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The levels and predictors of physical activity engagement within the treatment seeking transgender population: A matched control study

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Abstract

Background: Physical activity has been found to alleviate mental health problems and could be beneficial for at-risk populations, such as transgender people. This study had three aims. First, to explore the amount of physical activity that treatment seeking transgender people engage in, and to compare this to matched cisgender people. Second, to determine whether there was a difference in physical activity depending on cross-sex hormone use. Third, to determine factors which predict physical activity among treatment seeking transgender people.

Method: Transgender (n=360) and cisgender people (n=314) were recruited from the UK. Participants were asked to complete questionnaires about physical activity, symptoms of anxiety and depression, self-esteem, body satisfaction and transphobia.

Results: Transgender people engaged in less physical activity than cisgender people. Transgender people who were on cross-sex hormones engaged in more physical activity than transgender people who were not. In transgender people on cross-sex hormones, high body satisfaction was the best statistical predictor of physical activity while high self-esteem was the best statistical predictor in people who were not.

Conclusion: Transgender people are less active than cisgender people. Cross-sex hormone treatment appears to be able to indirectly increase physical activity within this population, which may be beneficial for mental well-being.

Introduction

Physical activity is defined as any activity (e.g., while working, playing, carrying out household chores and recreational pursuits) that involves muscular-skeletal movement and energy expenditure.[1] In 2010, 23% of adults around the world were not active enough,[1] highlighting that inactivity represents a global public health problem. Globally, engaging in insufficient physical activity is the fourth leading risk factor for non-communicable diseases (e.g., cancer, diabetes, cardiovascular disease),[1] which accounted for approximately 5.3 million deaths globally in 2008.[2] Physical activity has also been found to alleviate mental health problems, particularly depression and anxiety.[3-7] In light of this, physical activity may be beneficial for populations that are vulnerable to mental health problems.

One of these vulnerable populations is transgender people who experience incongruence between their sex assigned at birth and their gender identity. Transgender women are those assigned male at birth but who identify as female. Transgender men are those assigned female at birth but who identify as male. Some people may identify outside the binary gender system (e.g., gender neutral, non-gender, gender queer) or be more fluid in their gender identity (i.e., a person whose gender identity varies over time).[8] Cisgender people do not experience such gender incongruence.[8] The majority of transgender people will choose to socially transition (i.e., present as their gender identity at work, with friends and family) and many will choose to undergo a medical transition. This may include cross-sex hormone treatment (oestrogen for transgender females/non-binary and testosterone for transgender males/non-binary), mastectomy (transgender males/non-binary), breast augmentation (transgender females/non-binary), and surgery to create male or female genitalia depending on gender identity. However, it is important to point out that not every transgender person will wish to undergo a medical transition and that some individuals may only wish to undergo a partial medical transition (i.e., cross-sex hormones and no surgery).[9]

Mental health problems such as depression, anxiety, and self-harm have been found to be particularly prevalent in transgender people[10-18] and therefore physical activity may be a useful coping mechanism. In addition to this, engaging in frequent physical activity may help transgender people reach a suitable Body Mass Index required for gender confirming surgery (if this is what the person wishes). Although research is inconclusive, it has shown cross-sex hormone treatment may put transgender females at risk of cardiovascular disease and may make transgender males more susceptible to risk factors associated with cardiovascular disease.[19] For this reason, frequent physical activity engagement is essential to maintain heart health. Transgender males have also discussed being motivated to increase muscle mass on the upper torso through engaging in frequent weight training to enhance surgical outcomes post-mastectomy.[20] However, there is a lack of research that has explored levels of physical activity among transgender people and therefore it is unknown as to whether engaging in physical activity would be feasible among this population.

A systematic review concluded that the majority of transgender people have a negative experience when engaging in physical activity.[21] This is supported by a recent qualitative study[20] which found that a range of external factors, such as changing rooms, sport-related clothing and discrimination, and stigmatisation and prejudice on the basis of gender identity (transphobia), all discouraged transgender people from engaging in physical activity. Gender incongruence and body dissatisfaction were also identified as barriers to physical activity engagement.[20] Based on this knowledge, it is likely that levels of physical activity are low among the transgender population and therefore research should focus on identifying ways to increase activity levels in these individuals in light of the known mental health benefits.[3]

The only quantitative study to explore the amount of physical activity transgender people engage in supports this suggestion, as transgender people were found to engage in less physical activity then cisgender people.[22] This study recruited 47 cisgender people and

compared them with 33 (non-matched) transgender people. Although the study is of interest, the lack of matching between the two groups for age and gender (variables known to affect levels of physical activity[1,23]) limits the impact of its findings. In addition, there was a lack of information regarding the transgender participants' stage of medical transition (i.e., whether they were on cross-sex hormone treatment). Research has shown that cross-sex hormone treatment, which helps the person's body to align with their gender identity (either by the development of breasts for transgender females or by an increase in muscle mass and lowering of voice for transgender males), increases mental well-being in the transgender population.[11,24-27] This information is of significance when exploring physical activity within the transgender population as cisgender people with better mental health have been found to engage in more physical activity compared to people with poorer mental health. [5,28,29]

Although the studies discussed above have suggested that levels of physical activity are low among transgender people and have identified potential barriers to engaging in physical activity, they are limited by their qualitative nature, which means that findings cannot be generalised and interventions cannot be developed,[21] or by the small number of participants, lack of matching and lack of information about stage of transition.[22] Quantitatively understanding whether there is a physical activity inequality between cisgender and transgender people, as well as understanding factors that are associated with physical activity in the transgender population, is essential in order that specific initiatives to increase physical activity can be developed for this population.

Taking into consideration the limitations of previous studies, this study has three main aims. First, to explore the amount of physical activity that treatment seeking transgender people engage in, and to compare this to cisgender people matched for age and gender. Second, in light of the positive psychological benefits that cross-sex hormones can have on mental well-being in the transgender population[24] this study also aims to determine whether there is a

difference in physical activity levels between people who are and are not on cross-sex hormone treatment as well as to determine whether levels of physical activity in people who are on cross-sex hormone treatment are comparable to cisgender people, when age and gender are controlled for. Finally, this study aims to determine factors which predict physical activity participation in transgender individuals. This will be explored for the whole group of transgender participants and also for people who are and are not on cross-sex hormone treatment, separately. Factors which have previously been found to predict physical activity in the cisgender population will be explored as potential statistical predictors, such as younger age and male gender,[1,23] low anxiety and depression levels,[3,5] high body satisfaction[28,30] and high self-esteem.[29,31,32] Transphobia has been found to be a predisposing factor to high levels of anxiety, depression and low self-esteem[33,34] and has been identified as a barrier to physical activity in the transgender population.[21,31] Hence, transphobia will also be explored as a potential statistical predictor of physical activity.

First, it was hypothesised that treatment seeking transgender people would engage in less physical activity than cisgender people. Second, it was hypothesised that levels of physical activity would be greater in the group that were on cross-sex hormone treatment (compared to those who were not) and that this would be comparable to cisgender people's physical activity levels. Finally, it was hypothesised that younger age, male gender identity, lower levels of anxiety, lower levels of anxiety, lower levels of depression, high body satisfaction, high self-esteem, and fewer experiences of transphobia would predict greater physical activity engagement.

Methods

Participants and recruitment. Transgender participants aged 17 or over were recruited from a national transgender health service in the United Kingdom (UK) during a 12 month period

in 2015/2016. Participants were recruited at the assessment stage. None of the participants had received gender-affirming medical interventions from the service, but some were taking cross-sex hormones and blockers (medication used to inhibit puberty) from NHS providers (as their care was transferred from the child and adolescent service to the adult service), private providers or self-prescribed via the internet.

The cisgender participants were recruited from the community over four months in 2016 using a snowball sampling technique. Cisgender participants were required to not experience incongruence between the sex they were assigned at birth and their gender identity. All cisgender participants were age 18 or over.

The study was approved by an NHS research ethics committee and by the Research and Development Department of the Nottinghamshire Healthcare NHS Foundation Trust. Ethical approval for recruitment of the cisgender participants was granted from the first author's university research ethics committee.

Procedure. After informed consent had been obtained from participants, they were invited to complete the self-report questionnaires listed below. The completion of these questionnaires took approximately 20-30 minutes.

Measures. Socio-demographic information: Information was collected about participants' age, sex assigned at birth, and gender identity. For the transgender participants, information about whether they were taking cross-sex hormones was also collected.

Rapid Assessment of Physical Activity.[35] This measure has nine statements that rapidly assess the frequency of engagement in physical activity (e.g., *I do 30 minutes or more a day of moderate physical activities, 5 or more days a week*). Participants are asked to indicate whether the statement relates to them or not by ticking 'Yes' or 'No'. There are no other

response options. The scale has two subscales: 1) aerobic physical activity (7 items); and 2) strength and flexibility physical activity (2 items). In the current study, only the aerobic physical activity subscale was used. Total scores are calculated by choosing the highest item (1-7) with an affirmative response and scoring this accordingly. For example, if question 3 was the highest question that the participant responded 'yes' to, then they would be given a score of 3. High levels of physical activity engagement are indicated by a higher score. Scores under 6 are considered a suboptimal level of physical activity. Reliability analysis was not conducted for the current sample due to the 'yes', 'no' response style but this measure has been shown to have good reliability previously.[35]

Hospital Anxiety and Depression Scale.[36] This measure has 14 items; seven assess anxiety and seven assess depression. Scores for each subscale (anxiety and depression) are calculated by summing the scores for each individual item. For each subscale, scores between 0-7 are considered 'normal', scores between 8-10 are considered 'borderline clinical', and scores of 11 and above are considered 'clinically relevant'. The highest score possible is 21 for each subscale. The measure has previously been found to have good reliability.[37] In the current study, both the anxiety (α=0.86) and depression (α =0.75) subscales had good reliability.

Hamburg Body Drawing Scale (HBDS).[38] This measure was originally developed for use with individuals with different forms of psychoendocrinological disorder[39] and has since been adapted and validated with transgender people.[38] In total, satisfaction with 33 body parts is assessed. To assess individuals' overall satisfaction with their body, just one individual item is used (*"Satisfaction with your overall appearance"*). In the current study, only the item that assesses overall appearance satisfaction was used. A 5-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied) is used and therefore a high score indicates a high level of body satisfaction. Reliability analysis was not conducted for the current sample as only

one item of the HBDS was used but the scale has previously been found to have good reliability.[38]

Rosenberg Self-Esteem Scale.[40] This is a 10-item self-report measure that assesses self-esteem. Responses are scored on a 4-point Likert scale (*strongly agree* (0) to *strongly disagree* (3)). The global score is calculated by summing the scores from the individual items. A high score indicates a higher self-esteem (highest possible score is 30). The measure has previously been shown to have good reliability (α=0.88-0.90).[41] In the current sample, the measure had excellent reliability (α=0.91).

Experience of Transphobia.[42,43] An item assessing verbal transphobia (*"Have you ever been verbally abused or harassed due to your gender identity or presentation?")* and an item assessing physical transphobia *("Have you ever been physically abused or beaten due to your gender identity or presentation?"*) were adapted from previous studies that measured transphobia.[42,43] Participants were asked to rate, on a 4-point Likert scale (from *never* to *several times*), the frequency that they have experienced such behaviour. A higher score indicates a more frequent experience of verbal and/or physical transphobia.

Data analysis

Data were analysed using SPSS 23. The data were not normally distributed and therefore non-parametric tests were conducted, where possible.[44] To address the first aim, each transgender individual was matched by age and experienced gender identity with a cisgender participant and a Mann-Whitney U test was conducted to explore differences in physical activity between these two groups. For the second aim, a Mann-Whitney U test was conducted between people who had and had not taken cross-sex hormones to determine whether there was a difference in physical activity. Each transgender individual who had taken cross-sex hormones was then matched, by age and gender identity, with a cisgender

participant and a Mann-Whitney U test was conducted between these two groups to explore differences in physical activity. For all Mann-Whitney U analysis, an effect size was calculated ($z^2 \div N-1$). For the final aim, one-tailed Spearman's Rho correlations were conducted between physical activity and the potential statistical predictor variables (age, gender, anxiety, depression, overall body satisfaction, self-esteem and transphobia) for the whole group and also for those who were and were not on cross-sex hormone treatment, separately. Spearman's Rho correlations were conducted in relation to the participants' gender identity in accordance with recommendations made by Auer et al.[45] As gender identity had more than two categories (e.g., neither male or female), six dummy variables were created to allow this variable to be entered into the Spearman's Rho correlation analysis. Given the large number of Spearman's Rho correlations being run (i.e., 26), a Bonferroni correction was applied to correct for multiple comparisons. An adjusted p-value of .002 was therefore used to indicate significance in the correlations (i.e. 0.05 [standard p-value] / 26 [number of correlations] = 0.002 [adjusted p-value]). Only variables that significantly correlated with physical activity were entered into the subsequent analysis to increase its robustness.

To determine which variable(s) was the best statistical predictor of physical activity, stepwise multiple linear regression analysis was conducted. The level of significance used was $p<0.05$.

Results

During the data collection period, 383 people were accepted for assessment at the transgender health service. Of this sample, 360 participants (94%) provided informed consent to participate in the study. Three hundred and fourteen cisgender participants were recruited from the community and all provided informed consent.

Aim 1: Comparing levels of physical activity between transgender and cisgender people

From the pool of transgender (n=360) and cisgender (n=314) participants, 137 transgender and 137 cisgender participants were matched by age and gender identity. From the transgender sample, people with non-binary gender identities were removed from the matching process (n=30, 8.33%). A further 14 people (3.89%) were removed as they had not yet decided on their gender identity and a further three people (0.83%) were excluded as they did not provide any information about their gender identity. The socio-demographic characteristics of the matched transgender (n=137) and cisgender (n=137) participants are displayed in Table 1. According to Topolski et al.[36] both the transgender (mean=4.24) and cisgender (mean=5.12) participants engaged in insufficient levels of physical activity.

Insert Table 1 here

Cisgender participants engaged in significantly more physical activity (mean=5.12, *SD*=1.80, median=6.00, IQR=3.00) in comparison to those in the transgender group (mean=4.24, *SD*=2.05, median=4.00, IQR=3.00; *U*=7108.00, z=-3.53, effect size=.05, *p*=.001). To further explore any differences in physical activity between transgender and cisgender participants, participants were split in relation to their gender identity. This analysis showed that cisgender males (n=42, mean=5.40, *SD*=1.79, median=6.00, IQR=3.00) engaged in significantly more physical activity in comparison to transgender males (n=42, mean=4.17, *SD*=2.05, median=4.00, IQR=4.00; *U*=583.50, z=-2.73, effect size=.05, *p*=.004). Cisgender females (n=95, mean=5.00, *SD*=1.80, median=5.00, IQR=3.00) also engaged in significantly more physical activity than transgender females (n=95, mean=4.27, *SD*=2.07, median=4.00, IQR=3.00; *U*=3614.50, z=-2.41, effect size=.04, *p*=.007). The participants were then split in relation to the gender they were assigned at birth. Two comparisons were conducted: cisgender males (n=42) vs. transgender females (assigned male at birth; n=95, mean=4.34, *SD*=2.06, median=4.00, IQR=3.00; *U*=1412.00, z=-2.77, effect size=.06, *p*=.002), and

cisgender females (n=95) vs. transgender males (assigned female at birth; n=42, mean=4.02, *SD*=2.05, median=4.00, IQR=4.00; U=1451.50, z=-2.58, effect size=.05, *p*=.005). Both tests supported what was found when the analysis was conducted in relation to gender identity.

Aim 2: comparing physical activity levels of people who were on cross-sex hormone treatment and those who were not

It was found that the transgender patients who were on cross-sex hormone treatment (n=102) engaged in significantly more physical activity (mean=4.65, *SD*=1.92, median=4.00, IQR=3.00) compared to the patients who were not (n=241; mean=4.07, *SD*=1.82, median=4.00, IQR=3.00; *U*=10027.00, z=-2.74, effect size=.02, *p*=.003).

To determine whether the level of physical activity engaged in by transgender people who were on cross-sex hormones was comparable to the cisgender population, these two groups were matched by age and gender identity. People were excluded if they had not provided information about their gender identity (n=3, 2.94%), or if they had a non-binary gender identity (n=8, 7.84%). Therefore, 91 transgender people were matched with 91 cisgender people. In these samples, 52 identified as female and 39 as male. The mean age was 31.84 (*SD*=13.55).

Cisgender people (mean=5.33, *SD*=1.92, median=6.00, IQR=3.00) were found to engage in significantly more physical activity than transgender people who were on cross-sex hormones (mean=4.73, *SD*=1.97, median=5.00, IQR=4.00; *U*=3356.50, z=-2.27, effect size=.03, *p*=.010). When people with a female gender identity were explored, there was no significant difference in physical activity levels between transgender females on cross-sex hormone treatment (mean=4.79, *SD*=2.01, median=5.00, IQR=4.00) and cisgender females (mean=5.33, *SD*=1.92, median=6.00, IQR=3.00; *U*=1133.00, z=-1.47, effect size=.02, *p*=.065). When people with a male gender identity were explored, cisgender males

(mean=5.33, *SD*=1.94, median=6.00, IQR=3.00) engaged in significantly more physical activity than transgender males on cross-sex hormones (mean=4.64, *SD*=1.93, median=4.00, IQR=3.00; *U*=593.00, z=-1.73, effect size=.04, *p*=.041).

Aim 3: Statistical predictors of physical activity in transgender people

To satisfy the third aim, only transgender people were included (n=360). The socio-demographic variables of the transgender sample, presented for the whole sample, and separately for people who are on cross-sex hormone treatment (n=102) and those who are not (n=241), are displayed in Table 2.

Insert Table 2 here

Statistical predictors of physical activity for the whole sample of transgender participants. To examine the significant correlates of physical activity in the whole sample (n=360), one-tailed Spearman's Rho correlations were conducted (see Table 3). Age, depression, body satisfaction, and self-esteem were all found to be significantly correlated with physical activity. Therefore, the four significantly correlated variables were entered into a stepwise regression to explore the best statistical predictor(s) of physical activity. Overall the model was significant ($F(2,300)=12.34$, $p=.001$) and explained 7.6% ($R^2=.076$) of the total variance of physical activity. Self-esteem (β=.20, $p=.001$) and body satisfaction (β=.12, $p=.049$) were the best statistical predictors of physical activity, both of which had a positive relationship with the outcome variable.

Insert Table 3 here

Statistical predictors of physical activity in people who were and were not on cross-sex hormones. The socio-demographics of people who were and were not on cross-sex hormone treatment are presented in Table 2. Mann-Whitney U tests were also conducted to explore

differences between these two groups on the study's variables (see Table 4). People who were on cross-sex hormones were significantly older, reported higher levels of self-esteem and body satisfaction, and experienced less anxiety and depression in comparison to participants who were not on cross-sex hormones (see Table 4). There were no significant differences between the groups in relation to experiences of verbal and physical transphobia.

Insert Table 4 here

In the group that was not on cross-sex hormones, age, depression and self-esteem were found to be significantly correlated with physical activity (see Table 3) and these variables were therefore entered into a stepwise regression. Overall, the model was significant and explained 4.8% of the variance in physical activity engagement (see Table 5). The only variable to have a significant relationship with physical activity engagement was self-esteem which was positively related (see Table 5).

Insert Table 5 here

In the group that was on cross-sex hormones, body satisfaction and self-esteem were found to be significantly correlated with physical activity (see Table 3) and were therefore entered into a stepwise regression. Overall, the model was significant and explained 12.4% of the total variance in physical activity (see Table 5). The only variable that significantly predicted physical activity engagement was body satisfaction, which was positively related (see Table 5).

Discussion

This study found that, overall, treatment seeking transgender people engaged in less physical activity compared to cisgender people. Cross-sex hormone treatment was found to have an important role in physical activity as transgender people who were taking cross-sex hormones

engaged in significantly more physical activity compared to transgender people who did not; also, the best statistical predictors of physical activity in these two groups differed. While greater body satisfaction (i.e., feeling less dissatisfied with one's body) was found to be the best predictor of physical activity in transgender people who were taking cross-sex hormones, greater self-esteem was found to be the best statistical predictor in participants who were not taking cross-sex hormones. Transgender males (who were taking cross-sex hormones) engaged in less physical activity than cisgender males, however this study did not find a significant difference between transgender females who were on cross-sex hormone treatment and cisgender females. This highlights the importance of increasing the accessibility of cross-sex hormone treatment. Currently, people have to wait a significant amount of time before they are seen at transgender health services[46-48] but our findings suggest that this delay could be adversely impacting their physical activity engagement, which could contribute to poorer mental well-being.

Both the transgender and cisgender people in the current study reported engaging in insufficient levels of physical activity.[35] However, it was found that, overall, treatment seeking transgender people were significantly less active in comparison to cisgender people who were matched on age and gender identity. This finding supports previous research[22] and, given the known mental and physical health benefits of physical activity,[1-6] highlights the need to improve support for physical activity engagement of treatment seeking transgender people. Efforts should focus on factors that have been shown to predict physical activity within the transgender population.

Based on the amount of barriers that transgender people experience when engaging in physical activity and sport[20,21] it is understandable that greater self-esteem was found to be

the best statistical predictor of physical activity in this current study (for the whole group and for participants who had not taken cross-sex hormones). Although the mechanisms contributing to self-esteem levels are likely to differ in transgender and cisgender people, self-esteem has also been shown to affect physical activity engagement within the cisgender population.[29,31,32] Consequently, self-esteem interventions developed for the general population (e.g., behaviour change interventions that focus on self-esteem) may be useful in increasing physical activity within the transgender population.[49,50] Furthermore, gender-affirming medical treatment (e.g., cross-sex hormone treatment and gender-affirming surgery) has been found to increase self-esteem in transgender people[27,51] and hence also appears to be crucial in indirectly increasing physical activity levels in transgender people who are treatment seeking.

This study found that once cross-sex hormone treatment had commenced, self-esteem was no longer the best statistical predictor of physical activity. In addition, transgender people who were taking cross-sex hormones engaged in significantly more physical activity than participants who were not. This finding further supports the notion that cross-sex hormone treatment is crucial in indirectly increasing physical activity engagement (in transgender people who are treatment seeking). Participants who were taking cross-sex hormones had greater self-esteem levels, were less anxious and less depressed, and had a higher body satisfaction (i.e., were less dissatisfied with their bodies). These are all psychological factors that have been positively associated with physical activity in the cisgender population[5,28,29] and therefore may explain why this group was more active in the current study compared to the group of people who was not taking cross-sex hormones.

In transgender people who were taking cross-sex hormones, a higher level of body satisfaction was found to be the best statistical predictor of physical activity. This finding is

consistent with research that has found body satisfaction to increase once cross-sex hormone treatment has started[26,52] as well as research with cisgender people that has found that people who have higher levels of body satisfaction engage in more physical activity.[28,30] Interestingly, this study found that levels of physical activity in transgender females on cross-sex hormones did not differ to levels in cisgender females. Cross-sex hormones appear to alleviate the physical activity inequality seen between cisgender and transgender females. Therefore, body satisfaction interventions aimed at cisgender women in an effort to increase their physical activity levels may also be applicable among transgender females on cross-sex hormone treatment, although the feasibility of this would need to be tested.

In comparison to transgender males on cross-sex hormone treatment, cisgender males were found to engage in significantly more physical activity. This difference might be explained by the findings from a recent qualitative study where transgender males who were taking cross-sex hormones discussed how wearing a chest binder[a] during physical activity was extremely uncomfortable.[20] In addition, body satisfaction in transgender males has been found to significantly increase following chest reconstructive surgery.[53] In light of the current study's findings and previous research, chest reconstructive surgery should be offered in a timely manner in accordance with the recommended Standards of Care, if this is what the person wishes.[54,55] This may help to indirectly increase physical activity levels among transgender males (i.e., by increasing their levels of body satisfaction).

This is the first large scale study to compare physical activity levels of treatment seeking transgender people with a matched sample of cisgender people, and to quantitatively explore a range of factors which might predict physical activity. There are, however, some limitations. Transphobia was not significantly associated with physical activity, which was surprising

[a]A chest binder is a garment of clothing worn by some transgender men to minimise breast tissue and increase the appearance of a male chest.

given that 79% of survey respondents felt that transphobia was a barrier to participating in sport.[56] This lack of association in our study may be explained by the fact that some transgender people anticipate, as opposed to experience, transphobia[20,57] and the measure in the current study only asked about the experience of transphobia. In addition, the percentage of physical activity explained by the regression models was low. This was despite age and depression being significantly correlated with physical activity. Future research should consider exploring why these factors were significantly associated with physical activity, but did not statistically predict the behaviour. In the current study, the physical activity measure used lacked specificity in relation to the type of physical activity engaged in. In this area of research, understanding the type of physical activity engaged in may highlight important nuances in relation to exercise engaged in based on gender identity (i.e., to achieve a masculine or feminine body shape). Future research may also wish to extend the current study by exploring physical activity levels of non-binary people and determining how and why these may differ to transgender people who identify as female or male.

The findings of this research lead to several recommendations which could be useful for health professionals who are working with transgender individuals to implement in an effort to support physical activity engagement in this group. These include a need to develop or implement interventions to increase self-esteem and body satisfaction (and, in turn, physical activity). In addition to this, it is recommended that gender confirming medical interventions are offered in a timely manner, especially cross-sex hormone treatment and mastectomy, so as to facilitate transgender individuals' engagement in physical activity.

In conclusion, there is an inequality in physical activity engagement between treatment seeking transgender people (especially those not on cross-sex hormones) and cisgender people. Cross-sex hormone treatment appears to be crucial in indirectly increasing physical

activity engagement within the transgender population. Therefore the accessibility of cross-sex hormone treatment for transgender individuals needs to be increased.

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Table 1: Socio-demographic information for the cisgender and transgender samples who are matched for age and gender identity

	Cisgender (n=137) (%)	Transgender (n=137) (%)
Mean age (*SD*)	30.15 (11.87)	30.15 (11.87)
Sex assigned at birth		
Male	42 (30.7)	95 (69.3)
Female	95 (69.3)	42 (30.7)
Gender identity		
Male	42 (30.7)	42 (30.7)
Female	95 (69.3)	95 (69.3)
Cross-sex hormone treatment prior to assessment		
Yes	N/A	53 (38.7)
No	N/A	82 (59.9)
No response	N/A	2 (1.5)

Note: N/A means not applicable

Table 2: Socio-demographic characteristics of the whole sample of transgender participants, participants on cross-sex hormone treatment and those not on cross-sex hormone treatment

	Whole sample (N=360)	No cross-sex hormone treatment group (n=241)	Cross-sex hormone treatment group (n=102)
	Sample size (%)		
Sex assigned at birth			
Female	151 (41.9)	98 (40.7)	44(43.1)
Male	209 (58.1)	143 (59.3)	58 (56.9)
Gender identity			
Female	166 (46.1)	107 (44.4)	52 (51.0)
Male	131 (36.4)	84 (34.9)	39 (38.2)
Partly male and female	14 (3.9)	9 (3.7)	4 (3.9)
Neither male or female	17 (4.7)	13 (5.4)	3 (2.9)
Unsure	18 (5.0)	18 (7.5)	0 (0.0)
Other	8 (2.3)	7 (2.9)	1 (1.0)
Missing	6 (1.7)	3 (1.2)	3 (2.9)
Cross-sex hormone treatment			
Yes	102 (28.3)		
No	241 (66.9)		
No response	17 (4.7)		
CHT and blocker in combination			35 (34.3)
CHT only			67 (65.7)
Blockers only (no CHT)		7 (2.9)	

CHT: Cross-sex Hormone Treatment

Table 3: One-tailed Spearman's Rho correlations between physical activity and the study variables, presented for the whole sample and separately for those who were and were not on cross-sex hormone treatment prior to assessment

	Whole group (N=360)	No cross-sex hormone treatment group (n=241)	Cross-sex hormone treatment group (n=102)
	Physical activity	Physical activity	Physical activity
Age	.18***	.20***	.07
Male gender identity†	.03	.03	-.00
Female gender identity†	.05	.02	.09
Partly male and female gender identity†	-.10	-.09	-.09
Neither male or female gender identity†	-.04	.01	-.11
Not sure of gender identity†	-.04	-.02	N/A
Other gender identity†	-.02	-.03	.06
Verbal transphobia	.04	.08	-.08
Physical transphobia	.06	.08	-.02
Self-esteem	.27***	.23***	.29***
Anxiety	-.12	-.07	-.14
Depression	-.22***	-.21***	-.15
Body satisfaction	.21***	.11	.38***

***p<0.001 (corrected for multiple comparisons); † dummy coded variables; N/A means not applicable

Table 4: Descriptive statistics and tests of difference between transgender people who were and were not on cross-sex hormone treatment for all predictor variables

	No cross-sex hormone treatment group (n=241)		Cross-sex hormone treatment group (n=102)		Mann-Whitney U			
	Mean (*SD*)	Median (*IQR*)	Mean (*SD*)	Median (*IQR*)	U	z	Effect size	*p*
Age	26.91 (12.15)	22.00 (10.00)	32.81 (14.91)	29.00 (24.30)	9291.00	-3.58	0.04	.001
Verbal transphobia	1.51 (1.16)	2.00 (2.00)	1.58 (1.14)	2.00 (2.30)	11729.50	-.51	0.01	.310
Physical transphobia	0.34 (0.78)	0.00 (0.00)	0.38 (0.87)	0.00 (0.00)	12053.00	-.68	0.01	.460
Self-esteem	14.39 (5.92)	14.00 (9.00)	18.19 (6.39)	18.00 (25.00)	7332.50	-4.71	0.06	.001
Anxiety	10.20 (3.42)	9.00 (7.00)	9.09 (3.68)	7.00 (7.00)	9646.00	-2.84	0.02	.001
Depression	5.90 (3.26)	7.00 (5.50)	4.71 (3.29)	5.00 (6.00)	9264.00	-3.23	0.03	.022
Body satisfaction	1.86 (0.70)	2.00 (1.00)	2.17 (0.86)	2.00 (1.00)	7656.50	-3.00	0.03	.001

Table 5: Stepwise regression models reporting the unstandardized *beta*, standard error of beta, and the standardised beta (β) coefficients for (i) those who were not and (ii) those who were on cross-sex hormone treatment prior to assessment

	F	R^2	*beta*	SE *beta*	β
(i) No cross-sex hormone treatment group (n=241)	11.32**	.048			
Self-esteem			.07	.02	.22***
(ii) Cross-sex hormone treatment group (n=102)	11.16***	.124			
Body satisfaction			.79	.24	.35***

*p<0.05, **p<0.01, ***p<0.001