



1 **Why do people exercise in natural environments? Norwegian adults' motivations for**
2 **nature-, gym-, and sports-based exercise**

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13

14 *Abstract:*

15 Exercise in natural environments (“green exercise”) confers numerous health benefits, but
16 little is known about why people engage in green exercise. This study examined the
17 importance of nature experiences as a motivation for physical activity and the motivational
18 profile of people who engage in green exercise compared to gym- and sports-based exercise.
19 Physical activity motivations and typical times spent in different domains of physical activity
20 were reported by 2,168 Norwegian adults in a survey. Experiencing nature was generally
21 rated as the second-most important physical activity motivation, exceeded only by
22 convenience motivations, and it was especially important for older adults and those who
23 engage in greater amounts of instrumental physical activity. Green exercisers reported
24 stronger motivations concerning convenience and experiencing nature, whereas gym- or
25 sports-based exercisers reported stronger motivations for physical health and sociability. The
26 motivations associated with different leisure-time exercise domains may assist in
27 understanding optimal promotion of green exercise.

28 *Keywords:*

29 Outdoor recreation; health promotion; physical activity; greenspace; sedentary; leisure time.

30

31 *1. Introduction*

32 Natural environments have emerged as useful settings for promoting physical activity because
33 access to them has been consistently associated with moderate-to-vigorous physical activity
34 attainment worldwide [1]. Green exercise, i.e. physical activity within natural environments
35 [2], is often of a health-enhancing intensity [3,4] and it has been associated with additive
36 psychological benefits over physical activity in other types of environment, including
37 reduction of psychophysiological stress and enhanced mental health [5]. Such positive
38 psychological effects have been also shown to predict future engagement in physical activity
39 [6,7]. Therefore, promotion of green exercise can relieve some of the health and economic
40 burdens placed on society through inactivity as well as promote health in a broader sense. For
41 instance, green exercise has been estimated to save society around £2.2billion in the UK alone
42 through welfare gains [8]. Knowing why people choose to engage in green exercise could
43 inform promotional efforts in the future, but little research has been dedicated to this question
44 to date.

45 Generally, different domains of leisure-time physical activity (LTPA) have been associated
46 with different motivational profiles. For example, engaging in individual sports-based
47 physical activity has been associated with enjoyment and mastery motivations, while
48 participating in fitness groups and other exercise has been associated with appearance-related
49 motivations [9,10]. One issue with these studies is that they conflate indoor and outdoor
50 physical activity when the motivations for each are likely to be different. Enjoying nature was
51 reported as an important perceived benefit among visitors of natural parks [11]. Nature
52 relatedness and feelings about nature were significant predictors of visiting nearby natural
53 environments as well as engaging in high levels of green exercise [12,13]. The qualitative
54 literature has also revealed the importance of nature experiences as a factor of motivation for
55 green exercise. For example, leisure visits to UK parks were reported to be often motivated by

56 opportunities to engage with natural qualities of the space as well as physical and cognitive
57 restoration [14]. Similarly, enjoyment of engaging in outdoor activities and the sensory
58 experience of nature were important meanings and values related to being active outdoors in a
59 sample of middle-aged and older men living in a rural area of Norway [15]. However, the
60 value of nature experiences as a motivation for physical activity and, more generally, the
61 motivational profile of those who engage in green exercise as a primary domain of LTPA
62 remains little researched.

63 According to *Attention Restoration Theory* [16], natural environments are perceived by
64 individuals as intrinsically interesting and can therefore provide opportunities for cognitive
65 restoration. Consequently, nature experiences can lead to positive psychophysiological states
66 such as stress relief and more positive states of wellbeing. Another consequence of this
67 phenomenon is that, when one exercises in the presence of nature, their focus of attention will
68 be shifted towards the environment rather than towards internal feelings of fatigue, resulting
69 in reduced perceived exertion [17]. As described in the model proposed by Calogiuri &
70 Chroni [7], altogether, this can impact people's intention to engage in physical activity and
71 outdoor recreation, as well as help them sustain higher exercise intensities than they would
72 sustain in other environments. Nature-related affective beliefs (e.g. feelings about nature) play
73 an important role in this process, mediating the psychological effects of being exposed to
74 nature and serving as an important motivation to engage in green exercise [7,12]. However,
75 the preceding motivations depend also on peoples' environmental preferences and expected
76 physical activity benefits [18,19], as well as on the characteristics of the individuals' and their
77 living environment [7,20].

78 *1.1 Present study*

79 In the present study, results from a national survey of Norwegian adult's physical activity
80 behaviours are utilised to discover the motivations for different types of LTPA, including
81 green exercise. Our research questions were:

- 82 1. What is the relative importance of nature experiences in relation to other physical
83 activity motivations among adults in Norway and what demographic characteristics
84 are associated with them?
- 85 2. What physical activity motivations are associated with participation in green exercise
86 among adults in Norway and how do these differ from the motivations associated with
87 participation in other leisure-time physical activities?

88 *2. Method*

89 *2.1 Respondents*

90 In 2012, *Norsk Friluftsliv* (a Norwegian outdoor recreation organisation) commissioned a
91 national survey which aimed to explore physical activity behaviours and motivations among
92 adult Norwegians, with particular emphasis on participation in green exercise. The web-based
93 survey was administered by a market research company during October 2012. Invitations to
94 participate were sent via email to 8,620 individuals aged 18 or older, randomly selected from
95 a panel of approximately 50,000 individuals who regularly participate in the company's
96 surveys. The sample was stratified by gender, age and geographical area with the aim of
97 recruiting a broad demographic representative of the Norwegian population. In total, 2,168
98 responses were collected (response-rate=25%).

99 2.2 Measures

100 2.2.1 Primary domain of leisure-time physical activity

101 The outcome variable used in this study constituted the domain of moderate-to-vigorous
102 intensity LTPA which the respondent undertook for the most time in a typical week. In the
103 survey, the amount of time spent in moderate-to-vigorous physical activity in a typical week
104 was measured with the item: “For how much time (hours and minutes) through the course of a
105 regular week, do you engage in activities that increase your breathing or make you sweat?”
106 Subsequently, respondents were asked to report how much of this time was spent undertaking
107 a list of specific activities. Three of these activities could be considered leisure activities:
108 “organised sports,” “exercising in the gym,” and “walking or exercising in parks, green spaces
109 or other natural environments” (henceforth “green exercise”). For each respondent, each
110 numeric response was converted into a percentage of the overall time spent engaged in LTPA.
111 Each respondent was then assigned a primary domain of LTPA according to the type of
112 leisure-time activity they engaged in for the highest percentage of time in a typical week. In
113 all but 15 cases, this activity constituted over 50% of the overall time reported in the initial
114 question.

115 Respondents who engaged in more than one LTPA for equivalent proportions of time were
116 excluded (n=113). In Norway it is not uncommon for individuals to exercise their dog for
117 intrinsic reasons (e.g. whilst running, horse riding or sledding) as well as extrinsic reasons (to
118 exercise the animal). Therefore, due to possible overlap with green exercise, those who
119 reported “walking/exercising with dog or other domestic animal” as their primary domain of
120 overall physical activity (n = 148) were excluded from final analysis. Lastly, respondents for
121 whom the majority of typical weekly LTPA was unaccounted for by the activities listed in the
122 survey were also excluded (n=79). In total, 975 respondents’ primary domain was green
123 exercise, 373 was gym-based exercise and 200 was sports-based exercise. In addition to these

124 three categories, a fourth category was assigned to 280 respondents who reported not
125 engaging in any LTPA in a typical week.

126 2.2.2 Motivations for physical activity

127 In the survey, respondents were asked to rate the importance they assigned to 22 motivations
128 for engaging in physical activity generally on a scale from 1 (not important) to 4 (very
129 important). A fifth option (does not apply to me) was not considered in analysis. Two reasons
130 (“to get fresh air” and “to experience nature”) were used to create a “nature experience”
131 motivation category ($\alpha=.81$). Principal components analysis was used to cluster the other
132 motivations into superordinate groups. Components’ extraction was based on Eigenvalues
133 greater than 1 [21], examination of scree plots [22], and factor loadings above 0.45 [23]. No
134 motivation item loaded on more than one component. One motivation item (“to recover after
135 sickness, pregnancy or injury”) was excluded on the basis of a low communality coefficient
136 and factor loading. Five components were extracted. Briefly, these components were named
137 “affective benefits” ($\alpha=.86$), “convenience” ($\alpha=.68$), “sociability” ($\alpha=0.79$), “long-term
138 health” ($\alpha=.81$) and “body-oriented benefits” ($\alpha=.74$). Details of all six categories can be
139 viewed in Table 1.

140

Table 1.

Grouped motivations for physical activity according to results from principal components analysis

Superordinate group and included items^a	N^c	Eigenvalues	α
Nature experience ^b	2130	-	0.81
- To experience nature			
- To get fresh air			
Affective benefits	2137	6.15	0.86
- I experience mental wellbeing when I'm in good shape			
- I experience physical wellbeing when I'm in good shape			
- To relax, reduce stress			
- Because I enjoy it			
- To get excitement, challenges			
- It gives me better self-confidence			
Convenience	2146	1.79	0.68
- That I can keep a comfortable pace, with no pressure from others			
- That the activity is free or reasonably cheap			
- That I can do it at any time, when it suits me best			
- That I can do it near home, school, workplace, etc.			
Sociability	2144	1.61	0.79
- That I can be together with others			
- Being with my friends			
Long-term health	2119	1.32	0.81
- To reduce sick-leave from work/school			
- To have a long work-life			
- To be independent, active and healthy when I'll retire			
Body-oriented benefits	2139	1.05	0.74
- To keep/reduce my bodyweight			
- I think I have to			
- To get physical strength			
- To prevent health problems			

[a] Included items are ranked by factor loading

[b] This category was created "ad-hoc", as the two included items are closely related to green exercise

[c] Different sample sizes are result of excluding respondents who answered that the individual motivation items "did not apply" to them.

141

142

143 2.2.3 Controls

144 A battery of demographic items were also recorded in the survey. Age and sex were
145 controlled for as they have previously been associated with adult's participation in different
146 domains of LTPA [24]. Educational level has been positively associated with adult's overall
147 physical activity and the presence of young children in the household has been negatively
148 associated with adult's overall physical activity [25]; both of these were also controlled for in
149 analysis. Educational level was operationalised as two categories: those who had completed
150 13 years or less of education (i.e. up to the end of upper-secondary school in Norway) or those
151 who had completed more than this, or who were currently studying (i.e. anyone in, or having
152 completed, higher education, including university). The presence of young children in the
153 household was operationalised as a binary variable. Participant's home zip codes were
154 recorded and from this we were able to identify whether they resided in an urban or rural
155 location. This was controlled for because different patterns of leisure-time green exercise exist
156 for urban and rural dwellers [3]. Lastly, participation in instrumental physical activities was
157 controlled for. In addition to domains of leisure time physical activity, participants reported
158 the time spent in a typical week engaged in activities such as "active transport to/from work
159 or school," "physical activity within school or work hours," and "walking or exercising with a
160 dog or other domestic animal." The total time spent in these domains was calculated and used
161 as a linear control variable in analysis.

162 2.3 Analytical strategy

163 To address the first research question, a preliminary analysis was undertaken to determine
164 what demographic characteristics were associated with "nature experience" and the other five
165 superordinate physical activity motivations. Using Wilks' Lambda as the test statistic,
166 multivariate analyses of variance (MANOVA) were undertaken where the six physical
167 activity motivations were set as dependent variables and sex, educational level, presence of

168 young children in the household and urban/rural residence set as predictors in separate
169 models. Age and instrumental physical activity were entered as continuous covariates in
170 separate models. If a significant multivariate effect was observed, a univariate test (ANOVA)
171 was performed to establish relationships between individual motivations and the demographic
172 characteristics.

173 A nominal logistic regression model was then developed to answer our second research
174 question. This predicted respondent's primary domain of LTPA from different motivations for
175 physical activity. To determine the extent to which different motivations predicted green
176 exercise, respondent's whose primary domain of LTPA was green exercise were used as the
177 reference category in comparison to the three other domains (gym-based, sports-based and not
178 typically engaged in LTPA). The primary domain of LTPA was regressed upon the five
179 physical activity motivations derived from the principal components analysis (entered as
180 linear variables) as well as the other control variables. The "nature experience" motivation
181 was subsequently added to the model in order to understand the contribution of this specific
182 motivation in predicting the respondents' primary domain of LTPA.

183 *3. Results*

184 *3.1 Sample description*

185 The sample was well balanced with respect to sex (50.4% males; 49.6% females), and age
186 was normally distributed (median = 53.0 years). Most of the respondents had no responsibility
187 for small children (71.1%), lived in urban areas (60.1%) and had high educational level or
188 were currently studying (63.5%). Importantly, the majority of respondents reported fairly high
189 levels of overall physical activity (median=180.00 min/week), which appear to be
190 predominantly leisure-time physical activities. Among the instrumental domains of physical
191 activity, "walking/exercising with a dog or other domestic animal" was the one which

192 accounted for the greatest amount of overall physical activity (median=120 min/week), with
193 transport-related and occupational physical activity less so (median=60 min/week for both
194 domains). The different domains of LTPA were fairly equivalent in terms of weekly amounts
195 of time the respondents spent in each of them (median=120 min/week for all domains).

196 *3.2 Nature experience and other physical activity motivations*

197 As shown in table 2, “experiencing nature” was the second most important motivation for
198 physical activity in the sample, exceeded in importance only by “convenience”. “Affective”
199 and “body-oriented” motivations were also perceived as important, whereas “long-term
200 health” and “sociability” motivations were generally rated as less important. Results from the
201 MANOVA can also be viewed in Table 2. There were significant multivariate effects for
202 every demographic characteristic. “Experiencing nature” was especially important among
203 women, older adults, and those who engage in greater amounts of instrumental PA during a
204 regular week. Although the pattern of relative importance attributed to different motivations
205 remained relatively unchanged when observing each sex separately, females rated the
206 importance of all motivations significantly higher than males. Besides giving more
207 importance to the experience of nature, older adults attributed more importance to long-term
208 health motivations, whereas younger respondents assigned more importance to affective
209 benefits, and sociability motivations. Respondents with higher education levels assigned
210 significantly more importance to affective benefits and body-oriented benefits. Respondents
211 with no young children in the household assigned greater importance to convenience motives
212 than those with young children. Finally, besides giving more importance to the experience of
213 nature, the respondents who engaged in more instrumental physical activity in a typical week
214 also assigned more importance to affective benefits and convenience.

215

Table 2.

Results from a MANOVA analysis examining perceived importance attributed to the different motivations across demographic groups in the sample ($n=2,096$)^a.

Variable	Motivations for physical activity (M±SD)					
	Nature Experience	Affective beliefs	Convenience	Sociability	Long-term health	Body-oriented beliefs
Overall sample	3.16±0.75	3.02±0.66	3.26±0.54	2.52±0.78	2.93±0.82	3.00±0.62
Sex						
Male	3.04±0.76	2.93±0.67	3.17±0.56	2.42±0.77	2.81±0.82	2.86±0.62
Female	3.28±0.71	3.11±0.63	3.34±0.49	2.62±0.78	3.06±0.79	3.15±0.58
MANOVA: $F_{(6, 2089)}= 27.40^{***}$						
ANOVA: $F_{(1, 2094)}= \dots$	60.03***	36.60***	54.46***	32.50***	51.91***	119.71***
Age						
(continuous)	t = 6.56	t = -2.37	t = 1.13	t = -4.62	t = 10.28	t = -1.35
MANOVA: $F_{(6, 2089)}= 52.00^{***}$						
ANOVA: $F_{(1, 2094)}= \dots$	42.97***	5.61*	1.27	21.35***	105.77***	1.83
Education						
Lower education	3.14±0.75	2.95±0.66	3.25±0.57	2.56±0.77	2.92±0.82	2.96±0.65
Higher education	3.17±0.74	3.06±0.65	3.26±0.51	2.50±0.78	2.94±0.81	3.03±0.59
MANOVA: $F_{(6, 2089)}= 4.43^{***}$						
ANOVA: $F_{(1, 2094)}= \dots$	0.76	11.91**	0.02	2.88	0.54	6.42*
Young children at home						
No	3.17±0.75	3.02±0.66	3.27±0.53	2.51±0.80	2.95±0.83	2.99±0.63
Yes	3.12±0.73	3.03±0.64	3.21±0.54	2.54±0.74	2.90±0.78	3.04±0.59
MANOVA: $F_{(6, 2089)}= 3.11^{**}$						
ANOVA: $F_{(1, 2094)}= \dots$	2.07	0.09	6.89**	0.55	1.27	2.30

Residential location

Urban area	3.13±0.75	3.02±0.65	3.24±0.53	2.54±0.77	2.90±0.82	3.02±0.59
Rural area	3.20±0.74	3.02±0.66	3.28±0.55	2.48±0.79	2.97±0.81	2.98±0.66

*MANOVA: $F_{(6, 2089)} = 3.68^{**}$*

ANOVA: $F_{(1, 2094)} = \dots$

	3.67	0.00	2.25	3.30	3.72	1.86
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Instrumental physical activity

(continuous)

	t = 3.69	t = 2.58	t = 3.41	t = 1.02	t = 1.65	t = -1.04
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*MANOVA: $F_{(6, 2089)} = 5.22^{***}$*

ANOVA: $F_{(1, 2094)} = \dots$

	13.59 ^{***}	6.68 ^{**}	11.60 ^{**}	1.03	2.73	1.09
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* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] The reduced sample size is due to the exclusion of respondents who answered that any of the individual motivations items “did not apply” to them.

216 *3.3 Motivations for green exercise or other forms of leisure-time physical activity*

217 The results of the nominal logistic regression can be viewed in Table 3. The model revealed
218 distinct motivational profiles for respondents with different primary domains of LTPA.

219 Firstly, in the model unadjusted for “nature experience”, higher convenience motives were
220 significantly associated with a higher likelihood of having green exercise as a primary
221 domain of LTPA compared to both gym-based and sports-based exercise. However, greater
222 importance assigned to “body-oriented benefits” was associated with a significantly lower
223 likelihood of green exercise compared with gym-based and sports-based exercise. Higher
224 “long-term health” motivations were associated with a higher likelihood, and “sociability”
225 motivations with a lower likelihood, of green exercise compared to sports-based exercise..

226 Finally, higher motivations to achieve “affective benefits” were associated with a higher
227 likelihood of green exercise when compared with respondents undertaking no LTPA in a
228 typical week. In short, participation in green exercise was associated with higher
229 “convenience,” “affective benefits” and (to a lesser extent) “long-term health” motivations
230 after adjustment for demographic variables and before adding “nature experience” into the
231 model. Furthermore, older age was associated with a higher likelihood of green exercise
232 compared with all other domains. Being male, of lower education, having young children in
233 the household, living in a rural area and engaging in more instrumental physical activity in a
234 typical week were associated with a higher likelihood of green exercise compared to gym-
235 based exercise. Having young children in the household was additionally associated with a
236 higher likelihood of green exercise compared to sports-based exercise, whereas engaging in
237 more instrumental physical activity in a typical week was additionally associated with a
238 lower likelihood of green exercise compared to respondents who engage in no LTPA.

239

Table 3.

Nominal logistic regression modeling the relationship of favorite leisure-time physical activity with different motivational factors in adult Norwegians, after controlling for selected background (n= 1,761^a).

	Primary domain of LTPA – OR (95% CI)		
	Exercise in the gym	Participate in sports	Not engage in LTPA
	vs. Green exercise	vs. Green exercise	vs. Green Exercise
<i>Model I (Pseudo R²: Cox & Snell = 27%; Nagelkerke = 30%)</i>			
Affective benefits	1.12 (0.85-1.47)	0.98 (0.69-1.39)	2.51 (1.89-3.33)***
Convenience	3.10 (2.35-4.08)***	3.94 (2.84-5.48)***	1.18 (0.87-1.60)
Sociability	1.16 (0.97-1.40)	0.44 (0.34-0.57)***	1.07 (0.86-1.34)
Long-term health	0.96 (0.78-1.18)	1.31 (1.02-1.69)*	1.07 (0.85-1.34)
Body-oriented benefits	0.25 (0.18-0.34)***	0.61 (0.42-0.87)**	1.18 (0.87-1.60)
Age	1.04 (1.03-1.05)***	1.04 (1.03-1.05)***	1.04 (1.03-1.05)***
Sex			
Male	1.33 (1.01-1.74)*	0.95 (0.68-1.34)	1.11 (0.81-1.45)
Female=ref			
Education			
Lower education	1.51 (1.13-2.02)**	1.17 (0.83-1.65)	1.00 (0.73-1.37)
Higher education=ref			
Having small children			
No	0.64 (0.48-0.86)**	0.64 (0.45-0.93)*	0.99 (0.71-1.37)
Yes=ref			
Centrality			
Urban area	0.71 (0.54-0.94)*	1.25 (0.89-1.75)	1.01 (0.74-1.39)
Rural area=ref			
Overall instrumental PA	1.002 (1.001-1.003)**	1.001 (0.999-1.003)	0.999 (0.998-0.999)**
<i>Model II (Pseudo R²: Cox & Snell = 30%; Nagelkerke = 34%)</i>			
Nature experience	2.51 (1.96-3.21)***	2.60 (1.93-3.50)***	1.26 (0.95-1.66)
Affective benefits	0.64 (0.47-0.89)**	0.58 (0.39-0.86)**	2.19 (1.58-3.03)***
Convenience	2.59 (1.95-3.45)***	3.14 (2.23-4.41)***	1.14 (0.84-1.55)
Sociability	1.08 (0.89-1.30)	0.41 (0.32-0.53)***	1.06 (0.85-1.33)
Long-term health	0.90 (0.72-1.11)	1.19 (0.92-1.54)	1.05 (0.84-1.32)
Body-oriented benefits	0.25 (0.18-0.35)***	0.62 (0.43-0.90)*	1.18 (0.87-1.61)
Age	1.03 (1.02-1.04)***	1.03 (1.02-1.05)***	1.04 (1.02-1.05)***
Sex			
Male	1.48 (1.12-1.96)**	1.04 (0.74-1.47)	1.14 (0.83-1.56)
Female=ref			

Education			
Lower education	1.50 (1.11-2.01)**	1.16 (0.82-1.64)	1.00 (0.73-1.37)
Higher education=ref			
Having small children			
No	0.65 (0.48-0.89)**	0.66 (0.45-0.95)*	0.97 (0.70-1.36)
Yes=ref			
Centrality			
Urban area	0.73 (0.55-0.97)*	1.28 (0.91-1.81)	1.02 (0.74-1.40)
Rural area=ref			
Overall instrumental PA	1.002 (1.000-1.003)*	1.001 (0.999-1.003)	0.999 (0.998-0.999)**

* p<0.05; ** p<0.01; *** p<0.001

[a] Reduced sample size is the result of (i) excluding respondents who answered “do not apply” to any individual motivation item (n=67); (ii) excluding respondents who spent equal amounts of time in a typical week engaged in more than one LTPA domain (n=113); (iii) excluding respondents who reported that the majority of their typical moderate-to-vigorous physical activity in a typical week was unaccounted for by the specific types of activity explored in the survey (n=79), and; (iv) excluding respondents who reported exercising a dog or other domestic animal (n=148, see 2.2.1).

240

241 Most of these relationships remained after the inclusion of the “nature experience” motivation
 242 into the model. However, long-term health motives were no longer associated with a higher
 243 likelihood of having green exercise as a primary domain of LTPA compared with sport-based
 244 exercise. The first new pattern to emerge was that higher “affective benefits” motives were
 245 now associated with a lower likelihood of green exercise compared with both gym-based and
 246 sports-based exercise, whereas they remained associated with higher likelihood of green
 247 exercise compared with those who engage in no LTPA. Higher motivations for nature
 248 experience were, unsurprisingly, associated with a higher likelihood of green exercise
 249 compared to both gym-based and sports-based exercise, but not compared to those who
 250 engage in no LTPA. The associations with the sociodemographic variables remained also
 251 generally unchanged.

252 4. Discussion

253 4.1 Summary of findings

254 The findings of this study show that experiencing nature is generally perceived as an
255 important physical activity motivation in our sample, yielding the second-highest ratings of
256 importance in our sample, preceded only by convenience motivations. Nature experience
257 motivations were especially important among older adults and those who engage in greater
258 amounts of instrumental physical activity during a regular week. Furthermore, distinct
259 motivational profiles for respondents with different primary domains of LTPA were revealed:
260 compared with those who mainly exercise in the gym or participate in sports, those who
261 mainly engage in green exercise assigned more importance to nature experiences and
262 convenience motivations, and less importance to body-oriented and sociability motivations.

263 4.2 The importance of nature experiences as a green exercise motivation

264 Norwegians are known for being generally fond of green exercise and outdoor recreations
265 [26], and this could explain why nature experiences were attributed *such* high importance in
266 our sample. Previous surveys in the Norwegian adult population have identified “preventing
267 health problems” as the most important physical activity motivation [27], which is in line
268 with other international studies [28]. These studies however did not include nature
269 experiences (nor convenience) motivations as an option for their respondents, and this could
270 explain the differences with our findings. Consistent, in part, with previous cross-sectional
271 literature, we found that experiencing nature was perceived as a more important motivation
272 for physical activity among females [29], older adults [30] and those who engage in greater
273 amounts of instrumental physical activity during a regular week. Compared with males,
274 females tended to assign greater importance to all physical activity motivations, therefore sex
275 differences did not appear to be specifically related to nature experiences. Age presented

276 quite a different pattern: the importance of experiencing nature increased with increasing age,
277 while at the same time the importance of affective benefits and sociability motivations
278 decreased, suggesting that these motivations are quite distinct from each other. The increased
279 importance assigned to nature experiences in older adults is in line with the literature. Studies
280 have previously revealed that younger generations are less engaged with nature as compared
281 with older generations [31]. Although such phenomena are not yet well explored in the
282 physical activity domain, the findings observed in our sample support such findings in
283 previous studies.

284 On the importance attributed to nature experiences, it was unsurprising that “convenience”
285 was generally reported as the most important motivational factor for physical activity: “lack
286 of time” is known to be a very common barrier to physical activity [27,32] and two of the
287 items in our “convenience” category, “That I can do it at any time, when it suits me best” and
288 “That I can do it near home, school, workplace, etc.”, are clearly related to overcoming such
289 a barrier. It is also unsurprising that this motivation was perceived as more important among
290 those who engaged in greater amounts of instrumental physical activity. Interestingly, these
291 individuals also assigned greater importance to nature experience as a motivation. This
292 supports, in part, the model proposed by Calogiuri & Chroni [7], according to which the
293 presence of natural elements within people’s living environment can lead to positive affective
294 responses that will in turn impact their physical activity levels, for example, fostering
295 instrumental forms of physical activity such as walking or biking to nearby destinations.

296 *4.3 On the motivational profile of the green-exercisers*

297 Understandably, experiencing nature is confirmed to be an important motivation for green-
298 exercise. This is in line with quantitative and qualitative studies that have investigated the
299 motives and values of individuals who visit natural environments and engage in outdoor

300 recreation [11-15]. According to our findings, green exercisers are not driven by body-
301 oriented motives in comparison to sports- and gym-based exercisers. In part this can be
302 explained by previous literature, as body image themes are closely intertwined with sports
303 and fitness participation, at least in the media [33]. In contrast, motivations to engage in green
304 exercise involve focusing on external factors such as the natural surroundings [34], rather
305 than internal factors such as body image.

306 Another important motivational factor that distinguished green exercisers from those who
307 mainly engage in gym- and sports-based exercise was “convenience”. The importance of
308 natural environments and urban green spaces to physical activity has been long advocated,
309 based on the evidence that, if easily accessible and well maintained, natural environments can
310 provide users with spaces where they can engage in physical activity free of charge and at
311 times that better suit their daily schedules [7,35]. A large body of literature supports such
312 assumptions, showing that individuals who live in the proximity of safe and accessible
313 natural environments are more likely to engage in high levels of physical activity [1,20].
314 Interestingly, the item with the greatest factor loading within the category convenience was
315 "That I can keep a comfortable pace, with no pressure from others", suggesting that not only
316 the economical-, accessibility-, and time-related convenience factors are important
317 motivations, but also the possibility of self-regulating exercise intensity according to personal
318 preferences and comfort.

319 The association between affective motivations and green exercise participation changed
320 significantly after the motivation “nature experiences” was added into the model. The
321 relationship between green exercise and affective motivations changed from being non-
322 significant to being negative. However, such negative associations should not be interpreted
323 as the green exercisers giving little importance to the affective benefits of physical activity in
324 absolute terms. Exercise is known to provide psychological benefits independently of the

325 environment it takes place in [36]. Moreover, peoples' environmental preferences and
326 expected physical activity benefits are important factors determining the extent to which one
327 perceives natural environments as a suitable arenas for their exercise [18,19]. Thus, our
328 findings would indicate that those who assign greater importance to the affective benefits of
329 physical activity, but are at the same time not motivated by experiencing nature, are more
330 likely to exercise in the gym or participate in sport, especially if they believe that such
331 environments can better provide better opportunities to pursue body-oriented and social
332 benefits [18]. This interpretation is also supported by the fact that in the model adjusted for
333 nature experience motivations, negative associations with green exercise were found only in
334 the comparisons with gym- and sports-based exercise, whereas the association remained
335 positive when green exercise was compared with those who engage in no LTPA during an
336 average week.

337 Males, those with higher education, those who have small children in the household, those
338 who live in rural areas and those who engage in greater amounts of instrumental physical
339 activity during a regular week were more likely to engage in green exercise than in gym-
340 based exercise. No associations with demographic variables were observed when comparing
341 green exercisers with those who engage in sports nor with those who do not engage in any
342 LTPA during a regular week, suggesting that the demographic characteristics do not present
343 major barriers to green exercise. Moreover, given the similar importance of nature
344 experiences and convenience motivations, one may assume that those who engage in no
345 LTPA could be more easily persuaded to engage in green exercise rather than gym- or sport-
346 based exercise. These findings are in line and at the same time extend previous analyses in
347 the same sample [26]. Attention should be given however to the association of green exercise
348 with sex. We found that females were more likely to prefer gym-based exercise over green
349 exercise. The relation between sex and use of natural environments for physical activity is not

350 well understood, as the findings are mixed [7,20]. However, perceived safety is likely to be
351 an important issue [20,37,38].

352 *4.4 Limitations*

353 This is the first study to determine the motivational profile of adults who undertake green
354 exercise as their primary domain of LTPA. However, due to the cross-sectional nature of this
355 study, the analysis is subject to a number of limitations. Firstly, the analysis assumes that
356 participants accurately recall the time spent in different domains of leisure-time physical
357 activity. Since the perception of elapsed time can often be longer when engaged in green
358 exercise compared to other forms of exercise [39], it is plausible that participants recalled a
359 greater duration of green exercise than was actually the case. Nonetheless, there is evidence
360 that all forms of physical activity can lead to lengthened perceptions of time [40], so there
361 may be no reason to suggest that recall of time in green exercise was systematically
362 misremembered more than any other domain.

363 Secondly, and more pertinently to the present study, the analyses represent associations
364 between time spent in different LTPA domains and motivations for physical activity
365 generally. This means that we cannot ascribe any individual motivation to any particular
366 episode of physical activity. For example just because ratings of “convenience” motivations
367 for physical activity generally are associated with more participation in green exercise, this
368 does not mean that any one episode of green exercise was motivated by its convenience.
369 Future research may wish to interrogate datasets that have the ability to associate specific
370 active visits to natural environments with motivations for that specific visit; the UK’s
371 Monitor of Engagement with the Natural Environment survey [41] is one such dataset which
372 allows this possibility, albeit in a non-Scandinavian context.

373 Thirdly, the data from the survey determined how we clustered together different motivation
374 items. While we believe a principle components analysis was the fairest way to group the
375 individual motivation items, it also means that other conceptually related motivation items
376 may have been separated. For example, self-determination theory, a psychological theory of
377 motivation, posits that feelings of autonomy over one’s behaviour; the perception that one is
378 competent enough to perform a behaviour; and feelings of relatedness or personal connection,
379 converge to support the development and enactment of motivations [42]. The motivation
380 items, “that I can do it at any time which suits me,” and, “I think I have to” are both clearly
381 related to autonomous motivations for physical activity (the latter obviously referring to non-
382 autonomy), however in this analysis both are clustered under different superordinate
383 motivational constructs. Since systematic reviews have previously demonstrated consistent
384 positive relationships between autonomous forms of motivation and exercise participation
385 [43], clustering motivation items based on a psychological theory such as self-determination
386 theory may have been a useful avenue for investigating whether green exercise is associated
387 with more autonomous forms of motivation. Future research may want to cluster motivations
388 according to theories of motivation in order to test hypotheses about proposed pathways of
389 such theories.

390 *5. Conclusion*

391 In a large sample of Norwegian adults, participation in green exercise was associated with
392 physical activity motivations concerning convenience and the opportunity to experience
393 nature. These represent distinct motivational profiles from those who spend more time
394 engaged with gym- or sports-based exercise. Nature experience was also an important
395 motivator for older adults and those who engaged in greater amounts of instrumental physical
396 activity. Future research could investigate whether green exercise motivations are more
397 intrinsic or extrinsic by investigating combinations of motivational factors that are in line

398 with psychological theories of motivation. Nonetheless, the data presented here could help to
399 inform how to motivate different sub-populations to engage in green exercise in the future.

400

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407 *Author Contributions*

408 Dr Calogiuri conceived and designed the study, performed all the analyses and drafted the
409 manuscript. Dr Elliott replicated all analysis and provided substantial contributions to
410 revision of the intellectual content and final development of the manuscript. All authors
411 approved the final version of the manuscript.

412 *Conflicts of Interest*

413 The authors declare no conflict of interest. Norsk Friluftsliv designed the questionnaire used
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423

424 5.4 References

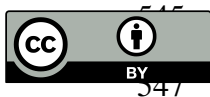
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