Relationship between physical self-perceptions and body composition following a 10 week exercise program for previously sedentary participants

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The aim of the present study was to investigate whether body composition and engagement in an exercise program influenced participants' physical self-perceptions. The study consisted of 92 participants, 40 males and 52 females; with an average age of 31.9 ± 9.37 years. The Physical Self-Perception Profile was used to assess physical self-perceptions (PSPP; Fox & Corbin, 1989). Body fat percentage was measured using a bioelectrical impedance analyser (RJL systems, Detroit). In addition, height, weight, BMI and WHR was assessed. The study consisted of an exercise intervention group (N = 72) and a control group (N = 20). Participants in the intervention group attended public gyms in North-west London. Measurements were taken at the induction session and after a 10 week intervention period. All participants were provided with an individual training program which followed the ACSM guidelines. Adherence was assessed by means of an electronic entry card to the gym facilities and a self-report measure. For statistical analysis the participants in the exercise group were categorised as either adherers (> 30 sessions; N = 35), and non-adherers (< 30 sessions; N = 26). Repeated measures analysis of variance [3 (adherers, non-adherers, control) x 2 (pre-, post-test)] and follow-up post-hoc comparisons showed that the adherers had a significant decrease in % body fat and BMI and a significant increase on the body, condition and strength subscales of the PSPP from pre- to the post-test. Additionally, correlational analysis for the change in the dependent variables from pre- to post-test showed only significant correlations for the adherers. The participants who adhered to the exercise program showed significant changes in their body composition in terms of a decrease in % body fat and BMI and this change was associated with perceiving oneself in better physical condition, and stronger. They were also more satisfied with their physique. These findings partially support Fox's (1997) intervention hypothesis in that engaging in regular physical exercise and its associated physical changes can positively alter participants' physical self-perceptions.

Introduction

In western society and culture the search for physical attractiveness has never been considered so important. The mass media's portrayal of body ideals, applying equally to both men and women, demand tautness, muscularity, visibly good health and not a blemish in sight (Pfister, 1995). The influence of these idealised body shapes has been associated with self-imposed pressure on individuals (Hills, 1990) to lose weight, deeming being fat and unfit as sociably unacceptable (Fallon, 1990). These societal expectations have a major influence on individuals' psycho-social adjustment (Desmond, Price, Gray & O'Connell, 1986). The greater emphasis on body shape and weight resulted in a shift of self-perceptions towards aspiring for a more slender appearance for women (Cash, 1990) and a more muscular one for men (Frederick, Fessler & Haselton, 2005).

With 95% of diets failing (Miller, Koceja & Hamilton, 1997), physical activity and exercise has grown to be a popular means of weight control and body sculpting (Willis & Campbell, 1992). Under the influence of numerous celebrity role models and sports stars, the population has built an obsession with fitness, clearly visible through the significant increase in gym memberships (Timperio, Cameron-Smith, Burns, Salmon & Crawford, 2000). A socially acceptable and cross-culturally promoted pass-time, exercise has been used by approximately 90% of those trying to control or adjust their body shape and size (Serdula, Williamson, Anda, Heaton & Byers, 1994).

The body and aspects of appearance, in this respect, are associated with global self-esteem (Fox, 1997). These physical and global self-esteem perceptions in turn have been shown to be import indicators of psychological well-being (Fox, 1998). In a recent review of the literature Fox (2000) found that 78% of RCT studies showed positive changes in self-esteem or self-concept through exercise participation. However, few studies have specifically focussed on the influence of exercise on changes in physical self-perceptions. In addition, most studies on this issue have been cross-sectional in nature. Such studies have established an association between physical self-perceptions and levels of exercise (e.g., Lindwall & Hassmen, 2004) but did not explore the possible causal mechanisms.

Studies investigating the relationship between physical self-perceptions and exercise behaviours longitudinally have shown mixed results. For example, Caruso and Gill (1992) did not find any changes in physical self-perceptions in male and female undergraduate students following a ten week exercise programme. Similar results were obtained by Aşçi, Kin and Koşar (1998) for an 8 week dance intervention program in Turkish undergraduates. In a more recent study, on the other hand, Lindwall and Lindgren (2005) showed changes in physical self-perceptions following a 6 months exercise intervention programme in adolescent Swedish girls. In addition, Aşçi (2003) found improvements in several aspects of the physical self following a 10 week physical fitness programme.

Explanations for the equivocal results obtained to date have been, design issues, lack of control groups, different intervention programs and the ceiling effect (e.g., Lindwall & Lindgren, 2005). With regard to the latter, improvements in physical self-perceptions are most likely to occur in participants initially with low scores at the start of the intervention (Fox, 2000).

Harter (1985) competence motivation theory suggests that physical self-perceptions could also be a strong motive for starting and maintaining a regular exercise regime. In particular, perceptions of physical competence have been shown to be predictors of effort and interest in sport and exercise (e.g., Crocker, Eklund, & Kowalski, 2000). Harter (1986) also highlighted that the importance placed on aspects like competence has a strong influence on subsequent behaviours and self-perceptions.

It is now well accepted that the self is a hierarchical and multidimensional concept in nature (Shavelson et al., 1976). Based on this assumption Fox and Corbin (1989) developed a psychometric instrument to assess physical self perceptions. The Physical Self-Perception Profile (PSPP) measures four sub-domains: sport competence (Sport), physical condition (Condition), bodily attractiveness (Body) and physical strength (Strength). In addition, it also assesses the more global construct of physical self worth (PSW) and perceptions of importance of the physical body to the overall self (Perceived Importance Profile (PIP). Studies using the PSPP have found that women tend to score lower on all sub-domains than men (Fox and Corbin, 1989).

It has been suggested that changes in fitness or body shape and size are not a prerequisite for increases in physical self-perceptions through exercise. Such an assumption would indicate that changes are more likely to be psychological in nature (Fox, 2000). However, studies have often not measured aspects of physical fitness or body composition. For example, Vaccero, and Clinton (1981) observed an increase in percentage body fat (from 26.6 to 27.2%) following a dance programme consisting of three, 45 minute sessions for 10 weeks. The non-significant changes in physical self-perceptions found by the previously mentioned study by Aşçi, Kin and Koşar (1998) could be explained by such an observation. On the other hand, it may actually be that the knowledge that regular physical exercise can decrease body fat and increase lean mass result in people perceiving morphological change despite little occurring.

In summary, the physical self is not only an important contributor to overall perceptions of self-worth, it is also related to health behaviour (Fox, 2002). Fox's (1997) 'intervention hypothesis', in this respect, suggests that participation in an exercise programme would potentially influence global self-perceptions. The aim of the present study was to investigate whether body composition and engagement in an exercise program influenced participants' physical self-perceptions.

Method

Participants

The study consisted of 92 participants, 40 males and 52 females (average age 31.9 ± 9.37 years). The main inclusion criterion for this study was that participants had to be sedentary for at least 6 months before commencement of the study. 72 participants were recruited to the experimental condition during inductions periods in public gyms. In addition, another 20 participants were recruited to act as a control group. The main inclusion criterion for this control group was that they did not participate in sport or exercise prior to the start of the study and were unlikely to do so during a 10 week intervention period. The study was approved by the University ethical committee and written consent was provided by all participants.

Apparatus

The Physical Self Perception Profile (PSPP) measures multidimensional aspects of the physical self (Fox & Corbin, 1989; Fox, 1990). It consists of 30 structured alternative questions. Two statements are made per item and the participant has to indicate which is more like them. Additionally, they indicate how true this statement is for them by answering either 'sort of true for me' or 'really true for me'. The PSPP has 5 factors (Sport, Body, Strength, Condition, Physical Self-Worth) with each factor consisting of 6 items. Within each subscale half the items are worded such that the first part of the statement reflects high competence and the other half are worded that the first part of the statement reflects low competence. The PSPP is accompanied by an 8-item Perceived Importance Profile (PIP) for the factors: Sport, Body, Strength and Condition. Adequate reliability (Cronbach alpha's between 0.70 and 0.92) and validity has been reported for the PSPP (Fox & Corbin, 1989).

Following completion of the PSPP and PIP participants' body fat percentage was measured using a bioelectrical impedance analyser (BIA) (RJL systems, Detroit). The BIA method of assessing body composition in adults is based on the notion of a high correlation between an adult's fat-free mass and the body's electrical resistance (Hoffer, Meador, & Simpson, 1969). The level of body fat is directly related to the flow of electricity. Impedance of the body is converted into body density, which in turn was converted into percentage body fat using the Siri equation. For the BIA participants were asked to lie in a supine position on a non-conductive surface with legs abducted, so that their thighs did not touch. Arms were also slightly abducted ensuring no contact with the torso. Aluminium foil spot electrodes were placed on the dorsal surfaces of the right hand and right foot at the metacarpals and metatarsals, respectively. Detector electrodes were placed at the right pisiform prominence of the wrist and between the medial and lateral melleoli at the ankle according to the manufacturers specifications. Due to the BIA being related to the length of the conductor, proper placement of the reference electrodes was paramount (Shell & Gross, 1987). Calibration with a 500-ohm resistance provided by the manufacturer preceded all testing. The analyser used different equations for males and females.

Height was measured using a portable stadiometer. Participants were asked to stand barefoot on a horizontal surface with heels together. It was checked that their back would be straight as possible with the buttock, shoulder blades and back of the head in contact with the pole of the stadiometer (Seca, 220 Stadiometer, Birmingham). Participants then were asked to 'look straight ahead' and to 'stand up tall'. Then the stadiometer's ruler was horizontally placed on their heads. Measurements were taken to the nearest millimetre using a portable, direct reading stadiometer. Using a digital scale (Soehnle scale with digital display), participants were measured in t-shirts and shorts, without shoes to the nearest 100 g. The same scale was used to measure all participants and they were checked for calibration and buttery each time before use. The scale was based on a solid supporting surface in the gyms. Based on height and weight participants BMI was calculated (BMI is a ratio of body weight and height squared (kg/m^2), where body weight is measured in kilograms and the height is in meters).

The waist-to-hip ratio was calculated from circumference measurements (WHR, waist circumference divided by hip circumference). Waist circumference was measured in centimetres at the narrowest part of torso, level of the 'natural' waist between ribs and iliac crest. Hip circumferences were measured at the maximum posterior extension of buttocks, by applying the tape around the abdomen at level of greatest anterior protuberance (Heyward & Stolarczyk, 1996). Waist and hip measurements were taken twice to the nearest 0.1cm using a measuring tape, while the participants remained in their t-shirts and shorts.

Procedure

The study consisted of an exercise intervention group (N = 72) and a control group (N = 20). Participants in the intervention group attended public gyms in North-west London. During a compulsory induction session to the gym, new members were offered the opportunity to participate in the study.

After completing consent forms, measurements where taken following the participants' induction session and after a 10 week period. All participants where provided with an individual training program which followed ACSM guidelines. The programme required participants to engage in exercise 3-5 times per week. They had to train all their major muscle groups, by completing 1-3 sets of 8-12 repetitions resistance exercise. This investigation attempted to identify changes in self-perceptions within a normal fitness environment. Therefore participants were asked to follow the prescribed programme own their own like other gym users. The second assessment took place after a 10 week period prior to a regular visit to the gym. Adherence was assessed by means of an electronic entry card to the gym facilities and a self-report measure.

Statistical Analysis

For statistical analysis the participants in the exercise group where categorised as either adherers (> 30 sessions; N = 35), and non-adherers (< 30 sessions; N = 26). Repeated measures analysis of variance [3 (adherers, non-adherers, control) x 2 (pre-, post-test)] and follow-up post-hoc comparisons (Fisher LSD) were conducted to detect changes in the participants' physical self-perceptions and body composition. In addition, correlations were calculated for the change in the dependent variables from pre-to post tests. Finally, a linear regression analysis was conducted to establish the relationship between attendance and changes in body composition and physical self-perceptions.

Results

Table 1 provides the mean scores for the different groups at the pre-test and the post-test whereas table 2 shows the results of the repeated measures analysis of variance. Post-hoc comparisons for the interaction effects for percentage body fat and BMI showed that only the adherers lowered their %fat and their BMI significantly. Similarly, the adherers showed a significant increase in their rating of their body and strength from pre- to post-test whereas no changes were observed in the non-adherers or controls. The post-hoc comparisons for the body importance interaction showed that the adherers showed a decrease in this variable whereas the controls showed a significant increase. The time main effects for sport, condition, PSW, sport importance and condition importance showed an increase for all these variables whereas a decrease was observed for WHR.

The correlational analysis for the change in the dependent variables from pre- to post-test showed significant correlations for the adherers between change in % body fat and the body subscale of the PSPP ($r = 0.34$, $p = 0.04$). Also, change in the WHR was associated with the sport ($r = 0.40$; $p = 0.02$), body ($r = 0.43$; $p = 0.01$ and strength ($r = 0.57$; $p < 0.001$) subscales. No significant correlations where obtained for the non-adherers and controls.

The linear regression for the number of sessions in attendance and changes in the anthropometric variables and subscales of the PSPP was highly significant ($F(8,80) = 5.55$; $P < 0.01$; $R = 0.62$; $R^2 = 0.38$). The more sessions attended by participants the greater the decrease in percentage fat (beta = -2.03; P = 0.03) and the larger the increase on the body (beta = 2.01; P = 0.03) and strength (beta = 2.06; P = 0.04) subscales of the PSPP.

Discussion

The main aim of this study was to investigate whether body composition and engagement in an exercise program influenced participants' physical self-perceptions. Participants who were classified as adherers showed a significant decrease in their BMI and their body fat percentage. In addition, body and strength subscale scores increased significantly in this group from pre- to post-test. The decrease in percentage body fat was correlated with the body subscale whereas the decrease in WHR was associated with the sport, body and strength dimensions. No changes were observed in the non-adherers or control conditions.

Of the 72 participants who started the training programme 49% attended the gym on more than 30 occasions during the 10 week intervention period. It is well documented in the literature that approximately 50% of participants drop-out or do not adhere sufficiently to exercise programmes to get the physiological and psychological benefits (Dishman, 1983). In addition, no initial differences were observed for any of the anthropometric variables or scales of the PSPP and PIP.

Prior to the training program the adherers showed increased levels of body fat and higher BMI scores than the non-adherers and control participants. Such an observation could indicate that adheres were in need of more exercise and would have benefited most from regular participation. The adheres subsequently showed a significant decrease in their body fat percentage and BMI. Although this study did not control for exercise duration and intensity the present findings suggest that regular participation in exercise results in significant alterations in body composition. This finding was supported by the regression analysis which indicated that the more sessions the participants attended to the larger the decrease in their fat percentage was. Similar findings have been observed in training studies in which participants required attendance on at least 3 occasions per week (e.g., Wilmore et al., 1999). It should be noted, however, that the change in body composition can not just be attributed to regular gym sessions. It might well be that the regular exercise was accompanied by a changed in daily physical activity patterns and dietary intake resulting in a negative calorie balance.

The study also showed that regular participation in exercise in a gym setting improved physical self-perceptions. In particular, improvements were observed for the body and strength sub-domains and to a lesser extent the condition sub-domain for those who engaged in regular exercise. Such a finding would provide tentative support to the positive effects of regular exercise on physical self-perceptions. The regression analysis, in this respect, indicated that more frequent visits resulted in larger improvements in perceptions of strength and body attractiveness. Studies to date have mainly found that the condition, strength and PSW domains are most susceptible to change through exercise whereas body attractiveness remains relatively unaffected (Fox, 1997 & 1998). A possible explanation for the body self-perception improvements might be related to participation motives. Many of the participants in this study indicated at the start of the programme that an important reason for joining a gym was to lose weight and improve body shape. The fact that strength and to a lesser extent condition improved can be explained by the type of activities people engage in when exercising in a gym environment.

The results for interventions studies on physical self-perceptions have been equivocal. Improvements in physical self-perceptions, in this respect, might be dependent on certain prerequisites. First, the baseline values were comparable with those obtained in sedentary adolescent Swedish girls (Lindwall & Lindgren, 2005) and indicated significant scope for further improvements (no ceiling effect). Second, the type of intervention (exercise in a gym environment) appears to be more conducive to change in perceptions than, for example, dance classes or regular physical education (e.g., Aşçi, Kin & Koşar, 1998; Caruso & Gill, 1992). Thirdly, studies have differed greatly in duration of the intervention period and the number and duration of sessions in this period. Finally, some studies failed to incorporate appropriate control conditions.

The significant interaction effect for the perceived body importance indicted that adherers scored significantly lower in the post test in comparison to baseline. The participants in the control condition on the other hand scored higher in the post-test than in the pre-test. This observed decrease in perceived importance for body in the adherers is an encouraging one. Exercising for external motives like body appearance is not conducive to long-term adherence and well-being. Placing less emphasis on the body and engaging in activities for intrinsic reasons, on the other hand, would result in maintenance of this kind of behaviour. No apparent reason is forthcoming why the control condition showed a significant increase for this variable.

The present study found moderate to high associations between changes in body compositions and improvements in physical self-perceptions. That is, for the adherers a decrease in body fat percentage was related to higher scores on the body sub-domain. Similarly, decreases in their WHR were related to increases on the sport, body and strength domains. No significant relationships were found for the non-adherers and control conditions between body composition variables and physical self-perceptions. Although correlational analysis can not establish causation, these findings would suggest that changes in physical self-perceptions are not purely based on psychological mechanisms as proposed by Fox (2000). Future, research is needed to assess the variance explained by physiological and/or anthropometrical variables and psycho-social factors.

A limitation of the present study was that we did not control for exercise duration and intensity. However, a more controlled environment and prescriptive exercise regime might have adverse effects of feelings of autonomy in participants resulting in drop-out (e.g., Deci & Ryan, 2002). Secondly, in future research it would be desirable to also assess participants' fitness and possible psycho-social factors which could influence physical self-perceptions. Thirdly, the results are limited to the population (previously non-active, public gym users) and activities executed (e.g. weight lifting, and using the exercise bike). Finally, the intervention period was relatively short (10 weeks). Improvements in body composition and fitness take some time to come to the fore. In addition it might well be that changes in self-perceptions are more likely to happen over a longer time period.

The findings of the present study partially support Fox's (1997) 'intervention hypothesis' in that engaging in regular physical exercise and its associated physical changes can positively alter participants' physical self-perceptions. From an applied perspective, regular exercise not only results in improved body composition (and fitness) but also enhanced physical self-perceptions. More positive physical self-perceptions on its turn have been shown to be associated with positive affect and life adjustment (Sonstroem, 1996). To this end, the current findings support the growing evidence that regular exercise has significant influence on our psychological well-being.

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Table 1. Mean scores for the adherers, non-adherers and control groups for the dependent variables.

	Adherers		Non-Adherers		Control	
	Pre	Post	Pre	Post	Pre	Post
% Fat	28.76	26.98	27.34	26.50	23.60	24.37
BMI	26.22	25.47	25.49	25.08	23.91	24.44
WHR	0.793	0.787	0.775	0.772	0.790	0.789
Sport	13.91	14.37	13.31	13.42	14.75	15.45
Condition	13.89	15.23	12.85	13.50	14.95	15.05
Body	13.09	14.74	13.04	13.23	14.50	14.75
Strength	13.94	14.89	13.19	13.08	14.10	13.70
PSW	13.80	14.77	13.42	14.15	15.35	15.15
Sport PIP	4.66	4.94	4.00	4.31	5.05	5.10
Condition PIP	4.91	5.31	4.65	4.92	5.15	5.60
Body PIP	5.26	4.83	4.32	4.15	4.15	5.45
Strength PIP	4.31	4.40	3.73	3.77	4.40	4.55

Table 2. Results of the repeated measures analysis of variance for the dependent variables.

	Condition main effect F(2,78)	Time main effect F(1,78)	Interaction F(2,78)
% Fat	F = 1.77; P = 0.18	F = 5.38; P = 0.02*	F = 7.72; P < 0.01**
BMI	F= 1.19; P = 0.31	F = 1.40; P = 0.24	F = 4.38; P = 0.02*
WHR	F = 0.53; P = 0.59	F = 6.16; P = 0.01*	F = 1.91; P = 0.16
Sport	F = 1.51; P = 0.23	F = 4.22; P = 0.04*	F = 0.61; P = 0.54

Condition	F = 2.87; P = 0.06	F = 9.65; P < 0.01**	F = 2.65; P = 0.07
Body	F = 1.51; P = 0.23	F = 8.08; P < 0.01**	F = 4.42; P = 0.02
Strength	F = 1.43; P = 0.25	F = 0.43; P = 0.51	F = 3.98; P = 0.02
PSW	F = 2.06; P = 0.13	F = 4.38; P = 0.04*	F = 2.05; P = 0.14
Sport PIP	F = 2.40; P = 0.10	F = 6.05; P = 0.02	F = 0.78; P = 0.46
Condition PIP	F = 1.82; P = 0.17	F = 10.92; P < 0.01**	F = 0.22; P = 0.81
Body PIP	F = 7.72; P < 0.01**	F = 2.81; P = 0.10	F = 12.85; P < 0.01**
Strength PIP	F = 2.27; P = 0.11	F = 0.68; P = 0.41	F = 0.07; P = 0.93