



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

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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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3 17 **Abstract**
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5 18 **Background:** Physical activity has been found to alleviate mental health problems and could
6
7 19 be beneficial for at-risk populations, such as transgender people. This study had three aims.
8
9 20 First, to explore the amount of physical activity that **treatment seeking** transgender people
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11 21 engage in, and to compare this to matched cisgender people. Second, to determine whether
12
13 22 there was a difference in physical activity depending on cross-sex hormone use. Third, to
14
15 23 determine factors which predict physical activity among **treatment seeking** transgender
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17 24 people.
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20 25 **Method:** Transgender (n=360) and cisgender people (n=314) were recruited from the UK.
21
22 26 Participants were asked to complete questionnaires about physical activity, symptoms of
23
24 27 anxiety and depression, self-esteem, body satisfaction and transphobia.
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27 28 **Results:** Transgender people engaged in less physical activity than cisgender people.
28
29 29 Transgender people who were on cross-sex hormones engaged in more physical activity than
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31 30 transgender people who were not. In transgender people on cross-sex hormones, high body
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33 31 satisfaction was the best **statistical** predictor of physical activity while high self-esteem was
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35 32 the best **statistical** predictor in people who were not.
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38 33 **Conclusion:** Transgender people are less active than cisgender people. Cross-sex hormone
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40 34 treatment appears to be able to indirectly increase physical activity within this population,
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42 35 **which may be beneficial for mental well-being.**
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36 Introduction

37 Physical activity is defined as any activity (e.g., while working, playing, carrying out
38 household chores and recreational pursuits) that involves muscular-skeletal movement and
39 energy expenditure.¹ In 2010, 23% of adults around the world were not active enough,¹
40 highlighting that inactivity represents a global public health problem. Globally, engaging in
41 insufficient physical activity is the fourth leading risk factor for non-communicable diseases
42 (e.g., cancer, diabetes, cardiovascular disease),¹ which accounted for approximately 5.3
43 million deaths globally in 2008.² Physical activity has also been found to alleviate mental
44 health problems, particularly depression and anxiety.³⁻⁷ In light of this, physical activity may
45 be beneficial for populations that are vulnerable to mental health problems.

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

Physical activity in transgender people

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3 61 Mental health problems such as depression, anxiety, and self-harm have been found to be
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5 62 particularly prevalent in transgender people¹⁰⁻¹⁸ and therefore physical activity may be a
6
7 63 useful coping mechanism. In addition to this, engaging in frequent physical activity may help
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9 64 transgender people reach a suitable Body Mass Index required for gender confirming surgery
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11 65 (if this is what the person wishes). Although research is inconclusive, it has shown cross-sex
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13 66 hormone treatment may put transgender females at risk of cardiovascular disease and may
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15 67 make transgender males more susceptible to risk factors associated with cardiovascular
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17 68 disease.¹⁹ For this reason, frequent physical activity engagement is essential to maintain heart
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19 69 health. Transgender males have also discussed being motivated to increase muscle mass on
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21 70 the upper torso through engaging in frequent weight training to enhance surgical outcomes
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23 71 post-mastectomy.²⁰ However, there is a lack of research that has explored levels of physical
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25 72 activity among transgender people and therefore it is unknown as to whether engaging in
26
27 73 physical activity would be feasible among this population.
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33 74 A systematic review concluded that the majority of transgender people have a negative
34
35 75 experience when engaging in physical activity.²¹ This is supported by a recent qualitative
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37 76 study²⁰ which found that a range of external factors, such as changing rooms, sport-related
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39 77 clothing and discrimination, and stigmatisation and prejudice on the basis of gender identity
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41 78 (transphobia), all discouraged transgender people from engaging in physical activity. Gender
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43 79 incongruence and body dissatisfaction were also identified as barriers to physical activity
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45 80 engagement.²⁰ Based on this knowledge, it is likely that levels of physical activity are low
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47 81 among the transgender population and therefore research should focus on identifying ways to
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49 82 increase activity levels in these individuals in light of the known mental health benefits.³
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54 83 The only quantitative study to explore the amount of physical activity transgender people
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56 84 engage in supports this suggestion, as transgender people were found to engage in less
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58 85 physical activity than cisgender people.²² This study recruited 47 cisgender people and
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3 86 compared them with 33 (non-matched) transgender people. Although the study is of interest,
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5 87 the lack of matching between the two groups for age and gender (variables known to affect
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7 88 levels of physical activity^{1,23}) limits the impact of its findings. In addition, there was a lack of
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10 89 information regarding the transgender participants' stage of medical transition (i.e., whether
11
12 90 they were on cross-sex hormone treatment). Research has shown that cross-sex hormone
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14 91 treatment, which helps the person's body to align with their gender identity (either by the
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16 92 development of breasts for transgender females or by an increase in muscle mass and
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18 93 lowering of voice for transgender males), increases mental well-being in the transgender
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21 94 population.^{11,24-27} This information is of significance when exploring physical activity within
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23 95 the transgender population as cisgender people with better mental health have been found to
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25 96 engage in more physical activity compared to people with poorer mental health.^{5,28,29}
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28 97 Although the studies discussed above have suggested that levels of physical activity are low
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30 98 among transgender people and have identified potential barriers to engaging in physical
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32 99 activity, they are limited by their qualitative nature, which means that findings cannot be
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35 100 generalised and interventions cannot be developed,²¹ or by the small number of participants,
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37 101 lack of matching and lack of information about stage of transition.²² Quantitatively
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39 102 understanding whether there is a physical activity inequality between cisgender and
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41 103 transgender people, as well as understanding factors that are associated with physical activity
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44 104 in the transgender population, is essential in order that specific initiatives to increase physical
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46 105 activity can be developed for this population.
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49 106 Taking into consideration the limitations of previous studies, this study has three main aims.
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51 107 First, to explore the amount of physical activity that treatment seeking transgender people
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53 108 engage in, and to compare this to cisgender people matched for age and gender. Second, in
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56 109 light of the positive psychological benefits that cross-sex hormones can have on mental well-
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58 110 being in the transgender population²⁴ this study also aims to determine whether there is a
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Physical activity in transgender people

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3 111 difference in physical activity levels between people who are and are not on cross-sex
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5 112 hormone treatment as well as to determine whether levels of physical activity in people who
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7 113 are on cross-sex hormone treatment are comparable to cisgender people, when age and
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9 114 gender are controlled for. Finally, this study aims to determine factors which predict physical
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11 115 activity participation in transgender individuals. This will be explored for the whole group of
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13 116 transgender participants and also for people who are and are not on cross-sex hormone
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15 117 treatment, separately. Factors which have previously been found to predict physical activity
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17 118 in the cisgender population will be explored as potential **statistical** predictors, such as
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19 119 younger age and male gender,^{1,23} low anxiety and depression levels,^{3,5} high body
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21 120 satisfaction^{28,30} and high self-esteem.^{29,31,32} Transphobia has been found to be a predisposing
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23 121 factor to high levels of anxiety, depression and low self-esteem^{33,34} and has been identified as
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25 122 a barrier to physical activity in the transgender population.^{21,31} Hence, transphobia will also
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27 123 be explored as a potential **statistical** predictor of physical activity.

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32 124 First, it was hypothesised that **treatment seeking** transgender people would engage in less
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34 125 physical activity than cisgender people. Second, it was hypothesised that levels of physical
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36 126 activity would be greater in the group that were on cross-sex hormone treatment (compared to
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38 127 those who were not) and that this would be comparable to cisgender people's physical
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40 128 activity levels. Finally, it was hypothesised that younger age, male gender identity, lower
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42 129 levels of anxiety, lower levels of anxiety, lower levels of depression, high body satisfaction,
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44 130 high self-esteem, and fewer experiences of transphobia would predict greater physical
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46 131 activity engagement.

132 **Methods**

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54 133 **Participants and recruitment.** Transgender participants **aged 17 or over** were recruited from
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56 134 a national transgender health service in the United Kingdom (UK) during a 12 month period
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3 135 in 2015/2016. Participants were recruited at the assessment stage. None of the participants
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5 136 had received gender-affirming medical interventions from the service, but some were taking
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7 137 cross-sex hormones and blockers (medication used to inhibit puberty) from NHS providers
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10 138 (as their care was transferred from the child and adolescent service to the adult service),
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12 139 private providers or self-prescribed via the internet.

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15 140 The cisgender participants were recruited from the community over four months in 2016
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17 141 using a snowball sampling technique. Cisgender participants were required to not experience
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19 142 incongruence between the sex they were assigned at birth and their gender identity. All
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21 143 cisgender participants were age 18 or over.

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24 144 The study was approved by an NHS research ethics committee and by the Research and
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26 145 Development Department of the Nottinghamshire Healthcare NHS Foundation Trust. Ethical
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28 146 approval for recruitment of the cisgender participants was granted from the first author's
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30 147 university research ethics committee.

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34 148 **Procedure.** After informed consent had been obtained from participants, they were invited to
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36 149 complete the self-report questionnaires listed below. The completion of these questionnaires
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38 150 took approximately 20-30 minutes.

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41 151 **Measures.** Socio-demographic information: Information was collected about participants'
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43 152 age, sex assigned at birth, and gender identity. For the transgender participants, information
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45 153 about whether they were taking cross-sex hormones was also collected.

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49 154 **Rapid Assessment of Physical Activity.**³⁵ This measure has nine statements that rapidly
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51 155 assess the frequency of engagement in physical activity (e.g., *I do 30 minutes or more a day*
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53 156 *of moderate physical activities, 5 or more days a week*). Participants are asked to indicate
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55 157 whether the statement relates to them or not by ticking 'Yes' or 'No'. There are no other
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Physical activity in transgender people

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3 158 response options. The scale has two subscales: 1) aerobic physical activity (7 items); and 2)
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5 159 strength and flexibility physical activity (2 items). In the current study, only the aerobic
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7 160 physical activity subscale was used. Total scores are calculated by choosing the highest item
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9 161 (1-7) with an affirmative response and scoring this accordingly. For example, if question 3
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11 162 was the highest question that the participant responded 'yes' to, then they would be given a
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13 163 score of 3. High levels of physical activity engagement are indicated by a higher score.
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15 164 Scores under 6 are considered a suboptimal level of physical activity. Reliability analysis was
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17 165 not conducted for the current sample due to the 'yes', 'no' response style but this measure has
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19 166 been shown to have good reliability previously.³⁵

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23 167 ***Hospital Anxiety and Depression Scale.***³⁶ This measure has 14 items; seven assess anxiety
24
25 168 and seven assess depression. Scores for each subscale (anxiety and depression) are calculated
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27 169 by summing the scores for each individual item. For each subscale, scores between 0-7 are
28
29 170 considered 'normal', scores between 8-10 are considered 'borderline clinical', and scores of
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31 171 11 and above are considered 'clinically relevant'. The highest score possible is 21 for each
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33 172 subscale. The measure has previously been found to have good reliability.³⁷ In the current
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35 173 study, both the anxiety ($\alpha=0.86$) and depression ($\alpha=0.75$) subscales had good reliability.

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39 174 ***Hamburg Body Drawing Scale (HBDS).***³⁸ This measure was originally developed for use
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41 175 with individuals with different forms of psychoendocrinological disorder³⁹ and has since been
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43 176 adapted and validated with transgender people.³⁸ In total, satisfaction with 33 body parts is
44
45 177 assessed. To assess individuals' overall satisfaction with their body, just one individual item
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47 178 is used ("*Satisfaction with your overall appearance*"). In the current study, only the item that
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49 179 assesses overall appearance satisfaction was used. A 5-point Likert scale ranging from 1
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51 180 (very dissatisfied) to 5 (very satisfied) is used and therefore a high score indicates a high level
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55 181 of body satisfaction. Reliability analysis was not conducted for the current sample as only

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

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

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

197 **Data analysis**

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

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3 206 participant and a Mann-Whitney U test was conducted between these two groups to explore
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5 207 differences in physical activity. For all Mann-Whitney U analysis, an effect size was
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7 208 calculated ($z^2 \div N-1$). For the final aim, one-tailed Spearman's Rho correlations were
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10 209 conducted between physical activity and the potential statistical predictor variables (age,
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12 210 gender, anxiety, depression, overall body satisfaction, self-esteem and transphobia) for the
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14 211 whole group and also for those who were and were not on cross-sex hormone treatment,
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16 212 separately. Spearman's Rho correlations were conducted in relation to the participants'
17
18 213 gender identity in accordance with recommendations made by Auer et al.⁴⁵ As gender identity
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20 214 had more than two categories (e.g., neither male or female), six dummy variables were
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22 215 created to allow this variable to be entered into the Spearman's Rho correlation analysis.
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24 216 Given the large number of Spearman's Rho correlations being run (i.e., 26), a Bonferroni
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26 217 correction was applied to correct for multiple comparisons. An adjusted p-value of .002 was
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28 218 therefore used to indicate significance in the correlations (i.e. 0.05 [standard p-value] / 26
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30 219 [number of correlations] = 0.002 [adjusted p-value]). Only variables that significantly
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32 220 correlated with physical activity were entered into the subsequent analysis to increase its
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34 221 robustness.

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39 222 To determine which variable(s) was the best statistical predictor of physical activity, stepwise
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41 223 multiple linear regression analysis was conducted. The level of significance used was $p < 0.05$.

224 Results

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

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

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

239 *Insert Table 1 here*

240 Cisgender participants engaged in significantly more physical activity (mean=5.12, $SD=1.80$,
241 median=6.00, IQR=3.00) in comparison to those in the transgender group (mean=4.24,
242 $SD=2.05$, median=4.00, IQR=3.00; $U=7108.00$, $z=-3.53$, effect size=.05, $p=.001$). To further
243 explore any differences in physical activity between transgender and cisgender participants,
244 participants were split in relation to their gender identity. This analysis showed that cisgender
245 males (n=42, mean=5.40, $SD=1.79$, median=6.00, IQR=3.00) engaged in significantly more
246 physical activity in comparison to transgender males (n=42, mean=4.17, $SD=2.05$,
247 median=4.00, IQR=4.00; $U=583.50$, $z=-2.73$, effect size=.05, $p=.004$). Cisgender females
248 (n=95, mean=5.00, $SD=1.80$, median=5.00, IQR=3.00) also engaged in significantly more
249 physical activity than transgender females (n=95, mean=4.27, $SD=2.07$, median=4.00,
250 IQR=3.00; $U=3614.50$, $z=-2.41$, effect size=.04, $p=.007$). The participants were then split in
251 relation to the gender they were assigned at birth. Two comparisons were conducted:
252 cisgender males (n=42) vs. transgender females (assigned male at birth; n=95, mean=4.34,
253 $SD=2.06$, median=4.00, IQR=3.00; $U=1412.00$, $z=-2.77$, effect size=.06, $p=.002$), and

Physical activity in transgender people

254 cisgender females (n=95) vs. transgender males (assigned female at birth; n=42, mean=4.02,
255 $SD=2.05$, median=4.00, IQR=4.00; $U=1451.50$, $z=-2.58$, effect size=.05, $p=.005$). Both tests
256 supported what was found when the analysis was conducted in relation to gender identity.

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

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

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

270 Cisgender people (mean=5.33, $SD=1.92$, median=6.00, IQR=3.00) were found to engage in
271 significantly more physical activity than transgender people who were on cross-sex hormones
272 (mean=4.73, $SD=1.97$, median=5.00, IQR=4.00; $U=3356.50$, $z=-2.27$, effect size=.03,
273 $p=.010$). When people with a female gender identity were explored, there was no significant
274 difference in physical activity levels between transgender females on cross-sex hormone
275 treatment (mean=4.79, $SD=2.01$, median=5.00, IQR=4.00) and cisgender females
276 (mean=5.33, $SD=1.92$, median=6.00, IQR=3.00; $U=1133.00$, $z=-1.47$, effect size=.02,
277 $p=.065$). When people with a male gender identity were explored, cisgender males

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3 278 (mean=5.33, $SD=1.94$, median=6.00, IQR=3.00) engaged in significantly more physical
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5 279 activity than transgender males on cross-sex hormones (mean=4.64, $SD=1.93$, median=4.00,
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7 280 IQR=3.00; $U=593.00$, $z=-1.73$, effect size=.04, $p=.041$).

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10 281 **Aim 3: Statistical predictors of physical activity in transgender people**

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13 282 To satisfy the third aim, only transgender people were included ($n=360$). The socio-
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15 283 demographic variables of the transgender sample, presented for the whole sample, and
16
17 284 separately for people who are on cross-sex hormone treatment ($n=102$) and those who are not
18
19 285 ($n=241$), are displayed in Table 2.

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23 286 *Insert Table 2 here*

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26 287 **Statistical predictors of physical activity for the whole sample of transgender participants.**

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28 288 To examine the significant correlates of physical activity in the whole sample ($n=360$), one-
29
30 289 tailed Spearman's Rho correlations were conducted (see Table 3). Age, depression, body
31
32 290 satisfaction, and self-esteem were all found to be significantly correlated with physical
33
34 291 activity. Therefore, the four significantly correlated variables were entered into a stepwise
35
36 292 regression to explore the best statistical predictor(s) of physical activity. Overall the model
37
38 293 was significant ($F(2,300)=12.34$, $p=.001$) and explained 7.6% ($R^2=.076$) of the total variance
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40 294 of physical activity. Self-esteem ($\beta=.20$, $p=.001$) and body satisfaction ($\beta=.12$, $p=.049$) were
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42 295 the best statistical predictors of physical activity, both of which had a positive relationship
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44 296 with the outcome variable.

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49 297 *Insert Table 3 here*

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52 298 **Statistical predictors of physical activity in people who were and were not on cross-sex**
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54 299 **hormones.** The socio-demographics of people who were and were not on cross-sex hormone
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56 300 treatment are presented in Table 2. Mann-Whitney U tests were also conducted to explore

Physical activity in transgender people

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3 301 differences between these two groups on the study's variables (see Table 4). People who
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5 302 were on cross-sex hormones were significantly older, reported higher levels of self-esteem
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7 303 and body satisfaction, and experienced less anxiety and depression in comparison to
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9 304 participants who were not on cross-sex hormones (see Table 4). There were no significant
10
11 305 differences between the groups in relation to experiences of verbal and physical transphobia.

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15 306 *Insert Table 4 here*

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18 307 In the group that was not on cross-sex hormones, age, depression and self-esteem were found
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20 308 to be significantly correlated with physical activity (see Table 3) and these variables were
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22 309 therefore entered into a stepwise regression. Overall, the model was significant and explained
23
24 310 4.8% of the variance in physical activity engagement (see Table 5). The only variable to have
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26 311 a significant relationship with physical activity engagement was self-esteem which was
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28 312 positively related (see Table 5).

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32 313 *Insert Table 5 here*

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35 314 In the group that was on cross-sex hormones, body satisfaction and self-esteem were found to
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37 315 be significantly correlated with physical activity (see Table 3) and were therefore entered into
38
39 316 a stepwise regression. Overall, the model was significant and explained 12.4% of the total
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41 317 variance in physical activity (see Table 5). The only variable that significantly predicted
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43 318 physical activity engagement was body satisfaction, which was positively related (see Table
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45 319 5).

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49 320 **Discussion**

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52 321 This study found that, overall, **treatment seeking** transgender people engaged in less physical
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54 322 activity compared to cisgender people. Cross-sex hormone treatment was found to have an
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56 323 important role in physical activity as transgender people who were taking cross-sex hormones

Physical activity in transgender people

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3 324 engaged in significantly more physical activity compared to transgender people who did not;
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5 325 also, the best **statistical** predictors of physical activity in these two groups differed. While
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7 326 greater body satisfaction (i.e., feeling less dissatisfied with one's body) was found to be the
8
9 327 best predictor of physical activity in transgender people who were taking cross-sex hormones,
10
11 328 greater self-esteem was found to be the best **statistical** predictor in participants who were not
12
13 329 taking cross-sex hormones. Transgender males (who were taking cross-sex hormones)
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15 330 engaged in less physical activity than cisgender males, however this study did not find a
16
17 331 significant difference between transgender females who were on cross-sex hormone treatment
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19 332 and cisgender females. This highlights the importance of increasing the accessibility of cross-
20
21 333 sex hormone treatment. Currently, people have to wait a significant amount of time before
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23 334 they are seen at transgender health services⁴⁶⁻⁴⁸ but our findings suggest that this delay could
24
25 335 be adversely impacting their physical activity engagement, which could contribute to poorer
26
27 336 mental well-being.
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34 338 Both the transgender and cisgender people in the current study reported engaging in
35
36 339 insufficient levels of physical activity.³⁵ However, it was found that, overall, treatment
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38 340 seeking transgender people were significantly less active in comparison to cisgender people
39
40 341 who were matched on age and gender identity. This finding supports previous research²² and,
41
42 342 given the known mental and physical health benefits of physical activity,¹⁻⁶ highlights the
43
44 343 need to improve support for physical activity engagement of **treatment seeking** transgender
45
46 344 people. Efforts should focus on factors that have been shown to predict physical activity
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48 345 within the transgender population.
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54 347 Based on the amount of barriers that transgender people experience when engaging in
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56 348 physical activity and sport^{20,21} it is understandable that greater self-esteem was found to be
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Physical activity in transgender people

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2
3 349 the best **statistical** predictor of physical activity in this current study (for the whole group and
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5 350 for participants who had not taken cross-sex hormones). Although the mechanisms
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7 351 contributing to self-esteem levels are likely to differ in transgender and cisgender people,
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9 352 self-esteem has also been shown to affect physical activity engagement within the cisgender
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11 353 population.^{29,31,32} Consequently, self-esteem interventions developed for the general
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13 354 population (e.g., behaviour change interventions that focus on self-esteem) may be useful in
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15 355 increasing physical activity within the transgender population.^{49,50} Furthermore, gender-
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17 356 affirming medical treatment (e.g., cross-sex hormone treatment and gender-affirming surgery)
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19 357 has been found to increase self-esteem in transgender people^{27,51} and hence also appears to be
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21 358 crucial in indirectly increasing physical activity levels **in transgender people who are**
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23 359 **treatment seeking.**
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28 360
29 361 This study found that once cross-sex hormone treatment had commenced, self-esteem was no
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31 362 longer the best **statistical** predictor of physical activity. In addition, transgender people who
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33 363 were taking cross-sex hormones engaged in significantly more physical activity than
34
35 364 participants who were not. This finding further supports the notion that cross-sex hormone
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37 365 treatment is crucial in indirectly increasing physical activity engagement (in transgender
38
39 366 people who are treatment seeking). Participants who were taking cross-sex hormones had
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41 367 greater self-esteem levels, were less anxious and less depressed, and had a higher body
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43 368 satisfaction (i.e., were less dissatisfied with their bodies). These are all psychological factors
44
45 369 that have been positively associated with physical activity in the cisgender population^{5,28,29}
46
47 370 and therefore may explain why this group was more active in the current study compared to
48
49 371 the group of people who was not taking cross-sex hormones.
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54 372 In transgender people who were taking cross-sex hormones, a higher level of body
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56 373 satisfaction was found to be the best **statistical** predictor of physical activity. This finding is
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3 374 consistent with research that has found body satisfaction to increase once cross-sex hormone
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5 375 treatment has started^{26,52} as well as research with cisgender people that has found that people
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7 376 who have higher levels of body satisfaction engage in more physical activity.^{28,30}
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9
10 377 Interestingly, this study found that levels of physical activity in transgender females on cross-
11
12 378 sex hormones did not differ to levels in cisgender females. Cross-sex hormones appear to
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14 379 alleviate the physical activity inequality seen between cisgender and transgender females.
15
16 380 Therefore, body satisfaction interventions aimed at cisgender women in an effort to increase
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18 381 their physical activity levels may also be applicable among transgender females on cross-sex
19
20 382 hormone treatment, although the feasibility of this would need to be tested.

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24 383 In comparison to transgender males on cross-sex hormone treatment, cisgender males were
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26 384 found to engage in significantly more physical activity. This difference might be explained by
27
28 385 the findings from a recent qualitative study where transgender males who were taking cross-
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30 386 sex hormones discussed how wearing a chest binder^a during physical activity was extremely
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32 387 uncomfortable.²⁰ In addition, body satisfaction in transgender males has been found to
33
34 388 significantly increase following chest reconstructive surgery.⁵³ In light of the current study's
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36 389 findings and previous research, chest reconstructive surgery should be offered in a timely
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38 390 manner in accordance with the recommended Standards of Care, if this is what the person
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40 391 wishes.^{54,55} This may help to indirectly increase physical activity levels among transgender
41
42 392 males (i.e., by increasing their levels of body satisfaction).

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45
46 393 This is the first large scale study to compare physical activity levels of treatment seeking
47
48 394 transgender people with a matched sample of cisgender people, and to quantitatively explore
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50 395 a range of factors which might predict physical activity. There are, however, some limitations.
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52 396 Transphobia was not significantly associated with physical activity, which was surprising

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56 ^aA chest binder is a garment of clothing worn by some transgender men to minimise breast tissue and increase
57 the appearance of a male chest.
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Physical activity in transgender people

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3 397 given that 79% of survey respondents felt that transphobia was a barrier to participating in
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5 398 sport.⁵⁶ This lack of association in our study may be explained by the fact that some
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7 399 transgender people anticipate, as opposed to experience, transphobia^{20,57} and the measure in
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9
10 400 the current study only asked about the experience of transphobia. In addition, the percentage
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12 401 of physical activity explained by the regression models was low. This was despite age and
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14 402 depression being significantly correlated with physical activity. Future research should
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16 403 consider exploring why these factors were significantly associated with physical activity, but
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18 404 did not statistically predict the behaviour. In the current study, the physical activity measure
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20 405 used lacked specificity in relation to the type of physical activity engaged in. In this area of
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22 406 research, understanding the type of physical activity engaged in may highlight important
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24 407 nuances in relation to exercise engaged in based on gender identity (i.e., to achieve a
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26 408 masculine or feminine body shape). Future research may also wish to extend the current
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28 409 study by exploring physical activity levels of non-binary people and determining how and
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30 410 why these may differ to transgender people who identify as female or male.

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35 411 The findings of this research lead to several recommendations which could be useful for
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37 412 health professionals who are working with transgender individuals to implement in an effort
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39 413 to support physical activity engagement in this group. These include a need to develop or
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41 414 implement interventions to increase self-esteem and body satisfaction (and, in turn, physical
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43 415 activity). In addition to this, it is recommended that gender confirming medical interventions
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45 416 are offered in a timely manner, especially cross-sex hormone treatment and mastectomy, so
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47 417 as to facilitate transgender individuals' engagement in physical activity.

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51 418 In conclusion, there is an inequality in physical activity engagement between treatment
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53 419 seeking transgender people (especially those not on cross-sex hormones) and cisgender
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55 420 people. Cross-sex hormone treatment appears to be crucial in indirectly increasing physical
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3 421 activity engagement within the transgender population. Therefore the accessibility of cross-
4
5 422 sex hormone treatment for transgender individuals needs to be increased.
6
7

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9

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29 432 **References**
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Physical activity in transgender people

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

	Cisgender	Transgender
	(n=137) (%)	(n=137) (%)
Mean age (<i>SD</i>)	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)

592 *Note: N/A means not applicable*

593

594 Table 2: Socio-demographic characteristics of the whole sample of transgender participants,
 595 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)	

596 CHT: Cross-sex Hormone Treatment

Physical activity in transgender people

597 Table 3: One-tailed Spearman's Rho correlations between physical activity and the study
 598 variables, presented for the whole sample and separately for those who were and were not on
 599 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***

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

601 applicable

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

	No cross-sex hormone treatment		Cross-sex hormone treatment		Mann-Whitney U			
	group (n=241)		group (n=102)		U	z	Effect size	p
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)				
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

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Physical activity in transgender people

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

	F	R^2	β	SE β	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***

608 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$