samples are constituted of individuals experiencing first episode psychosis, which further reduces generalizability to the population. Finally, with the exception of weight, waist circumference and body mass index, the studies did not utilise a standard set of outcomes, thus this limits the attributions regarding the value of social support.

4.3.3 Limitations in the review technique

The techniques used in narrative synthesis are limited by subjectivity of results, techniques chosen by author and stance or understanding of the author who undertook the analysis. The interpretation of findings which attribute the value of social support to particular outcome is subjective, and should be viewed with caution. The review was not able to consider the optimal dosage of support, or was it able to elucidate the unique effect generated by the different forms of social support. Further research is needed to specifically investigate this.

4.4 Recommendations for future research

A great understanding of how the different functional dimensions of social support are used within clinical settings is needed. Greater detail on what social support practices are reported as valuable by patients is required and further understanding of how policy can be changed in order to utilise the potential value of social support is required. Future research should try and establish what the direct effect of social support to facilitate physical activity engagement is on important health outcomes.

4.5 Conclusion

The current review established that a wide range of different types of social support are currently used by a number of different professionals. There is some evidence to suggest that providing social support may improve adherence and indirectly aid positive health outcomes (e.g. BMI). However, due to limitations in the literature it was difficult to disentangle the direct effects of social support on health outcomes. Therefore, future research should more clearly investigate the value of social support on important health outcomes from physical activity engagement.

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Declaration of Interests

The authors report no declaration of interests.

Table 1 Demographics of individuals from the included studies

Study	N	Diagnosis	Age, Gender and Weight	Details of Intervention	Intervention Process
Dodd 2013	8	DSM-IV Schizophrenia or Schizoaffective	Gender: 6 male Age: 45±10 years Weight: 75.5±9.3 Marital Status: Not identified	Intervention Setting: Gymnasium of the local rehabilitation setting Time: 28 week intervention Design: Single group pre-post. Phase 1: 4-week familiarisation. Phase 2: 24 week aerobic exercise and walking programme. Aim: Consider the feasibility of a group-based aerobic exercise and walking program on aspects of physical health and behaviour.	4 week familiarisation phase-exercises performed at very low intensities Groups 2-3 people-each supervised by qualified exercise physiologist with previous experience with implementing exercise programmes with people with severe mental illness.
Attux (2013)	160 Intervention: 81 Standard Care: 79	DSM-IV schizophrenia spectrum. Breakdown not given.	Gender: Intervention: 50♂ / Standard Care: 46♂ Age: Intervention: 32.6±9.9 years / Standard Care: 38.3±10.7 Weight/BMI: Intervention: 81.1±14.3kgs. Standard Care: 84.3±17.8 Recruitment setting: from 4 outpatient programmes Marital Status: Intervention: 64 Single, 8 Married, 9 Other (divorced widow). Standard Care: 62 Single, 10 Married, 7 Other (divorced widow).	Intervention Setting: Outpatient setting for meetings Time: 12 weeks Design: Randomised control trial Aim: to test the efficacy of a 12-week group lifestyle wellness program	12-week weight management One hour per week... 1 session for intro, 4 discussing dietary choices, 3 discussing importance of physical activity, 1 for self-esteem and motivation, 1 for management of anxiety, 1 open to relatives, 1 to end programme.
Archie (2003)	20 Intervention: 10	DSM-IV Schizophrenia or schizoaffective disorder	Gender: 10 male Age: 27 years Weight/BMI/WC: 31 kg/m ² / 105 cm. Recruitment setting: Psychiatric Disorders Inpatient Clinic Marital Status: Detail not given	Intervention Setting: Community fitness centre Time: 6-month full membership to setting Design: Prospective non-blind pilot study Aim: Consider if individuals would initiate and maintain exercise if provided with free access to a local community Young Men's Christian Association (YMCA) fitness facility.	Membership to YMCA (Young Men's Christian Association) fitness facility.
Bernard (2013)	12	DSM-IV-TR 9 Schizophrenia, 3 Schizoaffective disorder	Gender: Not detailed Age: 45.7±10.8 years Weight/BMI/WC: 4 were > 25kgs/m ² , 2 were >30 kg/m ² . Recruitment setting:	Intervention Setting: Inpatient location Time: 8-week counselling and exercise intervention Design: Oxygen group intervention Single group prospective design.	8 week counselling and exercise intervention. Five 75 min 'smoking reduction' group sessions Three 90 min exercise sessions

			<p>inpatients</p> <p>Marital Status: Not detailed</p>	<p>Aim: “to evaluate the feasibility, acceptability and effects of the oxygen group on smoking consumption” (pp., 24)</p>	
Beebe (2010)	17	<p>DSM-IV</p> <p>12 Schizoaffective Disorder</p> <p>5 Schizophrenia</p>	<p>Gender: 10 male</p> <p>Age: 43.2 years</p> <p>Weight: not identified.</p> <p>Recruitment setting: Outpatients at a community mental health setting</p> <p>Marital Status: Not given. 6 Living alone 7 living with family 4 with paid carer</p>	<p>Intervention Setting: Outpatient centre</p> <p>Time: 4-week</p> <p>Design: Single group prospective design</p> <p>Aim: Determine the feasibility and acceptability of a Walk, Address sensations, Learn about exercise, Cue exercise behaviour intervention (WALC).</p>	<p>WALC....Walk, Address sensations, Learn about exercise, Cue exercise behaviour</p> <p>Nutritional counselling</p> <p>Exercise</p> <p>Motivational counselling inc. professional support, encouragement and strategies to improve exercise habits.</p>
Duraiswamy (2007)	61	<p>DSM-IV</p> <p>Schizophrenia</p>	<p>Gender: 42 male</p> <p>Age: Yoga group: 32.5±7.9 years Exercise group: 31.1±7.9</p> <p>Weight: not detailed</p> <p>Recruitment setting: National institute of mental health and neuro sciences, India</p> <p>Marital Status: 18 married 43 unmarried</p>	<p>Intervention Setting: Outpatient therapy hall</p> <p>Time: 4-month intervention</p> <p>Design: Randomised control trial</p> <p>Aim: “examine the effects of a 4 months of yoga treatment as an add-on treatment on the psychopathology of schizophrenia patients” (pp 227).</p>	<p>4-month yoga therapy or physical exercise therapy</p>
Centorrion (2006)	17	<p>DSM-IV</p> <p>Schizophrenia or Schizoaffective disorder</p>	<p>Gender: 17 male</p> <p>Age: not detailed</p> <p>Weight: 105.0±18.4 kgs / 36.6±4.6</p> <p>Recruitment setting: Inpatient hospital</p> <p>Marital Status: Not given.</p>	<p>Intervention Setting: In patient hospital, weight management centre on hospital grounds</p> <p>Time: 12 month trial 2 phases lasting 24 weeks each.</p> <p>Design: Single group prospective design</p> <p>Aim: Consider the effect of a weight-control study for individuals with schizophrenia</p>	<p>2 x 24 week programmes</p> <p>First phase- -Twice weekly for diet and exercise counselling. -Sessions lasted 90 mins-first 45 mins nutritional counselling, followed by 45 mins of personalised fitness training. (During the first four weeks, food plans were developed for each subject incorporating individuals sleep, activity and hunger patterns) Four sessions were devoted to identifying strategies to decrease social isolation and inactivity. Second phase-as detailed above but less intensive. -minimum commitment of one session every</p>

					4 weeks
Beebe (2005)	10	DSM-IV of Schizophrenia or any sub-type	Gender: 8 male Age: not identified Weight: not identified Recruitment setting: Outpatient clinic Marital Status: 7 single, 3 married	Intervention Setting: Outpatient clinic in a specified room Time: 16 week study Design: Pilot randomised control trial Aim: To consider the benefits of a walking program to the physical and psychosocial health of individuals.	12 participants randomly assigned to experimental (n=6) and control (n=6) groups for a 16 week treadmill walking programme 3 x per week 2 participants did not attend any scheduled exercise sessions so were dropped.
Beebe (2011)	97	DSM-IV 28 Schizophrenia 69 Schizoaffective	Gender: 51 male Age: 46.9±2.0 years Weight: not identified Recruitment setting: Community outpatients centre Marital Status: Living alone 36 Living with family 42 Living with paid carer 19	Intervention Setting: Psychiatric research centre Time: 20 weeks. Design: Randomised control trial Aim: To consider the benefits of a motivational group exercise on individuals with schizophrenia Intervention group 4-week WALC + 16 week walking intervention. Control: 4 week time and attention control group + 16 week walking intervention	WALC-S Group (Walk, Address sensations, Learn about exercise, Cue exercise behaviour for SSDs) 1 hour weekly for 4 weeks, 8 subjects per group TAC Group (Time and Attention Control) 16 week walking programme Two different blinded graduate students. Began with warm up stretches, walking- beginning with 5 mins, increasing to 30 mins over the first 4 weeks. Cool down exercises-5 mins slow walking followed by stretches. Reminder and follow up calls.
Thyer (1984)	2	Psychiatrist diagnosis of Schizophrenia	Gender: 1 male Age: 64 & 53 years Weight: not identified Recruitment setting: Outpatient facility Marital Status: Not identified	Intervention Setting: Outpatient group care facility Time: 78 days Design: ABAB experimental design Aim: To consider the effectiveness of a contingency-management program on the exercise behaviour of individuals with schizophrenia	First baseline phase...7 days Stationary exercise bike with odometer was placed in the living room, in front of the TV. Residents were informed that it was for their health and recreation. They could ride it whenever they wished. They were asked to inform staff before and after riding the bike so that staff could collect readings from the odometer. First reinforcement phase...7 days Extra cigarettes and coffee and tea would be available if they used the exercise bike first. Specifically...one reinforcement for each one tenth of a mile (1/10) for the first mile, then one reinforcement for each 2/10 of a mile for the second mile and so on. Second baseline phase...7 days

					Cigarettes and coffee/tea made available solely on request. Second reinforcement phase...7 days As above
Bernard (1968)	1	Psychiatrist diagnosis of Schizophrenia	Gender: Female Age: not identified Weight/BMI/WC: 407 lbs Recruitment setting: Inpatient hospital Marital Status:	Intervention Setting: Inpatient hospital Time: 27 weeks Design: Case study Aim: To produce weight loss in a ward setting.	Single subject, 'experimental behaviour modification' 18 week calorie controlled diet. Weight loss 'rewarded' with 10 tokens for each pound lost. Tokens could be exchanged for privileges such as; phone calls, admission to dances, movies, rent on a private room on the ward.
Moore (1969)	1	Psychiatrist diagnosis of Schizophrenia	Gender: female Age: 24 years Weight: 170 lbs Recruitment setting: Inpatient hospital Marital Status: single	Intervention Setting: Inpatient hospital Time: 26 week period Design: Case study design Aim: To consider the effects of social reinforcement on the patient	Weight loss via reinforcement of social approval and acceptance to help inhibit eating. If 'S'(subject) had lost weight, E would respond with positive reinforcement around approval and acceptance for her weight loss. If she had gained weight or stayed the same, the E would respond negatively, by simply shaking his head. He would record the weight, inform the subject and then instruct her to return to the ward.
Upper (1971)	2	Psychiatrist diagnosis of Schizophrenia	Gender: male Age: 36 and 42years Weight/BMI/WC: 233 lbs and 201lbs Recruitment setting: Psychiatric inpatient ward Marital Status: Single and divorced	Intervention Setting: Psychiatric inpatient ward Time: 28 weeks Design: Case study Aim: Consider the effects of different forms of reinforcement on weight loss on an inpatient unit	Weight reduction programme. 1500- calorie diet with weekly weight ins. Use of reinforcing agents. Administration of tokens Privileges to be taken off-ward-4 types-meal, work, full and partial Social approval
McKibbin (2006)	57	Physician confirmed diagnosis 48 Schizophrenia 9 schizoaffective disorder	Gender: Intervention: 18 male Control: 17 male Age: Intervention 54.8±8.2 years Control: 53.1±10.4 Weight/BMI/WC: Not identified Recruitment setting: Community outpatient settings Marital Status: Not identified	Intervention Setting: Community outpatient setting Time: 24 sessions Design: Randomised control trial measurements at baseline and 6-month Aim: "test the efficacy of a novel, manualised 24-week lifestyle intervention to reduce obesity in middle aged and older persons with schizophrenia" (pp 37)	24 week Diabetes Awareness and Rehabilitation Training (DART) Behavioural change strategies implemented such as: Weekly weigh ins Pedometers Healthy food sampling Reinforcements for attendance and behavioural change (raffle for health related prize)

Methapata ra (2011)	64	DSM-IV Diagnosis of schizophrenia	Gender: 30 Male Age: Intervention 43.16±9.27 Control 37.59±10.83 years Weight/BMI/WC: Intervention 76.27±10.81 Control 73.70±12.31 Recruitment setting: Inpatient psychiatric hospital Marital Status: Not given.	Intervention Setting: Inpatient psychiatric hospital Time: 12 week intervention Design: Randomised control trial Aim: To examine the effects of a walking plus motivational interviewing intervention	12 week RCT, pedometer walking with motivational interviewing (PWMI). PWMI consists of 5 x 1 hour sessions- 1 st session-individual MI focused on obesity and motivation for daily walking 2 nd -group education re nutrition, exercise (warm up, cool down, pedometer use) 3 rd -SMART goals used to set individual goals 4 th -group session practising pedometer walking under supervision 5 th -feedback from therapist on patients practice, information on self-regulation strategies to cope with lapse and relapse.
Beebe (2013)	22	DSM-IV-TR 8 Schizophrenia 14 Schizoaffective disorder	Gender: Intervention: 6 Male Control: 6 Male Age: 48.1±13.3 years Weight/BMI/WC: Not given. Recruitment setting: Outpatient centre Marital Status: Intervention: 6 Lived alone, 3 with family, 2 paid caregiver. Control: 6 Lived alone, 4 with family, 1 paid caregiver.	Intervention Setting: Home based intervention Time: 1 week Design: Cohort study: Assessment of activity levels post an exercise intervention Aim: To consider the level of physical activity post intervention	Pilot study exploring the physical activity level of 22 people with Schizophrenia Spectrum Disorders (SSDS) 14-34 months (mean 22) after an exercise intervention during an RCT. 11 participants wore a pedometer every day for one week with no alteration of their normal activity.
Chen (2009)	33	DSM-IV Schizophrenia or Schizoaffective (breakdown not given)	Gender: 6 male Age: 31.9 ±6.4 years Weight/BMI/WC: 77.9±15.5 kgs Recruitment setting: Inpatient hospital Marital Status: N/A	Intervention Setting: Inpatient hospital Time: 10 weeks Design: Quasi-experimental multi modal weight control trial Aim: Evaluate the effectiveness of a weight control trial	10 week, multimodal weight control programme, "A Meaningful Day". Incorporating exercise, nutrition counselling and behavioural interventions. 10 x 90min group sessions consisting of: Drug adherence and relapse prevention (3 sessions) Structured life schedule (1 session) Healthy eating (6 sessions) 45 minutes aerobic exercise incorporated into each session except the first and last due to intro to programme and 'wrap up'. Participants encouraged to keep a food diary and to do an additional 45 mins exercise 3 x per week at home.
Marzolini (2009)	13	DSM-IV Schizophrenia or schizoaffective disorder	Gender: 8 male Age: 44.6±3.0 years Weight/BMI/WC: Intervention 81.5± 3.7kgs control 82.7±5.6 kgs Recruitment setting: Community outreach	Intervention Setting: Exercise to take place at a community recreation facility Time: 12-weeks Design:	12 week, community based exercise programme of resistance and aerobic training. Tests- Six minute walk test One rep max

			Marital Status: 13 single	Randomised control trial Aim: Consider the effects of an exercise program of aspects of physical and mental health	Anthropometric measurements
Ball (2001)	22	DSM-IV Schizophrenia or schizoaffective disorder	Gender: 15 Male Age: Treatment 43.8±8.1 years Comparison 43.3±7.1 Weight/BMI/WC: Treatment 237.9±57.8lbs Control 167.6±48.2 Recruitment setting: Outpatients for both groups Marital Status: Not given	Intervention Setting: Psychiatric research centre Time: 10-weeks Design: Control trial Aim: Consider if the weight watchers programme could be successful in reducing weight	'Weights Watchers' programme for patients with schizophrenia and olanzapine related weight gain. 6 week programme, although states 10 weekly WW meetings Exercise sessions 3 times per week, monitored by research staff
Warren (2011)	18	DSM-IV Schizophrenia or schizoaffective disorder	Gender: Male Age: 18-64 years Weight: Recruitment setting: Inpatient and outpatient mental health facility Marital status:	Intervention setting: Inpatient and outpatient mental health facility Time: 10 weeks Design: Single group, feasibility study Aim: To assess the feasibility of preparing people with schizophrenia for a 5K event using an exercise programme	Exercise programme adherence using 5k event as the goal 10 week training programme consisting of; 3 supervised walking/jogging sessions per week Once weekly educational meeting on healthy behaviours
Wu (2008)	128	DSM-IV Schizophrenia	Gender: Male Age: 18-45 Weight/BMI/WC: 62.4-66.7 kg/24.2-25.1/82.8-84.5cm Recruitment setting: Mental Health Institute Hospital Marital Status: Not given	Intervention setting: Mental Health Institute Hospital Time: 12 weeks Design: Randomised control trial Aim: To test the efficacy of lifestyle intervention and metformin alone and in combination for antipsychotic induced weight-gain and abnormalities in insulin sensitivity	128 patients randomly assigned to either: 12 weeks of placebo 750mg/d of metformin alone 750mg/d of metformin and lifestyle intervention Lifestyle intervention alone Lifestyle intervention included psycho-educational, dietary and exercise programmes Patient also continued their antipsychotic medication
Kwon (2006)	48	DSM-IV Schizophrenia or schizoaffective disorder	Gender: Male and female Age: 19-64 Weight/BMI/WC: Recruitment setting: Outpatient facility Marital Status: Not given	Intervention setting: Outpatient facility Time: 12 weeks Design: Randomised control trial Aim: Assess the efficacy of a weight management programme for patients with schizophrenia or	12-week weight management randomised control trial of patients with schizophrenia or schizoaffective disorder taking Olanzapine. Main study components consisted of diet and exercise management based on cognitive and behavioural therapy. Weight management, measurements of QOL, safety, and compliance with olanzapine treatment comprised the remainder of the

				schizoaffective disorder taking Olanzapine	study. Diet management Nutritional advice and keeping a food diary Exercise management Advice on lifestyle modifications regarding weight control Exercise diary Control group-food and exercise diaries only
Littrell (2003)	70	DSM-IV Schizophrenia or schizoaffective disorder	Gender: Male and female Age: 18+ Weight: Intervention group at baseline: Male: 192.93 ±31.67 Female: 155lbs ± 21.02 Standard care at baseline: Male: 202.1 ± 25.05 Female: 148.86 ± 40.36 Recruitment setting: Local community mental health centres and private psychiatrists Marital Status: Not given	Intervention setting: Outpatient facility Time: 6 months Design: Quasi-experimental Aim: Assess the effect of an educational interview on antipsychotic medication induced weight gain in patients with schizophrenia	Over 4 months, weekly psycho-education classes, using the 'Solution of Wellness' models (Ryan et al., 2000), focused on: Nutrition Fitness and exercise Healthy lifestyle Patients were followed for a further two months to assess weight change

Figure 1 Study Selection Flow Diagram (adapted from PRISMA, Moher et al. 2009)

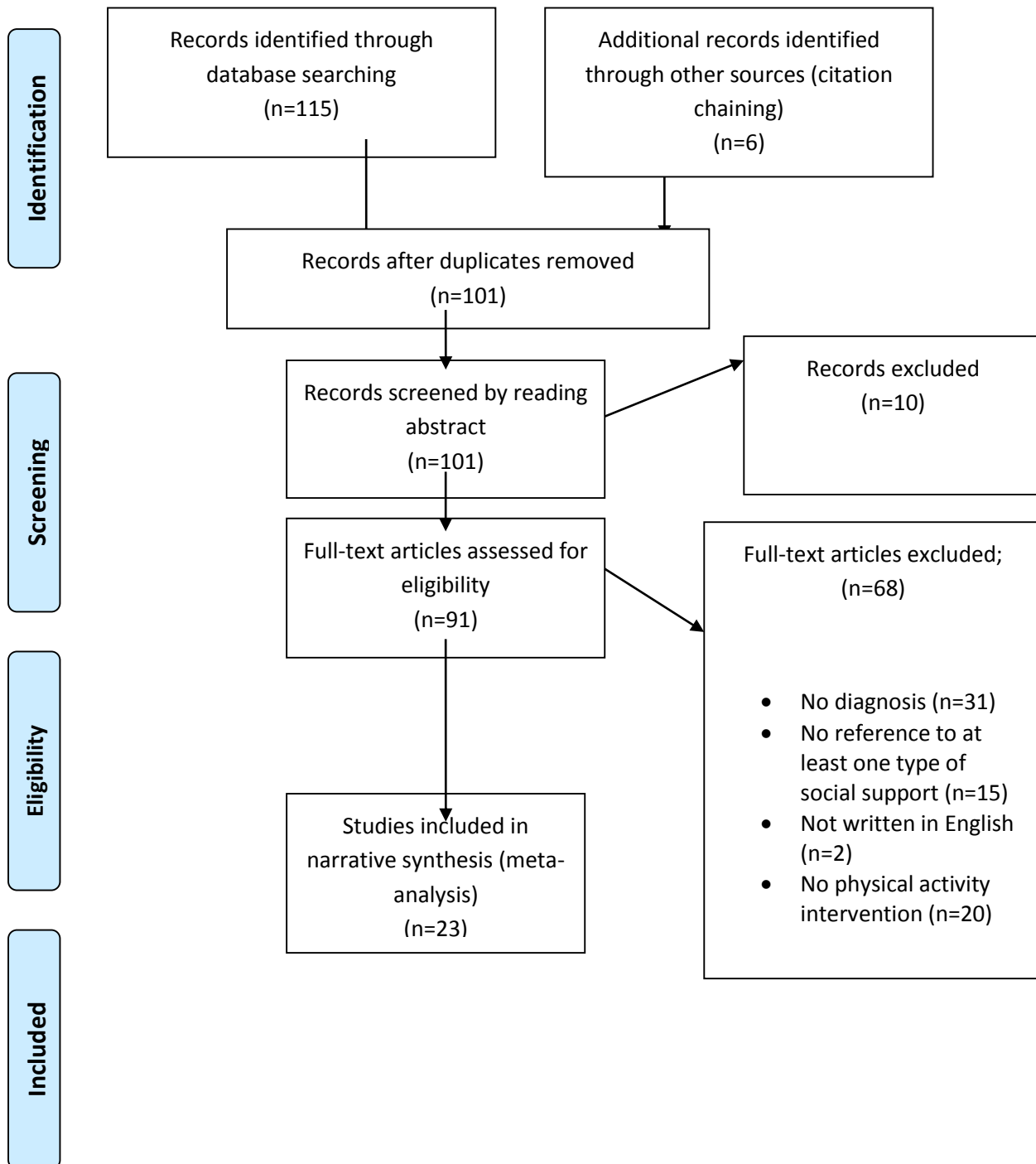


Table 2 Summary Assessment of the Overall Risk of Bias

Trial*	Components of risk of bias/key risk criteria						Summary within trial	Comments on high risk components
	1	2	3	4	5	6		
Littrell (2003)	U	H	H	H	L	H	H = 4 L = 1 U = 1	Selection bias = no allocation concealment Detection bias = no blinding Attrition bias = no intention to treat Other bias: No protocol previous published with a register
Beebe 2005	L	H	L	L	L	H	H = 2 L = 4 U = 0	Selection bias = not enough detail to consider if allocation concealment was achieved Other bias: No protocol previous published with a register
*Beebe 2010	H	H	H	H	H	L	H = 5 L = 0 U = 0	Selection bias = no randomisation or allocation Detection bias = no Blinding Attrition bias = not intention to treat Reporting bias = few outcomes considered
*Beebe 2011	L	H	L	L	L	L	H = 1 L = 5 U = 0	Selection bias = no allocation concealment
Ball 2001	H	H	H	L	H	H	H = 6 L = 0 U = 0	Selection bias = No randomisation or allocation Detection bias = no blinding undertaken. Attrition bias = 11 out of 21 completed = no intention to treat, but reasons for non-completion given. Reporting bias = summary analysis not given for ♀ results Other bias: No protocol previous published with a register.
Beebe 2013	L	H	H	L	L	L	H = 2 L = 4 U = 0	Selection bias = no allocation concealment Detection bias = no blinding
Marzolini (2009)	U	L	L	L	L	H	H = 1 L = 4 U = 1	Other bias: No protocol previous published with a register
Chen (2009)	H	H	H	L	H	L	H = 5 L = 2 U = 0	Selection bias = no allocation concealment or randomisation Detection bias = no blinding Attrition bias = no intention to treat Other bias: No protocol previous published with a register
Wu 2008	L	L	L	L	L	H	H = 1 L = 5 U = 0	Other bias = No protocol previous published with a register
*Methapatar a 2012	L	L	H	L	L	H	H = 2 L = 0 U = 0	Detection bias = no blinding Other bias = No protocol previous published with a register
*Warren 2011	H	H	H	H	L	H	H = 5 L = 1 U = 0	Selection bias = no randomisation or allocation concealment Detection bias = no blinding Attrition bias = no intention to treat Other bias: No protocol previous published with a register
McKibbin 2006	U	H	H	H	L	H	H = 4 L = 1 U = 1	Selection bias = no randomisation or allocation concealment Detection bias = no blinding Attrition bias = no intention to treat Other bias: No protocol previous published with a register
Dodd 2010	H	H	H	L	L	H	H = 4 L = 2 U = 0	Selection bias = no randomisation or allocation concealment Detection bias = no Blinding Attrition bias = not intention to treat Other bias: No protocol previous published with a register
Attux 2013	L	H	L	L	L	L	H = 1 L = 5 U = 0	Selection bias = no allocation concealment Other bias: "participants needed to be motivated to lose weight or show concern about weight gain." (pg., 2)
Archie 2003	U	H	H	L	L	H	H = 3 L = 2 U = 1	Selection bias = sequence generation was not clear or detailed. No allocation concealment Detection bias = no Blinding Other bias: No protocol previous published with a register
Bernard 2013	H	H	H	L	L	H	H = 4 L = 2 U = 0	Selection bias = no randomisation or allocation concealment Detection bias = no blinding

								Other bias: No protocol previous published with a register
Duraiswamy (2007)	L	H	H	H	L	H	H = 5 L = 2 U = 0	Selection bias = no allocation concealment Detection bias = no blinding Attrition bias = no intension to treat Other bias: No protocol previous published with a register
Centorrion (2006)	H	H	H	H	L	H	H = 5 L = 1 U = 0	Selection bias = no randomisation or allocation concealment Detection bias = no blinding Attrition bias = no intension to treat Other bias: No protocol previous published with a register
Kwon et al (2006)	U	H	H	H	L	H	H = 4 L = 1 U = 1	Selection bias = unclear randomisation or allocation concealment Detection bias = no blinding Attrition bias = no intension to treat Other bias: No protocol previous published with a register

*Trial denoted by first author. Risk of bias criteria: 1, Selection bias= random sequence generation; 2, selection bias=allocation concealment; 3, Detection/Performance bias=blinding of personnel, assessors and participants; 4 Attrition bias= incomplete outcome data; 5 Reporting Bias=short-term selective outcome reporting; 6, Other bias= potential threats to validity e.g., consideration of a protocol.

Levels of risk of bias: H, high risk of bias; U, unclear risk of bias; L, low risk of bias.

Table 3 Identifying the different functional types of support used by studies

Theme	Sub-theme	Code	Unit and study	No. of Studies
Emotional Support	Support outside exercise sessions	Knowing the individual well	Familiar member of staff from unit assisted individuals. [1]	1
		Phone calls	Call from therapist to check for difficulties with programme. [15]	1
	Accessing and Utilising Others	Accessing family	One session open to relatives and family. [2] Family member accompanied each individual to the consent sessions in order to help them understand form. [6] family support in terms of them not bringing sugary sweets/snacks [11] Family members encouraged to attend the race... [20]	4
		Access to professionals	Patients had regular visits to the psychiatrist [2] Reasons for missing session elicited by interview with clinician. [18]	2
		Access to other forms of support	Patients...attended sessions of other psychosocial interventions offered by the program.[2] Peer support. [7] Dietary counselling [7] Dairies and role play for dealing with distress. [2]	2
	Supervision of Exercise	General support	Supervised exercise sessions were included. [4] Special attention given to subjects with medication related impaired balance and coordination. [7] Attention...from staff or 'experimenter' were provided on a regular basis. [12] Provided with attention [13] Training sessions for 5km event were supported. [20]	5
		Care for individuals	Individuals were asked how they were feeling at the start and end of each session. [1] 'strategies used by the exercise trainer...' -allowing a break if participants became upset. [1] 'Friendly' atmosphere maintained during training rather than 'boot-camp'. [20] SP surveyed participants for any discomforts during basic stretches at WALC. [5:9]	5
		Practice with peers	Group practice for pedometer walking. [15]	1
Informational Support	Identifying how physical activity and exercise is performed	Technical instruction	Taught exercises...[1] Provided information on how and why to warm up the muscles, considered appropriate attire for exercise, importance of starting slowly and gradually increasing walking time and maintain adequate hydration. [5:9] Identified common discomforts experienced during exercise and suggested ways of reducing this e.g., heat or massage.... Individuals were told to notify participants if discomforts occurred. [5:9] Yoga teaching included breathing practice and relaxation techniques [6] Study personnel present at exercise sessions and demonstrated exercise and stretches.[8]	5
	Sessions used to inform the individual	Diet	Information sessions....to discuss dietary choices (4 sessions, focused on the food pyramid) [2] All subjects given information on diet [3] individuals interviewed about their eating [7] Dietary counselling and low calorie food plan – including a reduced-calorie nutritionally complete food plan individualised for each subject. [7] Health food sampling [14] Advice regarding ... healthy eating [17] Weight watchers point system to evaluate food choices [19] Dietary advice given by a registered dietician who ensured calorie intake worked. [21]	9

			Dietary advice... Dietician discussed food diaries and exercise coordinator the exercise diaries. For diet the following concepts were considered; food exchange table, using food models, importance of regular meals, healthy snaking, food shopping and preparation and reading food labels. [22] Content included ...healthy nutrition [23]	
		Physical Activity	Information sessions....to discuss physical activity (3 sessions for discussing its importance). [2] All subjects given information on exercise [3] Therapist taught yoga and exercise....exercises and yoga adherence and correctness reviewed once a month. [6] Individuals interviewed about their ... activity exercise [7] Researchers set and instructed participants on use of pedometer.[16] Exercise sessions directed by exercise physiologist for first week. [21] Exercise advice... Chose suitable forms of exercise and correct misconceptions. [22] Content included living ... fitness and exercise. [23]	8
		Health & Lifestyle	One session for the management of anxiety. [2] Sessions to help patients cope with withdrawal symptoms (anxiety). [4]All subjects given information on health [3] Individuals interviewed about their ... sleeping patterns [7] individuals were informed by staff that an exercise bike was purchased to benefit their health. [10] advice regarding ...lifestyle.... relapse prevention, and drug adherence. Emphasis of program was on a healthy lifestyle and structured life schedule. [17] Weekly healthy behaviour sessions in hour long classes were provided. [20] Education about modifying lifestyle. [22] Content included living a healthy lifestyle, wellness [23]	8
		Psycho-education	Psycho-education sessions including awareness of dietary habits. [2] Psycho-education of solutions of well-ness class was provided. [23]	2
		Opportunity for questions	Questions could be asked by participants about this. [15] Questions from participants were answered [16]	2
	Assessments, goal settings and other interactions	Fitness	Fitness assessment by coach [3] Monthly fitness evaluations. [7] Amount of exercise recorded. [19] Participants taught how to take their own pulse. [20] For exercise individuals were checked waist/hip ratio, educated on considering calorie consumption in activities, correct exercise performed. [22] Amount of exercise recorded for patient. [19]	5
		Weight and Diet	Periodic weight checks. Weight was undertaken daily and recorded on a wall chart. [12] Weekly weight ins [14] Assessment of food and caloric intake was undertaken. [21]	3
		Perceived exertion during exercise	Adapted physical activity educator ... recorded perceived exertion. [4] Ratings of perceived exertion monitored. [7] Information on how to stay hydrated and signs and symptoms of over exertion. [20]	3
		Goal Setting and exercise planning	SP assisted with individualised goal setting, included independent walking increasing days or minutes walked each week along with improvements in flexibility, energy level or psychiatric symptoms. [5:9] Personalised physical activity sessions were provided. [14] Goal setting using SMART goals (specific, measurable, acceptable, realistic, and timed). [15]	4
		Over-coming barriers	Study personnel assisted participants to generate solutions to barriers if needed [5:9].	2

	Hand outs of information	Calendar	Study personnel (SP) will provide calendars to cue exercise.... Calendars provided to track attendance. [5:9]	10
		Information sheet or booklet	Poster of regular stretches used. [5:9] Booklet provided to each participant of the verbal content... Booklet identified ways of overcoming common barriers such as increased fatigue, muscular soreness, finding the time to exercise, loneliness while exercising and boredom while exercising. [5:9] Written guidance given to individual for what to expect each week, which helped orient them to the program. [8] Educational materials (including how to change diet, diabetes management, types of exercise and use of activity monitors) were adapted for older adults with schizophrenia. [14] leaflet-‘What is a healthy lifestyle?’ and group education on nutrition, exercise, warming up, cooling down and pedometer. [15] Written information on how to use the pedometer was provided. [16] Information sheet regarding study and benefits for participation [18] Parent or partner asked to supervise diet at home. [19] Information sheet provided. [22] Photocopy of each module [23]	
	Contact Outside sessions	Phone call to identify session or adherence	SP will provide phone call before each WALC group [5:9] Participants received twice-daily phone calls to remind them to wear the pedometer each morning and remove it each night. [16]	3
		Exercise outside session	Fitness evaluations given on how to exercise 3*30 minutes when at home. [7] Participants were advised to exercise at the same pace on their own as they did in the sessions. Barriers to home exercise and ways to overcome barriers were discussed. [18]	2
		Enhanced ethical consideration and study detail	Individual meetings undertaken pre consent in order to review records ensure diagnostic criteria, explain study in detail and answer questions.[8] Enhanced capacity for research consent undertaken. [9] Each participant given information regarding risks/benefits of study. [20]	3
Esteem Support	Encouragement given during sessions	Verbal encouragement	‘strategies used by the exercise trainer...’-frequent encouragement [1] ‘strategies used by the exercise trainer...’- firm instructions [1] SP will provide verbal encouragement during each session... SP will verbally highlight positive physiological outcomes experienced by participants. [5:9] Individuals encouraged to follow food plan....Assistance given in each session to help individual adhere to the diet prescribed, help them improve choices and develop strategies to decrease over eating. [7] fitness coach present for exercise sessions-verbal encouragement. [17] we encouraged participants to complete 60 minutes but did not force them. [21]	5
		Reinforcing behaviour change	Positive reinforcement [11] verbal reinforcement from staff or ‘experimenter’ were provided on a regular basis. ‘social approval’ provided by staff. [12] each time an individual road on their bike they would inform staff who would note it down. [10] Weight was undertaken daily and recorded on a wall chart. If weight was loss from the previous day experimenter provided support and acceptance for individual. If weight was not loss experimenter would shake his head in a negative fashion, record weight and point out the difference. [12] Praised for weight loss. [13] weekly weight ins, pedometers, health food sampling and reinforcement based on attendance and behaviour change. [15]	8

			Exercise sessions monitored by at least one of the investigators. [19] Weekly diet and activity log was maintained. [20] keep a food and exercise diary was required motivation from discussion with professionals may have resulted. [22] When being weighed a research nurse would 'query' there exercise and dietary habits. [22] One token and a privilege was given for 3 lbs weight loss. With no weight gain no change was made, with weight increment individuals did not receive a token, were dropped a step on the privileges and did not receive verbal reinforcement. [13] Incremental reinforcement, within the first mile pedalled on the bike one token was given for every 1/10 of a mile, for the second mile pedalled on the bike one reinforcement was earned for every 2/10 of a mile and so on. [10]	
		Environmental encouragement	Music and dance were used to maintain enthusiasm for exercise sessions. [7]	1
		Role models	SP and other participants will serve as role models. [5:9] Sessions were undertaken in different forms to encourage participant including individual work, dyads, small groups and large groups. [22]	3
	Making changes within sessions	Changing equipment	Alternate equipment if they became bored or distracted [1]	1
		Change time	Exercising in the afternoon rather than the morning. [1]	1
	Encouragement outside the session	Interaction to help change behaviour	one session to discuss self-esteem and motivation with participants [2] Counselling sessions based on the transtheoretical model to promote interest in smoking reduction and increase confidence in their ability to change... Emphasis on the patients' self-efficacy to reduce smoking, to use process of change (cognitive and behavioural) and to engage in decisional balance. [4] Follow up calls if session missed participants will mark each session attended on their calendars. [5:9] SP will ask participants about exercise improvements experienced during each WALC. [5:9] SP will verbally highlight positive physiological outcomes experienced by participants. [5:9] Low fat choices at restaurants. [7] Individuals interviewed weekly about how to adhere to agreed exercise regime. [7] Individuals were encouraged to speak with the physician about diabetes management. [14] Motivational interviewing which focused on obesity and walking. Feedback from therapist re self-regulation principles and how to cope with lapse and relapse. ...Encouragement of participants to increase the minimum daily amount within 30 minutes to 5000 and 8000 per day from 3000 and 5000 if the goal was achieved. [15] motivational counselling techniques were utilised.... Participants were encouraged to keep a food and exercise diary. Participants were asked to undertake an additional 45 minutes of exercise 3 times a week at home. [17] [17] participants were encouraged to undertake an additional exercise session on their or during a home visit from a health care professional. [18]	9
		Other encouragement	pedometer given to participants [20]	1
Tangible Support	Transport	Transport to location	Participants transported to gym [1] Three individuals were provided with transport from a member of staff. [18]	2
		Tickets, vouchers or costs provided	Parking vouchers and bus tickets provided [3]	1
	Food	Removal	Removal of 'goodies' (food snacks) from family. [11]	1
		Reward	Individuals were notified that extra tea, coffee, cigarettes would be available if exercise was undertaken. [10] Participants given lunch vouchers after each training session. [20]	2

	Token/ticket system	For privileges	Paid 10 tokens for each pound loss. Tokens could be exchanged for privileges e.g., cigarettes, sweets. [11] Individuals were notified that extra tea, coffee, cigarettes would be available if exercise was undertaken. token economy program. Where tokens can be used to purchase two types of rewards: (a) meal privileges (hour at meal times to go to dining hall) (b) work privileges (two hours each morning and afternoon to attend a work assignment). Rewards could be partial (7am until 6.30 pm) or full (7am until 9.30 pm). [13] Tokens given weekly for weight loss, attendance to group meetings, participation in exercise, documentation provided by family/caregivers on adherence to exercise and diet-positive reinforcement. The tokens could be used to purchase gift items at an auction that was held on the final weight watchers week. [19]	3
		For prizes	Raffle ticket for small health related prizes given for attendance and behavioural change. [14]	1
	Rewards	Voucher/finance reward	Participants received \$20 gift card at the end of the study. [16]	1
		Other times	Participants given t-shirt and race number on race day. [20] Each received a medal. [20] Rewards were offered and included toilet paper, soap, and drinks which were sugar free. [21]	2

Key: 1 = Dodd (2010), 2 = Attux (2013), 3 = Archie (2003), 4 = Bernard (2013), 5 = Beebe (2010), 6 = Duraiswamy (2007), 7 = Centorriorion (2006), 8 = Beebe (2005), 9 = Beebe (2011), 10 = Thyer (1984), 11 = Bernard (1968), 12 = Moore (1969), 13 = Upper (1971), 14 = McKibbin (2006), 15 = Methapatara (2011), 16 = Beebe (2013), 17 = Chen (2009), 18 = Marzolini (2009), 19 = Ball (2001), 20 = Warren (2011), 21 = Wu (2008), 22 = Kwon (2006), 23 = Littrell (2003).

Table 4 The direct (d) or implied (i) benefits of physical activity from social support

Type of support	Implication (total studies [n] supporting statement, & total direct [d] and indirect [i] statements) In vivo unit from study	Implication statement & Proposed mechanism	Supporting evidence from existing reviews	Likelihood of impact (possibly, likely, or very likely)
Social support during session	<p><i>Increases attendance or adherence (n=10, d = 9, I = 4)</i></p> <p>I: the value of social support is that it was able to enhance compliance with the program [1]</p> <p>D: for some (n=2/10) individuals having no support from others to attend the exercise intervention was a reason not to go. Meaning that emotional and esteem support are important. [3]</p> <p>D: social support valued by participants and likely improved adherence [7]</p> <p>I: being an inpatient with close supervision and social support enables compliance [21]</p> <p>D: attendance, adherence and compliance were related to the positive effects of peer support [9]</p> <p>D: social support including trust and relationship severe as a motivation to initiate and maintain activity as well as comply with the sessions. [18]</p> <p>D: adherence and compliance were related to the positive effects of ... emotional ... social support [9]</p> <p>D: authors call on future research to consider how motivation to exercise can be increased identifying that strategies could include....buddy system, groups and personal trainers (emotional and esteem support). [3]</p> <p>D: motivation for attending sessions was gained by having a training partner [4]</p> <p>I: groups sessions with other peers increased self-confidence [4]</p> <p>I: social support as part of the intervention may have help contribute to the changes in Yale total activity log were noted (F = 7.09, p < 0.01) through adherence. [14]</p> <p>D: attendance, adherence and compliance were related to the positive effects of ... informational social support [9]</p> <p>D: informational support in the form of reminder calls aided compliance to the intervention. [16]</p>	<p>Having someone to go with, someone (peer or health care professional) to engage with or be supervised at the session is likely essential for adherence, attendance and compliance.</p>	<p>Social support essential for physical activity initiation [B]. Group processes and a sense of belonging can help facilitate adherence [C]</p> <p>Emotional support provides empathy, warmth and companionship [C].</p>	<p>Very likely statistically and clinically significant impact on adherence, attendance and compliance.</p>
	<p><i>Responding to needs and comfort during the session is important (n = 1, d = 0, I = 1)</i></p> <p>I: it is important to adjust the exercise intervention to increase compliance generally social support may have a role. [22]</p>	<p>A trainer/health care professional who is aware of how comfortable or uncomfortable (considering the individuals bio-psychosocial response) an individual is feeling and can respond to that and impact on adherence and continuation of exercise.</p>	<p>Wrong types of support can however increase resistance towards activity engagement, for instance, it is important not to place expectations on a patient, especially if unfit [B]</p>	<p>Possible (depending on individual variation, stage of mental illness) positive statistically significant and clinically meaningful impact on attendance and adherence</p>

		<i>Proposed mechanism:</i> an awareness of and sensitivity to ambiguous or negative stimuli (bio-psychosocial or environmental) can have a catastrophic effect on the ability to continue participation		
	<p><i>No support, need for comfort and emotional support to initiate the session (n = 5, d = 4, l = 1)</i> D: living with someone (family or carer) may help attendance then when compared to living alone (p= 0.032). [5] D: social support (group and peer) can influence ... attendance by eliminating some barriers to exercise include low motivation and perceived comfort at attending. [18] I: for some having a low comfort level (n=2/10) with attending could illustrate the importance of feeling comfortable in new setting and care needed within interventions [3] D: the community event provided positive experiences of social support and benefits the attendance and experience. [20] D: attendance ... were related to the positive effects of ... emotional ... social support [9]</p>	Being able to feel confident and comfortable to attend a new initiative without support is unlikely. Support to allow attendance is needed.	Isolation a barrier to physical activity [B] and is associated with lower physical activity level [A]	Very likely negative statistically and clinically significant impact on initiation and attendance.
		<i>Proposed mechanism:</i> there can be such significant bio-psychosocial challenges, of which isolation is central, that to overcome without support is extremely hard to achieve. Encouraging others (health care professionals, peers, family or close others) can act as a 'bridge' for attendance. Making attendance possible	Therapist who are sensitive and caring to patients, can create friendships which aids trust and adherence [B] Social cognitions (emotional perception and social knowledge) mediates a relationship between neurocognition and functional outcome [D] for instance social cue detection can significantly impact on social and work functioning [E]	
<i>Motivational techniques</i>	<p><i>Encouragement (n=7, d = 7, l = 3)</i> I: having low motivation (n=6/10) for exercise may require and benefit from esteem support.[3] I: motivation is required by individuals and social support helps an individual's motivation to initiate and maintain exercise [7] D: non responses to information support as a result of low motivation [5] D: for some (n=2/10) individuals having no support from others to attend the exercise intervention was a reason not to go. Meaning that...esteem support are important. [3] D: motivational techniques (esteem support) have resulted in high attendance (63% for 4 weeks) [5] D: to increase initiation of exercise and adherence health personnel need to provide esteem support and</p>	Motivation can be a central barrier which prevents access and maintenance to physical activity, but also prevents patients wanting to change. Verbal encouragement and enthusiasm can challenge this. It may be that individuals can go from not contemplating change to taking action following encouragement.	Esteem support provides, courage, motivation and encouragement [C]. Therapists need to provide encouragement to benefit change [B]	Very likely positive statistically and clinically significant impact on initiation, compliance, adherence and attendance.

	<p>information support as well as positive reinforcement. [8] D: attendance, adherence and compliance were related to the positive effects of esteem.....social support [9] D: Social reinforcement praise and encouragement (esteem support)promotes adherence to program. [13] D: knowledge about health diabetes may benefit from one-to-one reinforcement (esteem support) [14] I: individuals motivated to lose weight may have been receptive to types of support notably esteem support for successful weight loss. Those less motivated will likely benefit less from esteem efforts [2]</p>	<p><i>Proposed mechanism:</i> encouragement is able to overcome the effect of a-motivation and individuals can be persuaded to attend and want to change behaviour.</p>	<p>Therapist who are sensitive and caring to patients, can create friendships which aids motivation[B]. Social control and an increased sense of identity [B:G]</p>	
	<p><i>Positive verbal reinforcement (n=1, d = 1, I = 1)</i> D: Approving weight loss through social reinforcement (esteem support) when participant loss weight (35lbs in 26weeks) at the weekly weigh in, negative support (head shaking when weight was not lost). [12] I: Approving weight loss through social reinforcement (esteem support) promotes adherence and contributed to the participant loss weight (35lbs in 26weeks) [12]</p>	<p>In early research social reinforcement identified change in case studies of individuals.</p>		<p>Possible (depending on individual variation, stage of mental illness) positive statistically significant and clinically meaningful impact on attendance and adherence</p>
		<p><i>Proposed mechanism:</i> patients may want to please others and gain praise for successfully completing a challenge.</p>	<p>Companionship and a want to please others through a changing identity [B:G]</p>	
<i>Informational support</i>	<p>Knowledge of benefits (n = 2, d = 3, I = 0) D: knowledge about health diabetes may benefit from information (informational support) [14] D: informational social support as part of the intervention may have help contribute to the increase in diabetes knowledge (F = 18.2, p < 0.01) [14] D: informational support was valued from study personal. [4]</p>	<p>Understanding the multiple values and importance of exercise is essential to change attitudes and motivation to change behavior</p>	<p>Informational support can help facilitate changes in behaviour and lifestyle [C].</p>	<p>Possible positive statistically significant and clinically meaning change in behaviour</p>
		<p><i>Proposed mechanism:</i> information empowers the patient to want to change for the identified benefit or gain.</p>	<p>Participation enhanced by informing an individual; who is leading the sessions, what to expect in the session (environment, context, safety), and possible benefits of participation [B]. Mastery experiences generated as a result [G]</p>	

Tangible support or reinforcement	<p>Reward systems (n=6, d = 6, l = 0)</p> <p>D: A token system (tangible support) for privileges promotes adherence to program. [13]</p> <p>D: authors call on future research to consider how motivation to exercise can be increased identifying that strategies could include rewards (tangible support) [3]</p> <p>D: transport support (tangible support) e.g., city bus passes and information support (phone calls and written letters) supported the attendance. [5]</p> <p>D: Social support through reinforcement (tangible support) resulted in weight loss of 102 pound over 6 months (20%) [11]</p> <p>D: transport provided a significant barrier to attendance (when giving reasons for non attendance was represented by 60% of answers) – lack of tangible support may need addressing when considering transport needs. [5]</p> <p>D: transport (tangible support) acted as a barrier against participation (n= 14 or 22% of individuals who reported non-attendance) [9]</p>	Tangible rewards can remove and impact on the transport barriers for those who have little disposable income. Rewards for exercising may motivate.	Tangible support can aid adherence and motivation and 'kick start' behaviour change [C]	Possible impact statistically and clinically on attendance as well as bio-psychosocial benefits
		<i>Proposed mechanism:</i> The gain of tangible support may remove a barrier to attendance. The perceived value and gain of a reward may be greater than the cost of not exercising.	Acts against the financial and transport barriers [C]	
Physiological Outcomes	<p><i>Body weight, BMI and percentage of fat (n = 12, d = 13, l = 5)</i></p> <p>D: social support valued by participants ...and impacted on results (significant decreases in body weight $\approx 6\%$ [t = 4, P=0.001] and blood pressure $\approx 11\%$ [t = 4, P=0.0008]). [7]</p> <p>D: social support may have explained small benefits (...decrease of percentage fat 0.02%) in control group, esteem and information support gained from peer interaction. [8]</p> <p>D: Social reinforcement praise and encouragement (esteem support) as well as a token system (tangible support) for privileges aided weight loss (63 lbs in 28 weeks and 61 lbs in 26 weeks) [13]</p> <p>I: social support as part of the intervention may have help contribute to the observed benefits reductions in weight (F = 15, p < 0.01). [14]</p> <p>D: Behavior element of the program responsible for benefits in weight (t = -2.3, P = 0.03) reductions compared to control. Therefore social reinforcement, positive reinforcement or/and esteem and emotional support support may have a role in aiding weight loss. [15]</p> <p>D: motivational interviewing which included elements of social support (esteem support) aids success of the program e.g., benefits in weight (t = -2.3, P = 0.03) reductions compared to control. [15]</p> <p>D: esteem support is important for a weight control intervention and producing results: Significant weight reduction in all subjects (from 77.9 kg to 76.6 kg, t = 2.6, p = 0.014). [17]</p> <p>I: social support and group setting of program may aid benefits including weight loss e.g., median weight loss for 7 males was 7 pounds (F=5, P < 0.05). [19]</p> <p>D: informational support will help provide individuals with strategies to manage the weight gain. [19]</p> <p>I: being an inpatient with close supervision and social support enables benefits e.g., significant decrease in weight (p<0.001). [21]</p> <p>I: the value of social support is that it could have led ...weight reduction [1]</p> <p>D: informational support helps prevent significant weight gain [23]</p> <p>D: peer support can help transfer informational and aid weight maintenance [23]</p> <p>D: social support through verbal reinforcement (esteem support) produces changes in physical activity levels. [10]</p> <p>D: Social support through encouragement (esteem support) resulted in weight loss of 102 pound over 6 months (20%) [11]</p> <p>D: tangible support in the form of food incentives may not have worked to benefit weight loss (median difference at 0 and 10 weeks = -0.1kg, IQR: 2.5) and 3 gained over 7kg. [20]</p>	An interactional effect of different forms of social support (see above) will likely impact on the success and ability to achieve weight loss		Very likely positive impact statistically and clinically on weight
		<i>Proposed mechanism:</i> combined effect of different types of functional and structural support combine to provide a positive impact on the patients weight (primary outcome used in many studies)	Mastery and a sense of control generated [C:G] increases likelihood of a positive outcome	

	<p><i>Increases in fitness (n= 2, d = 1, l = 1)</i> I: the value of social support is that could have led do physiological improvements documents including increases in 6-minute walk test. [1] D: social support may have explained small benefits (6 minute walk distance, increase in 56 feet) [8]</p>	An interactional effect of different forms of social support (see above) will possibly impact on the success and ability to achieve weight loss		Possible positive impact statistically and clinically on fitness based parameters
		<i>Proposed mechanism:</i> combined effect of different types of functional and structural support combine to provide a positive impact on the patients weight (primary outcome used in many studies)	Mastery and a sense of control generated [C:G] increases likelihood of a positive outcome	
Psychological improvements	<p><i>Psychological gain (n = 1, d = 0, l = 3)</i> I: social support as part of the intervention may have help contribute to the... increase in self-efficacy [14] I: social support as part of the intervention may have help contribute to... dis-satisfaction and change (F = 9.1, P < 0.01).[14] I: informational social support as part of the intervention may have help contribute to setting and achieving goals (F = 9.8, p < 0.001) [14]</p>	Social support can impact on a patients satisfaction, self-belief and satisfaction with exercise. The impact can translate to other aspects of life	Social support can help increase social confidence [B,C]	Likely positive impact statistically and clinically on self-esteem and social confidence
		<i>Proposed mechanism:</i> successful experiences provide a source of self-confidence and self-belief for patients	Mastery and a sense of control generated [C:G] increases self-esteem and self-belief	
	<p><i>Acts against psychological barriers and enhances behavior change (n = 4, d = 2, l = 2)</i> I: social support as part of the intervention can be effective against psychosocial barriers [4] D: social support (group and peer) can influence participationby eliminating some barriers to exercise include low motivation and perceived comfort at attending. [18] I: social support as part of the intervention may have help contribute to ... managing psychosocial aspects (F = 9.6, p < 0.01) [14] D: informational support helps ... behavior change. [23]</p>	Implication: Individuals are vulnerable to psychosocial barrier such as cognitions and negative meta-perceptions or perceived stigma.	Trust and relationships with peers [C] and health care professionals [B] can help overcome barriers. Peer support can provide access positive role models [F]	Very likely positive impact statistically and clinically on attendance, compliance and adherence
		<i>Proposed mechanism:</i> Social support acts to buffer and prevent negative self and interaction assessments and thoughts	Belongingness, distraction and companionship [B;G] help attendance, compliance and adherence	
	<p><i>Reduces symptoms (n=1, d= 1, l = 0)</i> D: simple informational support is effective in supporting the uptake and use of yoga, therefore contributes to the effectiveness of the intervention (reduction in positive and negative symptom scale, F = 5.0, P = 0.03) [6]</p>	Social support can help decrease positive and negative symptoms		Possible positive impact statistically and clinically on positive and negative symptoms
		<i>Proposed mechanism:</i> social support may provide a distraction to the illness or simply access to more normal thoughts	Social control, belonging and developing an identity as well as distraction [B:G].	

			Sense of mastery and control [G]	
	<i>Quality of life (n=2, d = 1, l = 1)</i> D: social support generally could be responsible for improvements in quality of life: WHO brief quality of life scale (pre score 76±13 to 84±19, p = 0.003) observed. [17] I: weight management program and social support or interaction can improve quality of life [22]	Social support can improve quality of life through the varied types of functional and structural support		Possible positive impact statistically and clinically on quality of life
		<i>Proposed mechanism:</i> Improved functioning promotes access to a more 'normalised' existence and positive experiences.		

Key: Studies by Number: 1 = Dodd (2010), 2 = Attux (2013), 3 = Archie (2003), 4 = Bernard (2013), 5 = Beebe (2010), 6 = Duraiswamy (2007), 7 = Centorrión (2006), 8 = Beebe (2005), 9 = Beebe (2011), 10 = Thyer (1984), 11 = Bernard (1968), 12 = Moore (1969), 13 = Upper (1971), 14 = McKibbin (2006), 15 = Methapatara (2011), 16 = Beebe (2013), 17 = Chen (2009), 18 = Marzolini (2009), 19 = Ball (2001), 20 = Warren (2011), 21 = Wu (2008), 22 = Kwon (2006), 23 = Littrell (2003). Review support by letter = A = Vancampfort et al (2012), B = Soundy et al (2012), C = Soundy et al (2014), D = Schmidt et al (2011), E = Mancuso et al (2011), F = Davidson et al (2012), G = Thoits (2011).

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