Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original research

Running behavior and symptoms of respiratory tract infection during the COVID-19 pandemic
A large prospective Dutch cohort study

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ABSTRACT

Objectives: To explore changes in running behavior due to the Coronavirus Disease 2019 (COVID-19) pandemic, assess presence of symptoms suggestive for COVID-19 and identify whether there is an association between running behavior and COVID-19.
Design: Prospective cohort study.
Methods: For this study we used a cohort of runners participating in an ongoing randomized controlled trial on running injury prevention among recreational runners. At baseline, demographic and training variables were collected. Seven weeks after starting the lockdown, information on running behavior (interval training, training with partner and physical distancing during training) and running habits (training frequency, duration, distance and speed) were obtained. Furthermore, healthcare utilization and symptoms suggestive for COVID-19 were assessed. To determine the association between running and symptoms suggestive for COVID-19, univariate and multivariate logistic regression analyses were performed.
Results: Of the 2586 included participants, 2427 (93.9%) participants continued running during lockdown with no significant changes in mean weekly training variables. A total of 253 participants (9.8%) experienced symptoms suggestive for COVID-19 and 10 participants tested positive for COVID-19. Two participants were admitted to hospital due to COVID-19 with both one day of admission. Running behavior and running habits were not associated with the onset of symptoms suggestive for COVID-19.
Conclusions: The large majority of runners in the Netherlands did not change their running habits during lockdown. No association between running behavior or running habits and onset of symptoms suggestive for COVID-19 was identified. This implicates that running outdoor during lockdown does not negatively affect health of runners.

Practical implications

- Runners are able to maintain their normal training habits during lockdown due to the COVID-19 pandemic.
- Only a small numbers of runners were tested positive for COVID-19 or were shortly admitted to hospital due to COVID-19.
- The health of runners seem not to be affected negatively when running outdoor during lockdown due to the COVID-19 pandemic.

1. Introduction

Coronavirus Disease 2019 (COVID-19) has been reported worldwide in more than a million cases and resulted in more than 300,000 deaths since May 2020.[1] This new pandemic led to governments implementing lockdown with the aim to prevent healthcare services beyond its limits. In several countries athletes were strictly forbidden to perform outdoor physical activities. Overall this might have resulted in people undertaking less physical activities than normal for prolonged periods.[2] The Dutch government decided to implement a 'targeted lockdown' (March 9, 2020) with advices on meticulous hygiene measures and physical distancing and restrictions in traveling and group meetings. The Dutch authorities

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advised to stay home as much as possible, but performing outdoor physical activities was not restricted.

Running is a popular sport all over the world. In the Netherlands, approximately 12.5% of the Dutch population perform regular running activities.[3] These regular physical activities offer numerous health benefits, of which an improved immune function is of potential importance during this COVID-19 pandemic.[4] The immune system provides a potent and multi-layered defense against virus attacks. Depression of this immune system can occur during recovery from intense exercise,[5] so high-intensity interval training might result in invading viruses.

In the current phase of the COVID-19 pandemic, many countries are liberalizing their lockdown measures,[6] so individuals will have the ability to perform their outdoor sports again. A recent aerodynamics simulation experiment–however–demonstrated that there is substantial droplet exposure during running which would need a physical distance of 10 m.[7] These results questioned whether physically active people can safely participate in outdoor sports.[8] Another recent study highlighted that physically active individuals are more susceptible to wellbeing issues during a strict lockdown in China.[9] This strict lockdown has been used in multiple countries all over the world and might have had similar impact on the physically active population. It implicates that runners will probably have a strong desire to perform outdoor running activities again.

It is unknown whether Dutch runners changed their running behavior due to the pandemic and there are no data on the relationship between outdoor physical activities and symptoms of community-acquired respiratory tract infections (CARTI) or COVID-19 specifically. We therefore send out an additional questionnaire in our currently running large prospective study in runners with the aim to (1) explore changes in running habits due to the COVID-19 period, (2) assess presence of symptoms suggestive for COVID-19 and (3) identify whether there is an association between outdoor running activities and symptoms suggestive for COVID-19.

2. Methods

This study is part of the Shaping up Prevention for Running Injuries in the Netherlands using Ten steps (SPRINT) study. The SPRINT study is an ongoing randomized-controlled trial (RCT) among recreational runners with a minimum follow-up of three months, to investigate the effect of an online injury prevention program on the number of running-related injuries (Dutch Trial Registry; NL7694). Follow-up questionnaires were sent one month before, one week before and one month after the registered running event (not used for current study purpose). During follow-up, the Dutch government implemented a targeted lockdown due to COVID-19. Seven weeks after the start of the targeted lockdown, all participants received an additional COVID-19 questionnaire. A flowchart of the design is presented in Fig. 1. The SPRINT study was funded by the Netherlands Organization for Health Research and Development (ZonMW, grant number 50-53600-98-104). Medical ethics approvals for the SPRINT study and the additional COVID-19 questionnaire (using an amendment) were obtained by the Medical Ethical Committee of the Erasmus MC University Medical Center Rotterdam, the Netherlands (MEC-2019-0136).

Runners who registered for the running events DSW Bruggenloop Rotterdam 2019, Nacht van Groningen 2020, NN CPC Loop The Hague 2020 and NN Marathon Rotterdam 2020 (distances ranging from 10.0 to 42.2 km) were invited to participate in the SPRINT study. Interested runners, aged 18 years or older, were asked to provide electronic informed consent and complete the baseline questionnaire. Exclusion criteria were participation in our previous trial on RRI prevention,[10] no knowledge of the Dutch language and no access to internet and/or email.

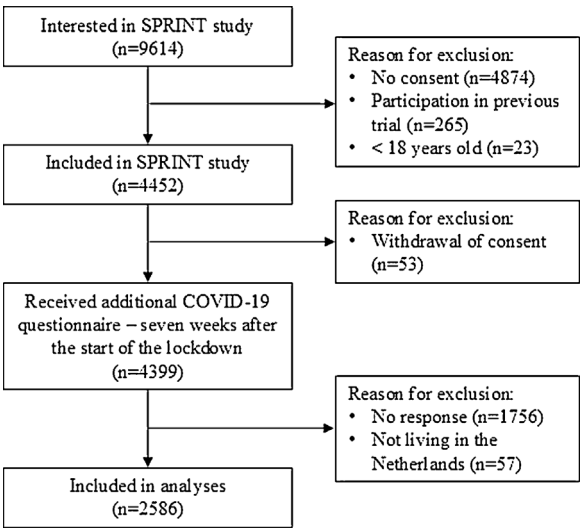

Fig. 1. Flowchart of the participants included in the SPRINT study.

In the baseline questionnaire information on demographics (sex, age, weight and height) were assessed. Weight and height were used to calculate the body mass index (BMI). Furthermore, participants were asked if they suffered from non-musculoskeletal comorbidities, and if yes which comorbidity. Only the comorbidities hypertension, cardiovascular disease and diabetes were included in this study, since these were reported as the most common underlying conditions in hospitalized patients with COVID-19.[11,12] Training-related information were administered with questions on running frequency, duration, distance and speed (average per week over the last 3 months). The additional COVID-19 questionnaire obtained information on five items:

- *Running habits*: running habits during lockdown were assessed by asking whether participants continued running outdoor (yes/no), and if yes their mean weekly training frequency, hours, distance and running speed were obtained (average per week over the last 7 weeks).
- *Symptoms and healthcare utilization*: participants were asked whether they experienced symptoms of CARTI (yes/no) in the preceding 7 weeks, including running nose, sore throat, fever, dry or productive cough, dyspnea during rest or exertion, myalgia, headache, chest pain, diarrhea, nausea or vomiting, eye infection, dysosmia, and fatigue. If yes, participants were questioned whether they consulted a general practitioner (GP) due to symptoms (yes/no), if they were tested for COVID-19 (yes/no), the result of this test (positive/negative) and if they were hospitalized due to COVID-19 (yes/no). If a participant was hospitalized, information on the amount of days and admission to intensive care (yes/no) was obtained.
- *Running behavior in relation to prevention of CARTI and COVID-19*: running behavior during lockdown was assessed by asking about type of training (endurance/interval/specific exercises), training with a partner who was not family related (yes/no) and maintaining a physical distance of 1.5 m during running (yes/no). Interval training was dichotomized in more or less than 50% of the training.
- *Preventive measures for CARTI and COVID-19*: participants were asked if they followed measures to prevent transmission of COVID-19. Measures questioned were meticulous hand hygiene, avoiding touching face, eyes and mouth, using face masks, physical distancing, no unnecessary travel and avoiding group meetings.

- *General risk factors for CARTI and COVID-19*: to obtain information about the risk of getting symptoms of CARTI or COVID-19 specifically, participants were asked if they had contact with possible infected individuals (yes/no), provided care to COVID-19 patients (yes/no) and if they experienced psychosocial stress and sleep disruption (five points scale form 5 (strongly agree) to 1 (strongly disagree)). For the current study purpose, experience of psychosocial stress and sleep disruption were categorized in yes ((strongly) agree) and no (sometimes and (strongly) disagree). Last, participants were asked in which province of the Netherlands they lived. Based on national data, living in the provinces Noord-Brabant and Limburg were risk factors for COVID-19 (Supplementary Fig. 1). Therefore, living in the province Noord-Brabant or Limburg was included and categorized in yes and no.

The primary outcome measures of this study were the percentage of runners continuing running training outdoor and the mean weekly training frequency, hours, distance and running speed during lockdown. Secondary outcome was the experience of symptoms suggestive for a COVID-19 infection. The most commonly reported COVID-19 symptoms are fever and cough, followed by dyspnea, sputum production and fatigue.[13–15] Experience of symptoms suggestive for COVID-19 was defined as reported fever or cough with at least one other commonly reported symptom (fever, cough, sputum production, dyspnea or fatigue). To be more inclusive, we selected an additional outcome measure defined as runners who experienced at least two symptoms of CARTI.

Descriptive statistics were used to describe characteristics obtained at baseline and follow-up, expressed in frequency or mean and standard deviations (SDs). Participants who completed the additional COVID-19 questionnaire and participants who did not complete this questionnaire were compared using independent sample *t*-tests (continuous data), Mann–Whitney *U* tests (continuous data) and chi–square tests (dichotomous data). To determine changes in running habits, differences in mean weekly training frequency, duration, hours and running speed between baseline and lockdown were evaluated with Wilcoxon signed rank tests. Participants who experienced symptoms suggestive for COVID-19 and with ≥2 CARTI symptoms were compared with participants without these symptoms using independent sample *t*-tests (continuous data) and chi–square tests (dichotomous data). Logistic regression analysis was used to examine the association between running behavior and running habits and symptoms suggestive for COVID-19. Four separate univariate and multivariate models (enter-method) were performed for each category: (1) demographic characteristics; (2) measures to prevent COVID-19; (3) general risk factors for COVID-19; (4) running habits and running behavior. Variables with a p-value <0.20 in the multivariate logistic regression analyses in these separate models were entered together in the final multivariate model. Results of the logistic regression analyses are presented as odds ratios (OR) with 95% confidence intervals. p-values <0.05 were regarded as statistically significant. All analyses were performed using SPSS version 25.0 (SPSS Inc, Chicago, Illinois).

3. Results

In total, 4452 participants were included in SPRINT study (Fig. 1). During follow-up 53 participants withdrew their consent. A total of 4399 participants were sent the additional COVID-19 questionnaire after a mean of 5.5 months (range 2.5–8.5). 2643 (60.1%) participants responded to the additional COVID-19 questionnaire. Of the responders, 57 (2.2%) participants reported not living in the Netherlands. As the lockdown measures varied between countries, these participants were excluded. A total of 2586 participants were included for further analyses. Compared to the participants who did not respond, responders were on average significantly older (44.4 vs. 39.1, p = <0.001) and trained more frequently (2.6 vs. 2.5 times a week, p = 0.01) (Supplementary Table 1).

Table 3
Final multivariate logistic regression model for characteristics associated with symptoms suggestive for COVID-19[a].

	Multivariate analysis	
	OR (95% CI)	p-value
Sex (male)	0.71 (0.53;0.97)[b]	0.03
Age (years)	0.98 (0.97;0.99)[b]	<0.01
BMI (kg/m^2)[c]	1.03 (0.98;1.09)	0.25
No unnecessary travel	1.67 (1.04;2.69)[b]	0.03
Contact with possible infected individuals	3.29 (2.45;4.42)[b]	<0.001
Providing care to COVID-19 patients	1.25 (0.73;2.12)	0.41
Psychosocial stress	1.09 (0.72;1.64)	0.69
Sleep disturbance	1.51 (0.93;2.44)	0.09
Weekly training hours	0.98 (0.92;1.05)	0.58
Interval training (>50%)	0.51 (0.20;1.29)	0.15
Training with partner	0.74 (0.52;1.05)	0.10

[a] Fever or cough with one other commonly reported symptom (fever, cough, sputum production, dyspnea or fatigue).
[b] Statistically significant association (p < 0.05).
[c] Body Mass Index.

A total of 2427 (93.9%) participants continued running training outdoor during the lockdown (Table 1). The mean (SD) weekly running frequency (2.6 (1.2) to 2.6 (1.3) times), duration (3.1 (2.8) to 3.0 (2.7) hours), distance (26.8 (21.6) to 25.8 (18.0) km) and speed (5.8 (0.9) min/km at both time points) did not change significantly between baseline and lockdown period (p-values 0.10, 0.12, 0.42 and 0.13, respectively).

Of the included participants, 253 (9.8%) participants experienced symptoms suggestive for COVID-19 during lockdown (Table 1). Participants who experienced these symptoms, were significantly younger (41.2 vs. 44.7, p = <0.001) and less often male (51.8% vs. 63.1%, p = <0.001) with an underlying condition (7.4% vs. 3.7%, p = <0.01). A total of 894 participants (34.6%) reported the experience of ≥2 CARTI symptoms during lockdown (Supplementary Table 2). Of the participants who experienced ≥2 CARTI symptoms, 83 participants (9.3%) contacted their GP due to their symptoms, of which 37 (4.1%) participants were tested for COVID-19 with a total of 10 positive tests (1.1%). Two participants (0.2%) were admitted to hospital due to COVID-19 with both one day of admission. No participants reported having been treated on the intensive care unit.

Frequently adapted measures to prevent symptoms of COVID-19 were meticulous hand hygiene (n = 2446, 94.6%), physical distancing (n = 2495, 96.5%), avoiding unnecessary travel (n = 2221, 85.9%) and avoidance of group meetings (n = 2307, 89.2%) (Table 1). Of the participants who continued running during lockdown, 2361 (97.3%) participants followed physical distancing during training and 581 (23.9%) participants trained with a non-family partner. Furthermore, 100 (4.1%) participants performed interval training of more than 50% of their trainings.

Table 2 presents the four separate defined regression models for symptoms suggestive for COVID-19 and Table 3 presents the final multivariate model. In the final model, male sex (OR 0.71, 95% CI 0.53;0.97) and lower age (OR 0.98, 95% CI 0.97;0.99) were negatively associated with symptoms suggestive for COVID-19 (Table 3). No unnecessary travel (OR 1.67, 95% CI 1.04;2.69) and contact with possible infected individuals (OR 3.29, 95% CI 2.45;4.42) were positively associated with symptoms suggestive for COVID-19. There was no association with running habits or running behavior. Association between included characteristics and CARTI symptoms are presented in Supplementary Tables 3–5. With this more inclusive

Table 1
Characteristics of participants who experienced symptoms suggestive for COVID-19[a].

	COVID-19 symptoms		
	Total (N = 2586)	Yes (N = 253)	No (N = 2333)
Baseline			
Demographic characteristics			
Sex (male)	1604 (62.0)	131 (51.8)	1473 (63.1)[b]
Age (years)[Δ]	44.4 (12.2)	41.2 (12.6)	44.7 (12.1)[b]
BMI (kg/m^2)[Δ,c]	23.2 (2.6)	23.3 (2.7)	23.2 (2.6)
Underlying condition[d]	94 (4.0)	16 (7.4)	78 (3.7)[b]
Living in province of South Holland	1469 (56.8)	145 (57.3)	1324 (56.8)
During lockdown period			
Running behavior			
Continuing running training outdoor	2427 (93.9)	229 (90.5)	2198 (94.2)[b]
Physical distancing during training[e]	2361 (97.3)	223 (97.4)	2138 (97.3)
Interval training (>50%)[e]	100 (4.1)	5 (2.2)	95 (4.3)
Training with partner[e]	581 (23.9)	45 (19.7)	536 (24.4)
Measures to prevent COVID-19			
Meticulous hand hygiene	2446 (94.6)	241 (95.3)	2205 (94.5)
Avoiding touching face, eyes and mouth	1095 (42.3)	112 (44.3)	983 (42.1)
Using face masks	101 (3.9)	10 (4.0)	91 (3.9)
Physical distancing	2495 (96.5)	245 (96.8)	2250 (96.4)
No unnecessary travel	2221 (85.9)	230 (90.9)	1991 (85.3)[b]
Avoiding group meetings	2307 (89.2)	235 (92.9)	2072 (88.8)[b]
General risk factors for COVID-19			
Contact with possible infected individuals	466 (18.0)	99 (39.1)	367 (15.7)[b]
Providing care to COVID-19 patients	137 (5.3)	22 (8.7)	115 (4.9)[b]
Psychosocial stress	319 (12.3)	44 (17.4)	275 (11.8)[b]
Sleep disturbance	201 (7.8)	31 (12.3)	170 (7.3)[b]
Living in a province with high COVID-19 infection rate	291 (11.3)	32 (12.6)	259 (11.1)

Categorical data are presented as N (%) and continuous data ([Δ]) as means (SD).
[a] Fever or cough with at least one other commonly reported symptom (fever, cough, sputum production, dyspnea or fatigue).
[b] Statistical significant difference between participants ($p < 0.05$).
[c] Body Mass Index.
[d] Hypertension, cardiovascular disease and/or diabetes.
[e] Based on participants who continued running training during lockdown (total of 2427 participants).

Table 2
Univariate and multivariate logistic regression analyses of characteristics associated with symptoms suggestive for COVID-19[a].

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value*
Model 1 - Demographic characteristics				
Sex (male)	0.63 (0.48;0.81)[b]	<0.001	0.67 (0.51;0.89)[b]	**0.01**
Age (years)	0.98 (0.97;0.99)[b]	<0.001	0.98 (0.97;0.99)[b]	**<0.001**
BMI (kg/m^2)[c]	1.01 (0.96;1.06)	0.66	1.05 (1.00;1.10)	**0.07**
Model 2 - Measures to prevent COVID-19				
Meticulous hand hygiene	1.17 (0.64;2.14)	0.62	1.00 (0.53;1.86)	0.99
Avoiding touching face, eyes and mouth	1.09 (0.84;1.42)	0.51	1.04 (0.79;1.36)	0.79
Using face masks	1.01 (0.52;1.97)	0.97	1.01 (0.51;1.97)	0.99
Physical distancing	1.13 (0.54;2.36)	0.75	0.93 (0.44;1.98)	0.85
No unnecessary travel	1.72 (1.10;2.68)[b]	0.02	1.56 (0.97;2.49)	**0.06**
Avoiding group meetings	1.65 (1.00;2.70)[b]	0.05	1.40 (0.82;2.37)	0.22
Model 3 - General risk factors for COVID-19				
Contact with possible infected individuals	3.44 (2.61;4.54)[b]	<0.001	3.34 (2.53;4.42)[b]	**<0.001**
Providing care to COVID-19 patients	1.84 (1.14;2.96)[b]	0.01	1.39 (0.85;2.28)	**0.19**
Psychosocial stress	1.58 (1.11;2.23)[b]	0.01	1.38 (0.95;2.01)	**0.10**
Sleep disturbance	1.78 (1.18;2.67)[b]	0.01	1.56 (1.01;2.43)[b]	**0.05**
Living in a province with high COVID-19 infection rate	1.16 (0.78;1.72)	0.46	1.06 (0.70;1.58)	0.80
Model 4 – Running habits and running behavior				
Weekly training hours	0.92 (0.86;0.99)[b]	0.02	0.95 (0.88;1.02)	**0.13**
Interval training (>50%)	0.49 (0.20;1.23)	0.13	0.50 (0.20;1.25)	**0.14**
Training with partner	0.76 (0.54;1.07)	0.11	0.78 (0.56;1.11)	**0.17**
Physical distancing during training	1.04 (0.45;2.44)	0.92	0.98 (0.42;2.32)	0.97

[a] Fever or cough with one other commonly reported symptom (fever, cough, sputum production, dyspnea or fatigue).
[b] Statistically significant association ($p < 0.05$).
[c] Body Mass Index.
* $p < 0.2$ presented in bold.

approach, lower age (OR 0.99, 95% CI 0.98;0.99) was negatively associated with at least two symptoms of CARTI. Contact with possible infected individuals (OR 2.19, 95% CI 1.78;2.70), psychosocial stress (OR 2.36, 95% CI 1.83;3.04) and sleep disturbance (OR 1.65, 95% CI 1.21;2.26) were positively associated with at least two symptoms of CARTI. There was also no association with running behavior or running habits.

4. Discussion

In this large prospective cohort study, we found that the large majority of runners maintained their normal running habits during the lockdown period due to COVID-19. Mean weekly running frequency, duration, distance and speed were all similar to values before the lockdown. Only a small number of runners were tested positive for COVID-19 (n = 10) or were shortly admitted to hospital due to COVID-19 (n = 2). A higher proportion of the included runners (n = 253, 9.8%) experienced symptoms suggestive for COVID-19. We did not identify an association between running behavior or running habits and onset of symptoms suggestive for COVID-19. This implicates that only a small minority of the runners experienced COVID-19 related problems and that running behavior does not seem to be an important factor associated with COVID-19.

These findings are very relevant because many countries are currently liberalizing their lockdown measures. In the Netherlands, people were able to perform outdoor sports activities during the lockdown. Our findings show that the large majority of runners did not change their running habits. It is hard for governments to establish which sport activities are safe to restart. A recent aerodynamics simulation study implicated that running outdoor is potentially unsafe due to substantial droplet exposure during running.[8] In our large cohort study, we did not identify an increased risk for COVID-19 infection using multiple outcome parameters.[7] A small portion of this relatively healthy population did have a positive COVID-19 test (0.4%) or a short (one day) hospital admission (0.08%). This is comparable to the Dutch national COVID-19 infection (0.3%) and hospital admission (0.08%) data (Supplementary Fig. 2). Another frequently mentioned drawback of continuing intensive running with interval training, is the temporary decreased immune function and thereby increased susceptibility for infection.[4] We did–however–not find an association between runners continuing interval training and onset of symptoms suggestive for COVID-19. This finding is in line with recent scientific views; the risk for infectious disease in athletes seems to be multifactorial and not only associated with training intensity.[16]

Restraining individuals from participation in outdoor running activities does not only further decrease their fitness level and health status, but also their mental status which is very important during a lockdown period.[9] The clinical and societal relevance of our findings will even further increase if we will encounter a second wave of the COVID-19 pandemic. During the liberalization of the preventive measures, countries must thoroughly revisit the scientific evidence of their measures before the second wave may come.[17]

The major strength is that this is the first prospective study to evaluate associations between running activity and COVID-19 related symptoms. The study topic is actual and it will probably remain important in the near future. It is one of the largest cohort studies performed in an athletic population, thereby making the findings more robust. The fact that we have prospectively collected data ensures that we can adequately answer our primary research question regarding change in running habits during the lockdown period.

This study has a number of limitations. The response rate (60.1%) was not optimal. However, there were no relevant differences in characteristics between responders and non-responders. It may be that non-responders did not respond to the questionnaire becd it will probably remain important in the near future. It is one of the largest cohort studies performed in an athletic population, thereby making the findings more robust. The fact that we have prospectively collected data ensures that we can adequately answer our primary research question regarding change in running habits during the lockdown period.

This study has a number of limitations. The response rate (60.1%) was not optimal. However, there were no relevant differences in characteristics between responders and non-responders. It may be that non-responders did not respond to the questionnaire because they were admitted to hospital, died due to COVID-19 within this period or experienced no problems related to COVID-19 at all. However, it is more likely that a larger number of responders experienced COVID-19 related problems. A potential limitation of the study was that the study parameters were collected using a questionnaire. Due to this study design, it is impossible to test whether the answers provided are the true answers (e.g. did the participants actually implement the precautions for COVID-19 or were they prone to provide a socially desirable answer?). Another limitation is the choice of outcome measures for COVID-19. Due to the limited test capacity for COVID-19 in the Netherlands, this outcome measure has limitations. For that reason, we used symptoms suggestive for COVID-19 and CARTI as outcome measures. As we did not detect an association between running behavior and COVID symptoms using both these strict and inclusive symptom-based outcome measures, we are more confident that this finding is correct. The absence of associations between running parameters and COVID-19 are potentially due to the strict adherence to the other preventive measures by the Dutch population. Results may differ when more people are outside. Furthermore, this study only assessed health parameters of the runners but not of potential subjects they might encounter during running (e.g. walkers). The runners might be protected by a well-functioning immune system and potentially infect walkers during their run.

Future research could be focused on the safety of running in small groups. If these runners respect the preventive measures for transmission of CARTI, it is potentially safe to start up running habits at the club.

5. Conclusion

The COVID-19 pandemic leads to a lot of changes worldwide, but the large majority of Dutch runners were able to maintain their normal running habits during the targeted lockdown period. Mean weekly running frequency, duration, distance and speed were all similar to values before the lockdown. Only a small number of runners were tested positive for COVID-19 or were shortly admitted to hospital due to COVID-19. 9.8% of the included runners experienced symptoms suggestive for COVID-19. We did not identify an association between running habits or running behavior and onset of symptoms suggestive for COVID-19. This implicates that running outdoor during lockdown due to the COVID-19 pandemic may not negatively affect the health of Dutch runners.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jsams.2020.10.009.

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