Evidence Search Report

Review Question:	What is the risk of transmission of COVID-19 from high respiratory efforts for prolonged periods of time (>15 min) at a physical distance of 3-4 m or more?		
Context:	Want to ensure the accuracy of a transmission risk table for contact tracers. Specifically, for the transmission risks for COVID-19 when subjects are engaging in "high respiratory efforts" e.g. coughing, sneezing, exercising, yelling, singing, etc.		
Review ID:	PH012501-01 ESR	**Complete Date:**	**January 26, 2021**
Subject(s):	Transmission, Risk Assessment		
Cite As:	Miller, L; Howell-Spooner, B. What is the risk of transmission of COVID-19 from high respiratory efforts for prolonged periods of time (>15 min) at a physical distance of 3-4 m or more? 2021 Jan 26; Document no.: PH012501-01 ESR. In: COVID-19 Rapid Evidence Reviews [Internet]. SK: SK COVID Evidence Support Team, c2020. 29 p. (CEST evidence search report)		

Librarian Notes & Comments

This search found minimal references to studies to assess risk of transmission with regard to the respiratory efforts or physical exertion of subjects. Most findings take a precautionary/prevention approach, and rely on laboratory-designed or modeled environments to inform airborne/droplet spread mechanics.

Some studies were found providing recommended precautions for sport & exercise - a closer look will determine whether (and what) evidence (if any) they are based upon.

Sincerely,

Lukas & Brianna

Disclaimer

Search Results: Guidance, Summaries & Other Grey Literature

Agency for Clinical Innovation & New South Wales Government

- High-risk settings for transmission of COVID-19. 18 November, 2020. https://aci.health.nsw.gov.au/__data/assets/pdf_file/0005/619133/20201118-Evidence-Check-High-risk-settings.pdf

Alberta Health Services

- Singing as a risk for transmission of SARS-CoV-2 virus. 22 May, 2020. https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-sag-singing-risk-transmission-rapid-review.pdf

CDC

- Attending Sporting Events. 9 September, 2020. https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/attending-sports.html
- Participate in Outdoor and Indoor Activities. 14 January, 2021. https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/participate-in-activities.html
- Personal and Social Activities. 6 January, 2021. https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/personal-social-activities.html
- Scientific Brief: SARS-CoV-2 and Potential Airborne Transmission. 5 October, 2020. https://www.cdc.gov/coronavirus/2019-ncov/more/scientific-brief-sars-cov-2.html

Center for Infectious Disease Research and Policy

- In-person classes, Greek life tied to college COVID outbreaks. 7 January, 2021. https://www.cidrap.umn.edu/news-perspective/2021/01/person-classes-greek-life-tied-college-covid-outbreaks

National Collaborating Centre for Environmental Health

- COVID-19 and outdoor safety: Considerations for use of outdoor recreational spaces. 17 April, 2020. https://ncceh.ca/documents/guide/covid-19-and-outdoor-safety-considerations-use-outdoor-recreational-spaces

National Collaborating Centre for Methods and Tools

- Rapid Review: What is known about the risk of COVID-19 transmission across different indoor settings in the community such as restaurants and gyms?. 4 November, 2020. https://www.nccmt.ca/covid-19/covid-19-rapid-evidence-service/30

Public Health Agency of Canada

- COVID-19: Guidance on indoor ventilation during the pandemic. 18 January, 2021. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/guide-indoor-ventilation-covid-19-pandemic.html

Stragety for Patient-Oriented Research

- Being Outside Safely and COVID-19. 4 May, 2020. https://www.nlcahr.mun.ca/CHRSP/COVID10OutdoorsMay2020.pdf
- Choirs and COVID-19. 20 May, 2020. https://www.nlcahr.mun.ca/CHRSP/COVID19ChoirsJune32020.pdf

Search Results: News, Blogs, Social Media

The Conversation

- How to prevent COVID-19 'superspreader' events indoors this winter. 27 October, 2020. https://theconversation.com/how-to-prevent-covid-19-superspreader-events-indoors-this-winter-147439

Search Results: Articles from Databases

Sorted by newest-oldest.

1. Atherstone C, Peterson ML, Malone M, et al. Time from Start of Quarantine to SARS-CoV-2 Positive Test Among Quarantined College and University Athletes - 17 States, June-October 2020. MMWR Morb Mortal Wkly Rep. 2021;70(1):7-11. DOI: 10.15585/mmwr.mm7001a2
ABSTRACT: To safely resume sports, college and university athletic programs and regional athletic conferences created plans to mitigate transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19). Mitigation measures included physical distancing, universal masking, and maximizing outdoor activity during training; routine testing; 10-day isolation of persons with COVID-19; and 14-day quarantine of athletes identified as close contacts* of persons with confirmed COVID-19. Regional athletic conferences created testing and quarantine policies based on National Collegiate Athletic Association (NCAA) guidance (1); testing policies varied by conference, school, and sport. To improve compliance with quarantine and reduce the personal and economic burden of quarantine adherence, the quarantine period has been reduced in several countries from 14 days to as few as 5 days with testing (2) or 10 days without testing (3). Data on quarantined athletes participating in NCAA sports were used to characterize COVID-19 exposures and assess the amount of time between quarantine start and first positive SARS-CoV-2 test result. Despite the potential risk for transmission from frequent, close contact associated with athletic activities (4), more athletes reported exposure to COVID-19 at social gatherings (40.7%) and from roommates (31.7%) than they did from exposures associated with athletic activities (12.7%). Among 1,830 quarantined athletes, 458 (25%) received positive reverse transcription-polymerase chain reaction (RT-PCR) test results during the 14-day quarantine, with a mean of 3.8 days from quarantine start (range = 0-14 days) until the positive test result. Among athletes who had not received a positive test result by quarantine day 5, the probability of having a positive test result decreased from 27% after day 5 to <5% after day 10. These findings support new guidance from CDC (5) in which different options are provided to shorten quarantine for persons such as collegiate athletes, especially if doing so will increase compliance, balancing the reduced duration of quarantine against a small but nonzero risk for postquarantine transmission. Improved adherence to mitigation measures (e.g., universal masking, physical distancing, and hand hygiene) at all times could further reduce exposures to SARS-CoV-2 and disruptions to athletic activities because of infections and quarantine (1,6).
URL: https://www.ncbi.nlm.nih.gov/pubmed/33417591
DOI: 10.15585/mmwr.mm7001a2

2. Bazant MZ, Bush JWM. Beyond Six Feet: A Guideline to Limit Indoor Airborne Transmission of COVID-19. medRxiv. 2021:2020.08.26.20182824. DOI: 10.1101/2020.08.26.20182824
ABSTRACT: The current revival of the world's economy is being predicated on social distancing, specifically the Six-Foot Rule, a guideline that offers little protection from pathogen-bearing aerosol droplets sufficiently small to be continuously mixed through an indoor space. The importance of airborne transmission of COVID-19 is now widely recognized. While tools for risk assessment have recently been developed, no safety guideline has been proposed to protect against it. We here build upon models of airborne disease transmission in order to derive an indoor safety guideline that would impose an upper bound on the "cumulative exposure time", the product of the

number of occupants and their time in an enclosed space. We demonstrate how this bound depends on the rates of ventilation and air filtration, dimensions of the room, breathing rate, respiratory activity and face-mask use of its occupants, and infectiousness of the respiratory aerosols. By synthesizing available data from the best characterized indoor spreading events with respiratory drop-size distributions, we estimate an infectious dose on the order of ten aerosol-borne virions. The new virus is thus inferred to be an order of magnitude more infectious than its forerunner, (SARS-CoV), consistent with the pandemic status achieved by COVID-19. Case studies are presented for classrooms and nursing homes, and a spreadsheet and online app are provided to facilitate use of our guideline. Implications for contact tracing and quarantining are considered, appropriate caveats enumerated. Particular consideration is given to respiratory jets, that may substantially elevate risk when face masks are not worn.Competing Interest StatementThe authors have declared no competing interest.Funding StatementNo external funding was received.Author DeclarationsI confirm all relevant ethical guidelines have been followed, and any necessary IRB and/or ethics committee approvals have been obtained.YesThe details of the IRB/oversight body that provided approval or exemption for the research described are given below:We confirm that all ethical guidelines have been followed.All necessary patient/participant consent has been obtained and the appropriate institutional forms have been archived.YesI understand that all clinical trials and any other prospective interventional studies must be registered with an ICMJE-approved registry, such as ClinicalTrials.gov. I confirm that any such study reported in the manuscript has been registered and the trial registration ID is provided (note: if posting a prospective study registered retrospectively, please provide a statement in the trial ID field explaining why the study was not registered in advance).YesI have followed all appropriate research reporting guidelines and uploaded the relevant EQUATOR Network research reporting checklist(s) and other pertinent material as supplementary files, if applicable.YesAn Excel spreadsheet is provided as a supplementary file to calculate our COVID-19 safety guideline for a specific indoor space. Expiratory aerosol droplet size distributions were taken from the cited literature, as either provided by the authors (Asadi et al, 2020) or digitally scanned from published figures (Morawska et al, 2009). http://www.mit.edu/~bazant/COVID-19
URL: https://www.medrxiv.org/content/medrxiv/early/2020/11/03/2020.08.26.20182824.full.pdf
DOI: 10.1101/2020.08.26.20182824

3. Elavsky S, Jandackova V, Knapova L, et al. Physical activity in an air-polluted environment: behavioral, psychological and neuroimaging protocol for a prospective cohort study (Healthy Aging in Industrial Environment study - Program 4). BMC Public Health. 2021;21(1):126. DOI: 10.1186/s12889-021-10166-4
ABSTRACT: BACKGROUND: Air pollution has been linked to increased mortality and morbidity. The Program 4 of the Healthy Aging in Industrial Environment study investigates whether the health and wellbeing benefits of physical activity (PA) can be fully realized in individuals living in highly polluted environments. Herein, we introduce the behavioral, psychological and neuroimaging protocol of the study. METHODS: This is a prospective cohort study of N = 1500 individuals aged 18-65 years comparing: (1) individuals living in the highly polluted, industrial region surrounding the city of Ostrava (n = 750), and (2) controls from the comparison region with relative low pollution levels in Southern Bohemia (n = 750). Quota sampling is used to obtain samples balanced on age, gender, PA status (60% active runners vs. 40% insufficiently active). Participants are screened and complete baseline assessments through online questionnaires and in-person lab-based assessments of physiological, biomechanical, neuroimaging and cognitive function parameters. Prospective 12-month intensive monitoring of air pollution and behavioral parameters (PA, inactivity, and sleep) follows, with a focus on PA-related injuries and psychological factors through fitness trackers, smartphones, and mobile apps. Subsequently, there will be a 5-year follow-up of the study cohort. DISCUSSION: The design of the study will allow for (1) the assessment of both short-term variation and long-term change in behavioral parameters, (2) evaluation of the incidence of musculoskeletal injuries and psychological factors impacting behavior and injury recovery, and (3) the impact that air pollution status (and change) has on behavior, psychological resilience, and injury recovery. Furthermore, the integration of MRI techniques and cognitive assessment in combination with data on behavioral, biological and environmental variables will provide an opportunity to examine brain structure and cognitive function in relation to health behavior and air pollution, as well as other factors affecting resilience against and vulnerability to adverse changes in brain structure and cognitive aging. This study will help inform individuals about personal risk factors and decision-makers about the impact of environmental factors on negative health outcomes and potential underlying

biological, behavioral and psychological mechanisms. Challenges and opportunities stemming from the timing of the study that coincided with the COVID-19 pandemic are also discussed.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33435943
DOI: 10.1186/s12889-021-10166-4

4. He R, Gao L, Trifonov M, et al. Aerosol generation from different wind instruments. J Aerosol Sci. 2021;151:105669. DOI: 10.1016/j.jaerosci.2020.105669
ABSTRACT: The potential airborne transmission of COVID-19 has raised significant concerns regarding the safety of musical activities involving wind instruments. However, currently, there is a lack of systematic study and quantitative information of the aerosol generation during these instruments, which is crucial for offering risk assessment and the corresponding mitigation strategies for the reopening of these activities. Collaborating with 15 musicians from the Minnesota Orchestra, we conduct a systematic study of the aerosol generation from a large variety of wind instruments under different music dynamic levels and articulation patterns. We find that the aerosol concentration from different brass and woodwinds exhibits two orders of magnitude variation. Accordingly, we categorize the instruments into low (tuba), intermediate (bassoon, piccolo, flute, bass clarinet, French horn, and clarinet) and high risk (trumpet, bass trombone, and oboe) levels based on a comparison of their aerosol generation with those from normal breathing and speaking. In addition, we observe that the aerosol generation can be affected by the changing dynamic level, articulation pattern, the normal respiratory behaviors of individuals, and even the usage of some special techniques during the instrument play. However, such effects vary substantially for different types of instrument, depending on specific breathing techniques as well as the tube structure and inlet design of the instrument. Overall, our findings can bring insights into the risk assessment of airborne decrease transmission and the corresponding mitigation strategies for various musical activities involving wind instrument plays, including orchestras, community and worship bands, music classes, etc.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32952210
DOI: 10.1016/j.jaerosci.2020.105669

5. Khoramipour K, Basereh A, Hekmatikar AA, et al. Physical activity and nutrition guidelines to help with the fight against COVID-19. J Sports Sci. 2021;39(1):101-7. DOI: 10.1080/02640414.2020.1807089
ABSTRACT: As the world is witnessing the epidemic of coronavirus disease 2019, emerging genetics and clinical pieces of evidence suggest a similar immunopathology to those of severe acute respiratory syndrome and Middle East respiratory syndrome. Staying at home to prevent the spread of the virus and consequently being largely inactive is associated with unintended consequences. These can actually enhance the infection risk and exacerbate poor health conditions including impaired immune function. Physical activity is a feasible way of improving health, particularly physical and mental health in a time of social isolation. However, people with certain health conditions in these circumstances may need a special physical activity programme in addition to any exercise they may already be performing via online programmes. This review aims to provide practical guidelines during the COVID-19 quarantine period. We suggest performing aerobic, resistance training, respiratory muscle training and yoga in the healthy, and in those with upper respiratory tract illness, patients with lower respiratory tract illness should be restricted to respiratory muscle training and yoga. In addition, vitamins D and C, omega-3 fatty acids, and regular consumption of fruit and vegetables might be considered as nutritional aids to support the immune system in those affected by COVID-19.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32842905
DOI: 10.1080/02640414.2020.1807089

6. Mohammadi A, Chowdhury MTU, Yang S, et al. Developing levels of pedestrian physical distancing during a pandemic. Safety Science. 2021;134(105066). DOI: 10.1016/j.ssci.2020.105066
ABSTRACT: The COVID-19 outbreak has fundamentally changed how people move around and live in a city. It is reported that the virus spreads through transmission via large droplets and/or small aerosols when an infected individual coughs or sneezes or even breathes or talks near an uninfected individual. This study considers the implications of physical distancing requirements for pedestrians using urban sidewalks. Pedestrian physical distancing can be described as a mobility intervention designed to limit virus infection by keeping people, for example, 2 m apart. Physical distancing assumes that the risk of transmission declines with the distance between

people, but a more sophisticated approach than the current binary approach which is simply based on a single distance may help health agencies to evaluate and monitor how well physical distancing is being achieved. The study developed pedestrian physical distancing indicators to quantitatively evaluate different levels of physical distancing and proposed levels of pedestrian physical distancing that can be used to select and implement appropriate mobility interventions. This study also developed a mathematical process to estimate the relative risk of viral transmission between pedestrians under different pedestrian walking conditions. Finally, we demonstrated the application of the proposed approach in a simulated virtual walkway environment using PTV Viswalk. We hope the study can help decision-makers in health agencies to select the most appropriate pedestrian mobility interventions for limiting spread of the virus on urban sidewalks. Copyright © 2020 Elsevier Ltd
DOI: 10.1016/j.ssci.2020.105066

7. Powell AW, Mays WA, Curran T, et al. The Adaptation of Pediatric Exercise Testing Programs to the Coronavirus/COVID-19 Pandemic. World J Pediatr Congenit Heart Surg. 2021;12(1):43-7. DOI: 10.1177/2150135120954816
ABSTRACT: OBJECTIVE: Response to the coronavirus/COVID-19 pandemic has resulted in several initiatives that directly impact hospital operations. There has been minimal information on how COVID-19 has affected exercise testing in pediatric patients. DESIGN: A web-based survey was designed and sent to pediatric exercise testing laboratories in the United States and Canada. Questions were designed to understand the initial and ongoing adaptations made by pediatric exercise testing laboratories in response to COVID-19. Results were analyzed as frequency data. RESULTS: There were responses from 42% (35/85) of programs, with 68% (23/34) of laboratories discontinuing all exercise testing. Of the 23 programs that discontinued testing, 15 (65%) are actively working on triage plans to reopen the exercise laboratory. Personal protective equipment use include gloves (96%; 25/26), surgical masks (88%; 23/26), N-95 masks (54%; 14/26), face shields (69%; 18/26), and gowns (62%; 16/26). Approximately 47% (15/32) of programs that typically acquire metabolic measurements reported either ceasing or modifying metabolic measurements during COVID-19. Additionally, 62% (16/26) of the programs that previously obtained pulmonary function testing reported either ceasing or modifying pulmonary function testing. Almost 60% of respondents expressed a desire for additional guidance on exercise laboratory management during COVID-19. CONCLUSIONS: Pediatric exercise testing laboratories largely closed during the early pandemic, with many of these programs either now open or working on a plan to open. Despite this, there remains heterogeneity in how to minimize exposure risks to patients and staff. Standardization of exercise testing guidelines during the COVID-19 pandemic may help reduce some of these differences.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32954937
DOI: 10.1177/2150135120954816

8. Ren H, He X, Bian X, et al. The Protective Roles of Exercise and Maintenance of Daily Living Routines for Chinese Adolescents During the COVID-19 Quarantine Period. J Adolesc Health. 2021;68(1):35-42. DOI: 10.1016/j.jadohealth.2020.09.026
ABSTRACT: PURPOSE: Adolescents are particularly vulnerable during the COVID-19 quarantine periods and may be at risk for developing psychological distress symptoms that extend beyond a crisis, including depression. This study examined adolescents' postquarantine depressive symptoms associated with pandemic stressors. The primary aim was to identify potential protective factors that may buffer the association between the presence of COVID-19 cases in adolescents' communities and their postquarantine depressive symptoms. METHODS: Adolescents from public schools were recruited from Zhengzhou city, Henan, China (N = 1,487, Mage=13.14 years, 50% girls). Adolescents reported the presence of confirmed or suspected COVID-19 cases in their communities, their daily activities and routines during the 2-month quarantine period, and depressive symptoms after the quarantine period. RESULTS: The presence of cases in adolescents' communities during the quarantine contributed to more depressive symptoms in adolescents after the quarantine. This association was buffered by adolescents' spending more time on physical activities and better maintenance of daily living routines during the quarantine period. The presence of community infection was also more strongly associated with depressive symptoms in older adolescents. CONCLUSIONS: The presence of COVID-19 cases in communities contributed to adolescents' poorer mental health, and the association was stronger for older adolescents. Spending time on physical activities and

maintaining daily living routines during the quarantine appear to be practical strategies that can be used by adolescents to mitigate the association between pandemic stressors and their diminishing mental health.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33121902
DOI: 10.1016/j.jadohealth.2020.09.026

9. Rowlands AV, Kloecker DE, Chudasama Y, et al. Association of Timing and Balance of Physical Activity and Rest/Sleep With Risk of COVID-19: A UK Biobank Study. Mayo Clin Proc. 2021;96(1):156-64. DOI: 10.1016/j.mayocp.2020.10.032
ABSTRACT: Behavioral lifestyle factors are associated with cardiometabolic disease and obesity, which are risk factors for coronavirus disease 2019 (COVID-19). We aimed to investigate whether physical activity, and the timing and balance of physical activity and sleep/rest, were associated with SARS-CoV-2 positivity and COVID-19 severity. Data from 91,248 UK Biobank participants with accelerometer data and complete covariate and linked COVID-19 data to July 19, 2020, were included. The risk of SARS-CoV-2 positivity and COVID-19 severity-in relation to overall physical activity, moderate-to-vigorous physical activity (MVPA), balance between activity and sleep/rest, and variability in timing of sleep/rest-was assessed with adjusted logistic regression. Of 207 individuals with a positive test result, 124 were classified as having a severe infection. Overall physical activity and MVPA were not associated with severe COVID-19, whereas a poor balance between activity and sleep/rest was (odds ratio [OR] per standard deviation: 0.71; 95% confidence interval [CI], 0.62 to 0.81]). This finding was related to higher daytime activity being associated with lower risk (OR, 0.75; 95% CI, 0.61 to 0.93) but higher movement during sleep/rest being associated with higher risk (OR, 1.26; 95% CI, 1.12 to 1.42) of severe infection. Greater variability in timing of sleep/rest was also associated with increased risk (OR, 1.21; 95% CI, 1.08 to 1.35). Results for testing positive were broadly consistent. In conclusion, these results highlight the importance of not just physical activity, but also quality sleep/rest and regular sleep/rest patterns, on risk of COVID-19. Our findings indicate the risk of COVID-19 was consistently approximately 1.2-fold greater per approximately 40-minute increase in variability in timing of proxy measures of sleep, indicative of irregular sleeping patterns.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33413813
DOI: 10.1016/j.mayocp.2020.10.032

10. Vance D, Shah P, Sataloff RT. COVID-19: Impact on the Musician and Returning to Singing; A Literature Review. J Voice. 2021. DOI: 10.1016/j.jvoice.2020.12.042
ABSTRACT: Objective The purpose of this study was to review current literature of the impact of COVID-19 on musicians and returning to singing. Methods A comprehensive search of peer-review articles was completed using PubMed, GoogleScholar, Scopus, and Web of Science. The search was completed using many key terms including voice, hoarseness, dysphonia, aphonia, cough, singers, and public speakers. The bibliography from each article found was searched to find additional articles. The search process revealed 56 peer-reviewed articles, 18 primary articles, ranging from the years 2019-2020. Conclusion COVID-19 has had a major impact on singers and other musicians worldwide. It can of affect the voice and can lead to paresis/paralysis of laryngeal nerves to long-term changes in respiratory function. There is a risk from aerosolization/droplet formation transmission with singing, and with playing wind and brass instruments, that can be mitigated by following COVID-19 guidelines. Ways to reduce possible transmission during singing and instrument play include virtual rehearsals or performances, mask-wearing, instrument covers, smaller choirs, performing outside, excellent ventilation being socially-distanced, shorter rehearsals, regularly cleaning commonly-touched surfaces and washing hands, avoiding contact with others, and temperature screening.
URL: http://www.sciencedirect.com/science/article/pii/S0892199721000035
DOI: 10.1016/j.jvoice.2020.12.042

11. Ahmed N, Maqsood A, Abduljabbar T, et al. Tobacco Smoking a Potential Risk Factor in Transmission of COVID-19 Infection. Pak J Med Sci. 2020;36(COVID19-S4):S104-S7. DOI: 10.12669/pjms.36.COVID19-S4.2739
ABSTRACT: Corona Virus disease 2019 (COVID-19) is a global pandemic and is caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) group of viruses. To date, April 25, 2020, more than 2.4 million humans are infected and more than a hundred thousand deaths have been reported from more than 200 countries from COVID-19. There is no evidence-based treatment for the infection and prevention of transmission using social

distancing, isolation and hygiene measures is widely recommended. Tobacco smoking is rampant in communities around the globe and the addiction to tobacco results in deaths of more than 8 million individuals each year. As COVID-19 transmits through salivary droplets and causes severe lung pneumonia, tobacco smokers are also at high risk of severe COVID-19 infection due to poor lung function, cross-infection and susceptible hygiene habits. Smoking tobacco (cigarette, e-cigarettes or waterpipe) produces exhaled smoke, coughing or sneezing, aerosols containing SARS-CoV-2 in the surroundings and contaminating surfaces. Therefore, smoking tobacco is a possible mode of transmission for the virus for both active and passive smokers. Smoking should be considered a risk factor for the disease transmission until further availability of evidence and measures to limit its direct and indirect effects should be implemented within the community.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32582324
DOI: 10.12669/pjms.36.COVID19-S4.2739

12. Bahl P, de Silva C, Bhattacharjee S, et al. Droplets and Aerosols generated by singing and the risk of COVID-19 for choirs. Clin Infect Dis. 2020. DOI: 10.1093/cid/ciaa1241
ABSTRACT: Choral singing has become a major risk during COVID-19 pandemic due to high infection rates. Our visualisation and velocimetry results reveal that majority of droplets expelled during singing follow the ambient airflow pattern. These results points toward the possibility of COVID-19 spread by small airborne droplets during singing.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32945338
DOI: 10.1093/cid/ciaa1241

13. Big Ten Cardiac Registry Steering C, Rink LD, Daniels CJ, et al. Competitive Sports, the Coronavirus Disease 2019 Pandemic, and Big Ten Athletics. Circ Cardiovasc Qual Outcomes. 2020;13(12):e007608. DOI: 10.1161/CIRCOUTCOMES.120.007608
URL: https://www.ncbi.nlm.nih.gov/pubmed/33125280
DOI: 10.1161/CIRCOUTCOMES.120.007608

14. Buldu JM, Antequera DR, Aguirre J. The resumption of sports competitions after COVID-19 lockdown: The case of the Spanish football league. Chaos Solitons Fractals. 2020;138:109964. DOI: 10.1016/j.chaos.2020.109964
ABSTRACT: In this work, we present a stochastic discrete-time SEIR Susceptible-Exposed-Infectious-Recovered model adapted to describe the propagation of COVID-19 during a football tournament. Specifically, we are concerned about the re-start of the Spanish national football league, La Liga, which is currently -May 2020- stopped with 11 fixtures remaining. Our model includes two additional states of an individual, confined and quarantined, which are reached when an individual presents COVID-19 symptoms or has undergone a virus test with a positive result. The model also accounts for the interaction dynamics of players, considering three different sources of infection: the player social circle, the contact with his/her team colleagues during training sessions, and the interaction with rivals during a match. Our results highlight the influence of the days between matches, the frequency of virus tests and their sensitivity on the number of players infected at the end of the season. Following our findings, we finally propose a variety of strategies to minimise the probability that COVID-19 propagates in case the season of La Liga was re-started after the current lockdown.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32518475
DOI: 10.1016/j.chaos.2020.109964

15. Bulfone TC, Malekinejad M, Rutherford GW, et al. Outdoor Transmission of SARS-CoV-2 and Other Respiratory Viruses, a Systematic Review. J Infect Dis. 2020. DOI: 10.1093/infdis/jiaa742
ABSTRACT: BACKGROUND: While risk of outdoor transmission of respiratory viral infections is hypothesized to be low, there is limited data of SARS-CoV-2 transmission in outdoor compared to indoor settings. METHODS: We conducted a systematic review of peer-reviewed papers indexed in PubMed, EMBASE and Web of Science and pre-prints in Europe PMC through August 12 th, 2020 that described cases of human transmission of SARS-CoV-2. Reports of other respiratory virus transmission were included for reference. RESULTS: Five identified studies found that a low proportion of reported global SARS-CoV-2 infections have occurred outdoors (<10%) and the odds of indoor transmission was very high compared to outdoors (18.7 times; 95% CI 6.0, 57.9). Five studies described

influenza transmission outdoors and two described adenovirus transmission outdoors. There was high heterogeneity in study quality and individual definitions of outdoor settings which limited our ability to draw conclusions about outdoor transmission risks. In general, factors such as duration and frequency of personal contact, lack of personal protective equipment and occasional indoor gathering during a largely outdoor experience were associated with outdoor reports of infection. CONCLUSION: Existing evidence supports the wide-held belief that the the risk of SARS-CoV-2 transmission is lower outdoors but there are significant gaps in our understanding of specific pathways.
URL: https://www.ncbi.nlm.nih.gov/pubmed/33249484
DOI: 10.1093/infdis/jiaa742

16. Buonanno G, Stabile L, Morawska L. Estimation of airborne viral emission: Quanta emission rate of SARS-CoV-2 for infection risk assessment. Environ Int. 2020;141:105794. DOI: 10.1016/j.envint.2020.105794
ABSTRACT: Airborne transmission is a pathway of contagion that is still not sufficiently investigated despite the evidence in the scientific literature of the role it can play in the context of an epidemic. While the medical research area dedicates efforts to find cures and remedies to counteract the effects of a virus, the engineering area is involved in providing risk assessments in indoor environments by simulating the airborne transmission of the virus during an epidemic. To this end, virus air emission data are needed. Unfortunately, this information is usually available only after the outbreak, based on specific reverse engineering cases. In this work, a novel approach to estimate the viral load emitted by a contagious subject on the basis of the viral load in the mouth, the type of respiratory activity (e.g. breathing, speaking, whispering), respiratory physiological parameters (e.g. inhalation rate), and activity level (e.g. resting, standing, light exercise) is proposed. The results showed that high quanta emission rates (>100 quanta h(-1)) can be reached by an asymptomatic infectious SARS-CoV-2 subject performing vocalization during light activities (i.e. walking slowly) whereas a symptomatic SARS-CoV-2 subject in resting conditions mostly has a low quanta emission rate (<1 quantum h(-1)). The findings in terms of quanta emission rates were then adopted in infection risk models to demonstrate its application by evaluating the number of people infected by an asymptomatic SARS-CoV-2 subject in Italian indoor microenvironments before and after the introduction of virus containment measures. The results obtained from the simulations clearly highlight that a key role is played by proper ventilation in containment of the virus in indoor environments.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32416374
DOI: 10.1016/j.envint.2020.105794

17. Carmody S, Murray A, Borodina M, et al. When can professional sport recommence safely during the COVID-19 pandemic? Risk assessment and factors to consider. Br J Sports Med. 2020;54(16):946-8. DOI: 10.1136/bjsports-2020-102539
URL: https://www.ncbi.nlm.nih.gov/pubmed/32381501
DOI: 10.1136/bjsports-2020-102539

18. Chen P, Mao L, Nassis GP, et al. Coronavirus disease (COVID-19): The need to maintain regular physical activity while taking precautions. J Sport Health Sci. 2020;9(2):103-4. DOI: 10.1016/j.jshs.2020.02.001
URL: https://www.ncbi.nlm.nih.gov/pubmed/32099716
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ABSTRACT: Our research aimed to review the potential risk of infection by SARS-CoV-2. We used an excerpt of a data set generated in May 2020 for reviewing the SARS-CoV-2 prevention concept of orchestras, singers and actors. People were sampled for droplet release for one-hour activities using a Grimm spectrometer covering a spectrum of 1 to 32 microm diameter. We estimated the number of "quanta" in the exhaled liquid from viral concentrations of 10(6) to 10(11)/mL, based on the Human Infective Dose 50 of 218 viral particles. We employed the Wells-Riley equation to estimate the risk of infection in typical meeting rooms for a one-hour meeting of 2, 4 and 6 people observing a 2 m distance. The four participating adults released a mean of 1.28 nLm(3) while breathing, 1.68 nL/m(3) while speaking normally, and two adults released a mean of 4.44 nL/m(3) while talking with a raised voice. The combination of 50% breathing, 45% talking normally and 5% speaking with a raised voice increased the risk of infection above 5% for a one-hour meeting of two people. The result is based on 6 quanta released, corresponding to an initial virus concentration of 1000/nL (10(9)/mL) in the fluid of the upper respiratory tract. Our data confirm the importance of using facemasks in combination with other measures to prevent transmission of SARS-CoV-2 at the workplace.
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ABSTRACT: National and international guidelines recommend droplet/airborne transmission and contact precautions for those caring for coronavirus disease 2019 (COVID-19) patients in ambulatory and acute care settings. The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, an acute respiratory infectious agent, is primarily transmitted between people through respiratory droplets and contact routes. A recognized key to transmission of COVID-19, and droplet infections generally, is the dispersion of bioaerosols from the patient. Increased risk of transmission has been associated with aerosol generating procedures that include endotracheal intubation, bronchoscopy, open suctioning, administration of nebulized treatment, manual ventilation before intubation, turning the patient to the prone position, disconnecting the patient from the ventilator, noninvasive positive-pressure ventilation, tracheostomy, and cardiopulmonary resuscitation. The knowledge that COVID-19 subjects can be asymptomatic and still shed virus, producing infectious droplets during breathing, suggests that health care workers (HCWs) should assume every patient is potentially infectious during this pandemic. Taking actions to reduce risk of transmission to HCWs is, therefore, a vital consideration for safe delivery of all medical aerosols. Guidelines for use of personal protective equipment (glove, gowns, masks, shield, and/or powered air purifying respiratory) during high-risk procedures are essential and should be considered for use with lower risk procedures such as administration of uncontaminated medical aerosols. Bioaerosols generated by infected patients are a major source of transmission for SARS CoV-2, and other infectious agents. In contrast, therapeutic aerosols do not add to the risk of disease transmission unless contaminated by patients or HCWs.
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ABSTRACT: Recent studies have indicated that COVID-19 is an airborne disease, which has driven conservative social distancing and widescale usage of face coverings. Airborne virus transmission occurs through droplets formed during respiratory events (breathing, speaking, coughing, and sneezing) associated with the airflow through a network of nasal and buccal passages. The airflow interacts with saliva/mucus films where droplets are formed and dispersed, creating a route to transmit SARS-CoV-2. Here, we present a series of numerical simulations to investigate droplet dispersion from a sneeze while varying a series of human physiological factors that can be associated with illness, anatomy, stress condition, and sex of an individual. The model measures the transmission risk utilizing an approximated upper respiratory tract geometry for the following variations: (1) the effect of saliva properties and (2) the effect of geometric features within the buccal/nasal passages. These effects relate to natural human physiological responses to illness, stress, and sex of the host as well as features relating to poor dental health. The results find that the resulting exposure levels are highly dependent on the fluid dynamics that can vary depending on several human factors. For example, a sneeze without flow in the nasal passage (consistent with congestion) yields a 300% rise in the droplet content at 1.83 m (approximately 6 ft) and an increase over 60% on the spray distance 5 s after the sneeze. Alternatively, when the viscosity of the saliva is increased (consistent with the human response to illness), the number of droplets is both fewer and larger, which leads to an estimated 47% reduction in the transmission risk. These findings yield novel insight into variability in the exposure distance and indicate how physiological factors affect transmissibility rates. Such factors may partly relate to how the immune system of a human has evolved to prevent transmission or be an underlying factor driving superspreading events in the COVID-19 pandemic.
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ABSTRACT: At the end of 2019, in Wuhan, the Hubei Province's capital city in China, the first cases of COVID-19 disease caused by the novel coronavirus, SARS-CoV-2, were described. The rapid spread of the infection through

the world resulted in the World Health Organization announcing the COVID-19 a global pandemic in March 2020. The main routes of transmission of the novel coronavirus SARS-CoV-2, according to current evidence, are via droplets inhalation, direct contact with contaminated surfaces, and transmission via the mucous membranes of the mouth, nose, and eyes, and probably through airborne particles from the respiratory tract, generated during coughing and sneezing of infected individuals. During the pulmonary function testing (PFTs), which require strenuous breathing maneuvers and generate high-intensity airflow, aerosols, and micro-aerosols are formed from respiratory secretions and may contain viral and bacterial particles. Therefore, such forced respiratory maneuvers pose a significant risk of spreading the infection to patients and laboratory staff. According to current knowledge, the source of infection may also be an asymptomatic and a pre-symptomatic individual. Coronavirus SARS-CoV-2 has been increasingly prevalent in the community, and this increases a potential risk to all patients tested lung function and staff working there. As the patients' and staff's safety is of unprecedented importance, the additional precautions when performing pulmonary function tests are necessary and unquestionable. In consequence, the greater availability of consumables and personal protective equipment is indispensable. The reorganization of daily practice will prolong test time, reduce the number of tests performed, and slow down patients' flow. The guidance provides practical advice to health care professionals on performing pulmonary function tests during the COVID-19 pandemic. It has been developed basing on currently available information and recommendations from relevant health care institutions. As the COVID-19 pandemic is a rapidly evolving situation and the new scientific data has been becoming are available, the guidance will be updated over time.
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ABSTRACT: BACKGROUND: Coronavirus disease 2019 (COVID-19) has spread to the world. Whether there is an association between lifestyle behaviors and the acquisition of COVID-19 remains unclear. METHODS: In this case-control study, we recruited 105 patients with SARS-CoV-2 infection as a case group from the Wuhan Tongji Hospital (Wuhan, China). For each case two control subjects were recruited. Participants were randomly selected from communities in Wuhan and matched for sex, age (+/- 2yrs), and pre-existing comorbidities (hypertension and diabetes). RESULTS: A total of 105 patients diagnosed with COVID-19 and 210 controls were included. Compared with control group, the case group had higher proportions of lack of sleep (30.5% vs. 14.8%, P = 0.001) and increased physical activities (56.2% vs. 32.9%, P < 0.001). And patients in the case group were more likely to have alopecia (28.6% vs. 10.0%, P < 0.001) than people from the control group. Overall, we found that lack of sleep [adjusted odds ratio (OR) 1.56, 95% confidence interval (CI) 1.03-2.39)], physical activities (>/= 5 times a week) (adjusted OR 2.05, 95%CI 1.39-3.02) and alopecia (adjusted OR 1.73, 95%CI 1.13-2.66) were independent risk factors for COVID-19 infection. Conversely, low-dose alcohol intake (<100g alcohol per week), hand hygiene, and fruits intake (daily) were significantly associated with a decrease in morbidity. CONCLUSIONS: Individual lifestyle behaviors and health status can affect the occurrence of COVID-19.
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ABSTRACT: In December of 2019, there was an outbreak of a severe acute respiratory syndrome caused by the coronavirus 2 (SARS-CoV-2 or COVID-19) in China. The virus rapidly spread into the whole world causing an unprecedented pandemic and forcing governments to impose a global quarantine, entering an extreme unknown situation. The organizational consequences of quarantine/isolation are absence of organized training and competition, lack of communication among athletes and coaches, inability to move freely, lack of adequate sunlight exposure, and inappropriate training conditions. The reduction of mobility imposed to contain the advance of the SARS-Cov-2 pandemic can negatively affect the physical condition and health of individuals leading to muscle atrophy, progressive loss of muscle strength, and reductions in neuromuscular and mechanical capacities. Resistance training (RT) might be an effective tool to counteract these adverse consequences. RT is considered an essential part of an exercise program due to its numerous health and athletic benefits. However, in

the face of the SARS-Cov-2 outbreak, many people might be concerned with safety issues regarding its practice, especially in indoor exercise facilities, such as gyms and fitness centers. These concerns might be associated with RT impact in the immune system, respiratory changes, and contamination due to equipment sharing and agglomeration. In this current opinion article, we provide insights to address these issues to facilitate the return of RT practices under the new logistical and health challenges. We understand that RT can be adapted to allow its performance with measures adopted to control coronavirus outbreak such that the benefits would largely overcome the potential risks. The article provides some practical information to help on its implementation.
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ABSTRACT: During the COVID-19 pandemic, the temporary closure of physical activity and sports facilities, and the generalized cancellation or postponement of sports events have a massive impact on social and economic development. In this study, we explored the feasibility of using tracking data from a football match to assess interpersonal contact between individuals by calculating two measures of respiratory exposure. The dynamic tracking positioning of all players and referees during one international football match was analyzed. For each individual, two measures of respiratory exposure were calculated, based on the 2 m interpersonal distance recommendations for contact tracing for COVID-19 control. Overall, individuals spent a median of 0.12 mm:ss (IQR = 0.45 mm:ss) exposed to interpersonal contact of fewer than 2 m from others. The highest value of exposure was observed between two players of opposing teams (6.35 mm:ss). The results suggest that tracking data can be used to assess respiratory exposure to interpersonal contact in team sports, such as football. The measures of exposure calculated can be used to the prompt identification of high-risk contacts of COVID-19 cases during a match or a training session, but also the risk stratification of different sports and physical activities.
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ABSTRACT: We conducted the first large-scale general population study on lifestyle risk factors (smoking, physical inactivity, obesity, and excessive alcohol intake) for COVID-19 using prospective cohort data with national registry linkage to hospitalisation. Participants were 387,109 men and women (56.4 +/- 8.8 yr; 55.1% women) residing in England from UK Biobank study. Physical activity, smoking, and alcohol intake, were assessed by questionnaire at baseline (2006-2010). Body mass index, from measured height and weight, was used as an indicator of overall obesity. Outcome was cases of COVID-19 serious enough to warrant a hospital admission from 16-March-2020 to 26-April-2020. There were 760 COVID-19 cases. After adjustment for age, sex and mutually for each lifestyle factor, physical inactivity (Relative risk, 1.32, 95% confidence interval, 1.10, 1.58), smoking (1.42;1.12, 1.79) and obesity (2.05 ;1.68, 2.49) but not heavy alcohol consumption (1.12; 0.93, 1.35) were all related to COVID-19. We also found a dose-dependent increase in risk of COVID-19 with less favourable lifestyle scores, such that participants in the most adverse category had 4-fold higher risk (4.41; 2.52-7.71) compared to people with the most optimal lifestyle. C-reactive protein levels were associated with elevated risk of COVID-19 in a dose-dependent manner, and partly (10-16%) explained associations between adverse lifestyle and COVID-19. Based on UK risk factor prevalence estimates, unhealthy behaviours in combination accounted for up to 51% of the population attributable fraction of severe COVID-19. Our findings suggest that an unhealthy lifestyle synonymous with an elevated risk of non-communicable disease is also a risk factor for COVID-19 hospital admission, which might be partly explained by low grade inflammation. Adopting simple lifestyle changes could lower the risk of severe infection.
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ABSTRACT: On March 17, 2020, a member of a Skagit County, Washington, choir informed Skagit County Public Health (SCPH) that several members of the 122-member choir had become ill. Three persons, two from Skagit County and one from another area, had test results positive for SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19). Another 25 persons had compatible symptoms. SCPH obtained the choir's member list and began an investigation on March 18. Among 61 persons who attended a March 10 choir practice at which one person was known to be symptomatic, 53 cases were identified, including 33 confirmed and 20 probable cases (secondary attack rates of 53.3% among confirmed cases and 86.7% among all cases). Three of the 53 persons who became ill were hospitalized (5.7%), and two died (3.7%). The 2.5-hour singing practice provided several opportunities for droplet and fomite transmission, including members sitting close to one another, sharing snacks, and stacking chairs at the end of the practice. The act of singing, itself, might have contributed to transmission through emission of aerosols, which is affected by loudness of vocalization (1). Certain persons, known as superemitters, who release more aerosol particles during speech than do their peers, might have contributed to this and previously reported COVID-19 superspreading events (2-5). These data demonstrate the high transmissibility of SARS-CoV-2 and the possibility of superemitters contributing to broad transmission in certain unique activities and circumstances. It is recommended that persons avoid face-to-face contact with others, not gather in groups, avoid crowded places, maintain physical distancing of at least 6 feet to reduce transmission, and wear cloth face coverings in public settings where other social distancing measures are difficult to maintain.
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ABSTRACT: OBJECTIVES: This study aimed to compare the risk of infection of children with that of adults and to explore risk factors of infection with severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) by following up close contacts of COVID-19 patients. METHOD: The retrospective cohort study was performed among close contacts of index cases diagnosed with COVID-19 in Guangzhou, China. Demographic characteristics, clinical symptoms and exposure information were extracted. Logistic regression analysis was employed to explore the risk factors. The restricted cubic spline was conducted to examine to the dose-response relationship between age and SARS-CoV-2 infection. RESULTS: The secondary attack rate (SAR) was 4.4% in 1,344 close contacts. The group of household contacts (17.2%) had the highest SAR. The rare-frequency contact ($p < 0.001$) and moderate-frequency contact ($p < 0.001$) were associated with lower risk of infection. Exposure to index cases with dry cough symptoms was associated with infection in close contacts ($p = 0.004$). Compared with children, adults had a significantly increased risk of infection ($p = 0.014$). There is a linear positive correlation between age and infection ($p = 0.001$). CONCLUSIONS: Children are probably less susceptible to COVID-19. Close contacts with frequent contact with patients and those exposed to patients with cough symptoms are associated with an increased risk of infection.
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ABSTRACT: During 24 days in Cheonan, South Korea, 112 persons were infected with severe acute respiratory syndrome coronavirus 2 associated with fitness dance classes at 12 sports facilities. Intense physical exercise in densely populated sports facilities could increase risk for infection. Vigorous exercise in confined spaces should be minimized during outbreaks.
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ABSTRACT: The World Health Organization recognized SARS-CoV-2 as a public health concern and declared it as a pandemic on March 11, 2020. Over 12 million people have been affected across several countries since it was first recognized. SARS-CoV-2 is thought to commonly spread via respiratory droplets formed while talking, coughing, and sneezing of an infected patient. As several cases, with an absence of travel history to the majorly affected areas were identified, a strong possibility of community transmission could have been possible. Broadly, two modes of transmission of COVID-19 exist-direct and indirect. The direct mode includes (1) transmission via aerosols formed via surgical and dental procedures and/or in the form of respiratory droplet nuclei; (2) other body fluids and secretions, for example, feces, saliva, urine, semen, and tears; and (3) mother-to-child. Indirect transmission may occur via (1) fomites or surfaces (e.g., furniture and fixtures) present within the immediate environment of an infected patient and (2) objects used on the infected person (e.g., stethoscope or thermometer). As many of these modes may be underestimated, it is necessary to emphasize and illustrate them. The goal of this paper is to briefly review how SARS-CoV-2 is shown to transmit via various modes and propose measures to reduce the risk of spread within the population and operating personnel.
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ABSTRACT: The coronavirus disease-2019 (COVID-19) pandemic has heightened the awareness of aerosol generation by human expiratory events and their potential role in viral respiratory disease transmission. Concerns over high severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) viral burden of mucosal surfaces has raised questions about the aerosol-generating potential and dangers of many otorhinolaryngologic procedures. However, the risks of aerosol generation and associated viral transmission by droplet or airborne routes for many otorhinolaryngology procedures are largely unknown. Indoor aerosol and droplet viral respiratory transmission risk is influenced by 4 factors: (1) aerosol or droplet properties; (2) indoor airflow; (3) virus-specific factors; and (4) host-specific factors. Herein we elaborate on known aerosol vs droplet properties, indoor airflow, and aerosol-generating events to provide context for risks of aerosol infectious transmission. We also provide simple but typically effective measures for mitigating the spread and inhalation of viral aerosols in indoor settings. Understanding principles of infectious transmission, aerosol and droplet generation, as well as concepts of indoor airflow, will assist in the integration of new data on SARS-CoV-2 transmission and activities that can generate aerosol to best inform on the need for escalation or de-escalation from current societal and institutional guidelines for protection during aerosol-generating procedures.
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ABSTRACT: Widespread transmission of a novel coronavirus, COVID-19, has caused major public health and economic problems around the world. Significant mitigation efforts have been implemented to reduce the spread of COVID-19 but the role of ambient noise and elevated vocal effort on airborne transmission have not been widely reported. Elevated vocal effort has been shown to increase emission of potentially infectious respiratory droplets, which can remain airborne for up to several hours. Multiple confirmed clusters of COVID-19 transmission were associated with settings where elevated vocal effort is generally required for communication, often due to high ambient noise levels, including crowded bars and restaurants, meat packing facilities, and long-stay nursing homes. Clusters of COVID-19 transmission have been frequently reported in each of these settings. Therefore, analysis of COVID-19 transmission clusters in different settings should consider whether higher ambient noise levels, which are associated with increased vocal effort, may be a contributing factor in those settings. Mitigation strategies that include reduction of ambient noise, softer speech practices, and the use of technology such as microphones and speakers to decrease vocal effort will likely reduce the risk of transmitting COVID-19 or other airborne pathogens.
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ABSTRACT: The dispersion of viral droplets plays a key role in the transmission of COVID-19. In this work, we analyze the dispersion of cough-generated droplets in the wake of a walking person for different space sizes. The air flow is simulated by solving the Reynolds-averaged Navier-Stokes equations, and the droplets are modeled as passive Lagrangian particles. Simulation results show that the cloud of droplets locates around and below the waist height of the manikin after 2 s from coughing, which indicates that kids walking behind an infectious patient are exposed to higher transmission risk than adults. More importantly, two distinct droplet dispersion modes occupying significantly different contamination regions are discovered. A slight change of space size is found being able to trigger the transition of dispersion modes even though the flow patterns are still similar. This shows the importance of accurately simulating the air flow in predicting the dispersion of viral droplets and implies the necessity to set different safe-distancing guidelines for different environments.
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ABSTRACT: A mathematical model for estimating the risk of airborne transmission of a respiratory infection such as COVID-19 is presented. The model employs basic concepts from fluid dynamics and incorporates the known scope of factors involved in the airborne transmission of such diseases. Simplicity in the mathematical form of the model is by design so that it can serve not only as a common basis for scientific inquiry across disciplinary boundaries but it can also be understandable by a broad audience outside science and academia. The caveats and limitations of the model are discussed in detail. The model is used to assess the protection from transmission afforded by face coverings made from a variety of fabrics. The reduction in the transmission risk associated with increased physical distance between the host and susceptible is also quantified by coupling the model with available and new large eddy simulation data on scalar dispersion in canonical flows. Finally, the effect of the level of physical activity (or exercise intensity) of the host and the susceptible in enhancing the transmission risk is also assessed.
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ABSTRACT: BACKGROUND AND AIMS: COVID-19 is a public world crisis, however, it is a self-limited infection. In COVID-19, the strength of immune and respiratory systems is a critical element. Thus, this review was conducted to demonstrate the short and long term effects of increasing the aerobic capacity on increasing the function and strength of immune and respiratory systems, particularly those essential for overcoming COVID-19 infections and associated disorders. METHODS: This review was carried out by searching in Web of Science, Scopus, EBSCO, Medline databases. The search was conducted over clinical trials and literature and systematic reviews on the effects of increasing the aerobic capacity on the function and strength of specific immune and respiratory elements essential for overcoming COVID-19 infections. RESULTS: This review found that increasing the aerobic capacity could produce short-term safe improvements in the function of immune and respiratory systems, particularly those specific for COVID-19 infections. This could be mainly produced through three mechanisms. Firstly, it could improve immunity by increasing the level and function of immune cells and immunoglobulins, regulating CRP levels, and decreasing anxiety and depression. Secondly, it could improve respiratory system functions by acting as an antibiotic, antioxidant, and antimycotic, restoring normal lung tissue elasticity and strength. Lastly, it could act as a protective barrier to decrease COVID-19 risk factors, which helps to decrease the incidence and progression of COVID-19. CONCLUSION: This review summarizes that increasing the aerobic capacity is recommended because it has potential of improving immune and respiratory functions which would help counter COVID-19.

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ABSTRACT: Physical inactivity is one major modifiable risk factor for dementia (especially Alzheimer's disease). Due to contact restrictions and isolation measures in response to the current COVID-19 (coronavirus disease 2019) pandemic, physical inactivity levels have increased by up to 30%, which will likely have adverse consequences for primary and secondary dementia prevention. Therefore, new interdisciplinary prevention approaches (eg, outdoor exercise; app-based exercise with online partners) are urgently needed that account for the suspected long-term lifestyle changes that the current-and upcoming-pandemics are likely to entail (increased use of home office, social isolation, avoidance of fitness centers and club sports, and so on).
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ABSTRACT: For estimating the infection risk from virus-containing airborne droplets, it is crucial to consider the interplay of all relevant physical-chemical effects that affect droplet evaporation and sedimentation times. For droplet radii in the range 70 nm < R < 60 mum, evaporation can be described in the stagnant-flow approximation and is diffusion-limited. Analytical equations are presented for the droplet evaporation rate, the time-dependent droplet size, and the sedimentation time, including evaporation cooling and solute osmotic-pressure effects. Evaporation makes the time for initially large droplets to sediment much longer and thus significantly increases the viral air load. Using recent estimates for SARS-CoV-2 concentrations in sputum and droplet production rates while speaking, a single infected person that constantly speaks without a mouth cover produces a total steady-state air load of more than 10(4) virions at a given time. In a midsize closed room, this leads to a viral inhalation frequency of at least 2.5 per minute. Low relative humidity, as encountered in airliners and inside buildings in the winter, accelerates evaporation and thus keeps initially larger droplets suspended in air. Typical air-exchange rates decrease the viral air load from droplets with an initial radius larger than 20 mum only moderately.
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ABSTRACT: At the time of writing, it is unclear how the COVID-19 pandemic will play out in rapidly urbanising regions of the world. In these regions, the realities of large overcrowded informal settlements, a high burden of infectious and non-communicable diseases, as well as malnutrition and precarity of livelihoods, have raised added concerns about the potential impact of the COVID-19 pandemic in these contexts. COVID-19 infection control measures have been shown to have some effects in slowing down the progress of the pandemic, effectively buying time to prepare the healthcare system. However, there has been less of a focus on the indirect impacts of these measures on health behaviours and the consequent health risks, particularly in the most vulnerable. In this current debate piece, focusing on two of the four risk factors that contribute to >80% of the NCD burden, we consider the possible ways that the restrictions put in place to control the pandemic, have the potential to impact on dietary and physical activity behaviours and their determinants. By considering mitigation responses implemented by governments in several LMIC cities, we identify key lessons that highlight the potential of economic, political, food and built environment sectors, mobilised during the pandemic, to retain health as a priority beyond the context of pandemic response. Such whole-of society approaches are feasible and necessary to support equitable healthy eating and active living required to address other epidemics and to lower the baseline need for healthcare in the long term.
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ABSTRACT: Background: The world is currently undergoing a pandemic, caused by the SARS-CoV-2 virus. According to World Health Organization (WHO), patients suffering from chronic illnesses (e.g., cardiovascular, pulmonary, obesity, diabetes mellitus and oncology diseases) appear to be at the highest risk for COVID-19 associated sequelae. These patients are advised to avoid rehabilitation center visits to minimize the risk of exposure to the virus. However, inability to participate in rehabilitation and being home-bound can increase the risk for and potential worsening of chronic health conditions due to increased sedentary behaviors, decreased physical activity levels, and reduced daily energy expenditure. In this dilemma between risk of contracting virus versus risk of worsening of existing illness, Tele-Rehab appears to be the best approach to continued rehabilitation. The purpose of this study was to determine the effects of Tele-Rehab using simple, available monitoring techniques on patients' physical fitness and health related quality of life (HRQoL). Method(s): 47 patients (23 Cardiovascular, 15 Pulmonary and 9 oncology) participated in the SETTLE program. Before joining the program and after completion of 1 month, patients were assessed on their physical fitness, using the six-minute walk test (original/modified) and on their HRQoL with the use of SF-36 (Short Form-36), SGRQ (Saint George Respiratory Questionnaire) and FACIT (Functional Assessment of Chronic Illness Therapy). The average daily step counts measured by the PACER App were used to monitor and improve physical activity levels. Result(s): There was a statistically significant 9.2% improvement (p=0.0418) in the 6MWTD after one month of Tele-Rehab which was consistent within different disease groups. The HRQoL measured by SF-36 showed no significant change but, there was no diminution, despite the strict lockdown. HRQoL for pulmonary patients using SGRQ showed statistically significant declines in symptoms (51.33%, p=0.0025) and disease impact (44.91%, p=0.0078). Trial Outcome Index for cancer patients, was calculated by subtracting social and emotional components from the FACIT total scores. There was a statistically significant, 8.99% improvement (p=0.0313) in the score post Tele-Rehab for all oncology patients. The average number of steps walked by patients were 4096.8 per day. Conclusion(s): Our results indicate that a short-term, supervised virtual Tele-Rehab program has significant positive effects on physical fitness of cardiac, pulmonary and oncology patients. Use of a step counter with regular education in home-based interventions could supplement positive health behaviors and promote regular physical activity even under strict lockdown. The virtual supervised exercise program had beneficial effects on HRQoL of pulmonary and oncology patients during COVID-19.
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ABSTRACT: CO2 is co-exhaled with aerosols containing SARS-CoV-2 by COVID-19 infected people and can be used as a proxy of SARS-CoV-2 concentrations indoors. Indoor CO2 measurements by low-cost sensors hold promise for mass monitoring of indoor aerosol transmission risk for COVID-19 and other respiratory diseases. We derive analytical expressions of CO2-based risk proxies and apply them to various typical indoor environments. Contrary to some earlier recommendations setting a single indoor CO2 threshold, we show that the CO2 level corresponding to a given infection risk varies by over 2 orders of magnitude for different environments and activities. Although large uncertainties, mainly from virus exhalation rates, are still associated with our infection risk estimates, our study provides more specific and practical recommendations for low-cost CO2-based indoor infection risk monitoring.
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ABSTRACT: SARS-CoV-2 (COVID-19) is a new virus causing respiratory illness outbreak. Nowadays, COVID-19 has spread to several countries around the world and is presently a major global concern. It appears that no certain effective pharmaceutical agent is currently available for it. It seems that obesity is one of the biggest risk factors related to COVID-19 hospitalization and critical illness. The strengthening of the body systems by non-drug ways is very important especially in obese people. On the basis of some indirect evidence, it seems that moderate physical activity can be recommended as a non-pharmacological, inexpensive, and viable way to cope with corona. On the other hand, recommending higher intensity exercise needs further consideration to make final decision in this regard.
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ABSTRACT: INTRODUCTION: The COVID-19 pandemic is causing devastating global morbidity and mortality. Worldwide measures are taken to prevent human to human transmission and improve general health. Public lifestyle and health are affected by social distancing and isolation. A strong host immune response to the novel coronavirus is a key factor, for protection against infection and avoiding reaching severe stages of the disease. AREAS COVERED: Pathophysiology and the human immune response of similar coronaviruses have been previously described. The novel coronavirus has distinct clinical stages related to the immune response. Exercise improves host innate immunity and affords protection to viral infections. Exercise also mitigates the negative effects of isolation including stress, anxiety, and sedentarism, all of which further reduces immunity and increases non-communicable disease risk. EXPERT OPINION: Improving host immunity and mitigating the negative effects of isolation via physical activity is strongly justified. Exercise should be done in moderate intensities and volumes during the current pandemic, which is a nutritionally, psychologically, socially challenging environment in the presence of a virulent viral organism. Proactively creating innovative health promotion models with technology and government involvement with the best available evidence should be encouraged to reduce physical inactivity during the current COVID-19 pandemic and after.
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ABSTRACT: Importance: Individuals with asymptomatic or mild coronavirus disease 2019 (COVID-19) have been reported to frequently transmit the disease even without direct contact. The severe acute respiratory syndrome coronavirus 2 has been found at very high concentrations in swab and sputum samples from such individuals. Objective: To estimate the virus levels released from individuals with asymptomatic to moderate COVID-19 into different aerosol sizes by normal breathing and coughing, and to determine what exposure could result from this in a room shared with such individuals. Design, Setting, and Participants: This mathematical modeling study

combined the size-distribution of exhaled breath microdroplets for coughing and normal breathing with viral swab and sputum concentrations as approximation for lung lining liquid to obtain an estimate of emitted virus levels. Viral data were obtained from studies published as of May 20, 2020. The resulting emission data fed a single-compartment model of airborne concentrations in a room of 50 m3, the size of a small office or medical examination room. Main Outcomes and Measures: Modeling was used to estimate the viral load emitted by individuals breathing normally or coughing, and the concentrations expected in the simulated room at different ventilation rates. Results: The mean estimated viral load in microdroplets emitted by simulated individuals while breathing regularly was 0.0000049 copies/cm3, with a range of 0.0000000049 to 0.637 copies/cm3. The corresponding estimates for simulated coughing individuals were a mean of 0.277 copies/cm3 per cough, with a range of 0.000277 to 36 030 copies/cm3 per cough. The estimated concentrations in a room with an individual who was coughing frequently were very high, with a maximum of 7.44 million copies/m3 from an individual who was a high emitter. However, regular breathing from an individual who was a high emitter was modeled to result in lower room concentrations of up to 1248 copies/m3. Conclusions and Relevance: In this modeling study, breathing and coughing were estimated to release large numbers of viruses, ranging from thousands to millions of virus copies per cubic meter in a room with an individual with COVID-19 with a high viral load, depending on ventilation and microdroplet formation process. The estimated infectious risk posed by a person with typical viral load who breathes normally was low. The results suggest that only few people with very high viral load pose an infection risk in poorly ventilated closed environments. These findings suggest that strict respiratory protection may be needed when there is a chance to be in the same small room with an individual, whether symptomatic or not, especially for a prolonged period.
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ABSTRACT: Public health measures to cope with the Covid-19 pandemic, imposed also a shutdown of sports facilities and swimming pools. Safety issues related to recreational waters were emerging during the lockdown, rising concerns on how and when reopening pools and on how improve their management while SARS-CoV-2 is circulating in the population. The GSMS-SItI, Working Group on Movement Sciences for Health of the Italian Society of Hygiene Preventive Medicine and Public Health, discussed and summarized some indications for a suitable preventive approach. Several measures are highlighted, including social distancing, optimized water management, airflow and microclimatic parameters in the pool as well in the annexed rooms, verification of sanitation procedures. The GSMS-SItI underlines that prevention should be based on monitoring of the local epidemiological situation and on the constant collaboration with the local health authority and the national health service.
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ABSTRACT: Background Evidence for indoor airborne transmission of SARS-CoV-2 is accumulating. If SARS-CoV-2 also spreads via aerosols, this has implications for measures taken to limit transmission.Objectives The aim of this study is to assess exposure to airborne SARS-CoV-2 particles from breathing, speaking, coughing and sneezing in an indoor environment.Methods An exposure assessment model was developed to estimate numbers of SARS-CoV-2 particles in aerosol droplets, expelled during breathing, speaking, coughing and sneezing by an infected person in an unventilated indoor environment, and subsequent inhalation by one or more persons. Scenarios encompass a range of virus concentrations, room sizes and exposure times.Results The calculated total volume of expelled aerosol droplets was highest for a sneeze, followed by a cough and speaking for 20 minutes, and lastly breathing for 20 minutes. A few to as much as tens of millions of virus particles were expelled. Exposure probability strongly depends on the viral concentration in mucus, as well as on the scenario. Exposure probabilities were generally below 1% at a virus concentration in mucus below 105 per mL for all scenarios, increasing steeply at different

higher concentrations. According to nose / throat swab data collected from patients, 75%, 50% and 5% of infected individuals carry an estimated number of SARS-CoV-2 per mL mucus of at least 105, 106 and 108, respectively.Discussion Exposure to SARS-CoV-2 via aerosols generated during breathing, speaking, coughing and sneezing in an unventilated indoor environment is possible. This study forms a basis to estimate probabilities of exposure to SARS-Cov-2 by airborne transmission in indoor spaces. As long as it is uncertain what fraction of the airborne virus particles is infectious and as long as a dose response relation is lacking, it is recommended to be precautious.Competing Interest StatementThe authors have declared no competing interest.Funding StatementThis work was funded by the Dutch Ministry of Health, Welfare, and Sports (VWS).Author DeclarationsI confirm all relevant ethical guidelines have been followed, and any necessary IRB and/or ethics committee approvals have been obtained.YesThe details of the IRB/oversight body that provided approval or exemption for the research described are given below:No IRB or ethics committee approval was needed for this study.All necessary patient/participant consent has been obtained and the appropriate institutional forms have been archived.YesI understand that all clinical trials and any other prospective interventional studies must be registered with an ICMJE-approved registry, such as ClinicalTrials.gov. I confirm that any such study reported in the manuscript has been registered and the trial registration ID is provided (note: if posting a prospective study registered retrospectively, please provide a statement in the trial ID field explaining why the study was not registered in advance).YesI have followed all appropriate research reporting guidelines and uploaded the relevant EQUATOR Network research reporting checklist(s) and other pertinent material as supplementary files, if applicable.YesData could be made available upon request.
URL: https://www.medrxiv.org/content/medrxiv/early/2020/07/05/2020.07.02.20144832.full.pdf
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ABSTRACT: Aerobic exercise is traditionally recommended to improve general health and prevent many non-communicable diseases. However, the measures adopted to control the novel Coronavirus (COVID-19) outbreak culminated with closing of exercise facilities and fitness centers and, as a primary consequence, impaired aerobic exercise practice. This contributed to an increase in risk factors associated with physical inactivity such as insulin resistance, high blood pressure, low-grade inflammation, weight gain, and mental health problems. The scenario is worrisome, and it is important to propose alternatives for exercise practice during the COVID-19 pandemic. Interval training (IT) emerges as an exercise mode that might be feasible, low-cost, and potentially safe to be performed in many different places. IT consists of interspersing relative brief bouts of high-intensity exercise with recovery periods and promotes similar or greater health benefits when compared to moderate-intensity continuous exercise. Among the different types of IT, sprint interval training and "Tabata protocols" might be particularly useful during social isolation. These protocols can be controlled and performed without the need of complex equipment and can be adapted to different places, including domestic environments. In this article, we present variations of IT as possible alternatives to cope physical inactivity during COVID-19 pandemics with a focus on its practical applications. The protocols suggested can be performed without the need of specialized equipment or facilities, in a time-efficient manner, and aiming to prevent detraining or even improve physical fitness and general health.
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ABSTRACT: Psychological distress caused by decreased physical activity (PA) is a growing concern among the elderly due to public health measures since the coronavirus disease (COVID-19). We aimed to (1) assess how public health restrictions impact PA, subjective well-being (SWB), and health-related quality of life (HRQoL) of community-dwelling elderly, and (2) investigate risk factors that lead to a decline in PA. Self-administered questionnaires assessed the changes in PA, SWB, HRQoL. Multivariate logistic regression analysis was performed to identify significant associated risk factors for decreased PA. Of 165 participants (valid response rate, 41.3%; mean

age, 78.5 +/- 8.0 years), 47.3% became less active, 23.0% became more active, and 29.7% maintained PA levels. There was a significant decrease in SWB at baseline and follow-up after COVID-19 restrictions in the less active group (p < 0.01). Higher levels of moderate or strenuous exercise/sports activity at baseline (odds ratio [OR], 1.12; 95% confidence interval [CI], 1.01-1.24), and lower mental component HRQoL scores at baseline (OR, 0.96; 95% CI, 0.93-0.99) were associated with an increased risk of decreased PA. Public health restrictions impact the PA of the elderly, especially those who had higher levels of exercise/sports activity and lower HRQoL before COVID-19. Decreased PA was strongly associated with lower SWB.
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ABSTRACT: The aim was to explore the self-reported impact of the COVID-19 pandemic on nutrition and physical activity behaviour in Dutch older adults and to identify subgroups most susceptible to this impact. Participants (N = 1119, aged 62-98 y, 52.8% female) of the Longitudinal Aging Study Amsterdam living independently completed a COVID-19 questionnaire. Questions on diagnosis, quarantine and hospitalization were asked, as well as impact of the pandemic on ten nutrition and physical activity behaviours. Associations of pre-COVID-19 assessed characteristics (age, sex, region, household composition, self-rated health, BMI, physical activity, functional limitations) with reported impact were tested using logistic regression analyses. About half of the sample (48.3-54.3%) reported a decrease in physical activity and exercise due to the pandemic. An impact on nutritional behaviour predisposing to overnutrition (e.g., snacking more) was reported by 20.3-32.4%. In contrast, 6.9-15.1% reported an impact on behaviour predisposing to undernutrition (e.g., skipping warm meals). Those who had been in quarantine (n = 123) more often reported a negative impact. Subgroups with higher risk of impact could be identified. This study shows a negative impact of the COVID-19 pandemic on nutrition and physical activity behaviour of many older adults, which may increase their risk of malnutrition, frailty, sarcopenia and disability.
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ABSTRACT: We provide research findings on the physics of aerosol and droplet dispersion relevant to the hypothesized aerosol transmission of SARS-CoV-2 during the current pandemic. We utilize physics-based modeling at different levels of complexity, along with previous literature on coronaviruses, to investigate the possibility of airborne transmission. The previous literature, our 0D-3D simulations by various physics-based models, and theoretical calculations, indicate that the typical size range of speech and cough originated droplets (d 20 mu m) allows lingering in the air for O (1 h) so that they could be inhaled. Consistent with the previous literature, numerical evidence on the rapid drying process of even large droplets, up to sizes O (100 mu m) , into droplet nuclei/aerosols is provided. Based on the literature and the public media sources, we provide evidence that the individuals, who have been tested positive on COVID-19, could have been exposed to aerosols/droplet nuclei by inhaling them in significant numbers e.g. O (100) . By 3D scale-resolving computational fluid dynamics (CFD) simulations, we give various examples on the transport and dilution of aerosols (d 20 mu m) over distances O (10 m) in generic environments. We study susceptible and infected individuals in generic public places by Monte-Carlo modelling. The developed model takes into account the locally varying aerosol concentration levels which the susceptible accumulate via inhalation. The introduced concept, 'exposure time' to virus containing aerosols is proposed to complement the traditional 'safety distance' thinking. We show that the exposure time to inhale O (100) aerosols could range from O (1 s) to O (1 min) or even to O (1 h) depending on the situation. The Monte-Carlo simulations, along with the theory, provide clear quantitative insight to the exposure time in different public indoor environments.
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ABSTRACT: The coronavirus 2019 (COVID-19) pandemic has posed a significant threat to human health around the world. A severe risk of infection has been observed in elderly populations. In addition, individuals with obesity and obesity-related comorbidities have also been identified to be at a higher risk of infection for COVID-19. We have attempted here to provide evidence in support of exercise management as a prevention strategy for improving health and minimizing the effects of COVID-19. Therefore, exercise duration, frequency, and intensity benefits are summarized in an attempt to provide guidelines for the general population. In terms of exercise effects, there are multiple benefits of exercise related to human health. These include, decreases in adipose tissue, improvements in cardio-respiratory fitness, enhanced metabolic homeostasis, and suppress inflammation active. With respect to the amount of exercise performed individuals should exercise at a moderate intensity for at least 150 min/wk as an initial target. Increases in intensity and duration of exercise training are necessary for significant fitness benefits, weight loss, and prevention of weight regain. In relation to walking, 10,000 steps/day at a rate of 64-170 steps/minute for at least 10 min duration is reasonable for healthy adults. For exercise intensity, a combination of resistance training (RT), aerobic training (AT) as well as high-intensity interval training (HIIT) incorporated with moderate-intensity continuous training (MICT) can be recognized as an optimal exercise mode for health benefits. Aerobic training and MICT should be viewed as a basis for exercise in combination with appropriate volumes and types of RT and HIIT. Activities should be performed according to professional guidelines and advice. If implemented, these measures may reduce infection rates, underlying pathologies, and assist in decreasing mortality associated with COVID-19 pandemic.
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ABSTRACT: BACKGROUND: Physical distancing measures taken to contain COVID-19 transmission may substantially reduce physical activity levels and cause individuals to adopt a more sedentary lifestyle. OBJECTIVE: The objective of this study is to determine if there was any change in daily steps, an important component of daily physical activity, and examine risk factors for frequent low daily steps during the COVID-19 epidemic. METHODS: We used data collected from the Step Study, a population-based longitudinal study of walking activity among residents aged >/=40 years in Changsha, China. Daily steps were collected via a smartphone linked to WeChat, a social networking platform. We plotted mean daily steps and the prevalence of low daily steps (</=1500 steps/day) 30 days before (reference period) and 30 days after (epidemic period) January 21, 2020 (date of the first COVID-19 case diagnosed in Changsha), and compared it with the same corresponding period from 2019. We examined the association of risk factors with the prevalence of frequent low daily steps (</=1500 steps/day for >/=14 days) using logistic regression. RESULTS: Among 3544 participants (mean age 51.6 years; n=1226 females, 34.6%), mean daily steps dropped from 8097 to 5440 and the prevalence of low daily steps increased from 3% (2287/76,136 person-day) to 18.5% (12,951/70,183 person-day) during the reference and epidemic periods, respectively. No such phenomenon was observed during the corresponding period in 2019. Older age (P for interaction=.001) and female sex (P for interaction<.001) were both associated with a higher prevalence of frequent low daily steps and were more pronounced during the epidemic period. More education was associated with a lower prevalence of frequent low daily steps during the reference period but not the epidemic period (P for interaction=.34). Body mass index or comorbidity were not associated with frequent low daily steps during either period. CONCLUSIONS: Daily steps of Changsha residents aged >/=40 years dropped significantly during the COVID-19 period, especially among older adults and females. Although successful physical distancing, measured by the rapid downward trend in daily step counts of residents, played a critical role in the containment of the COVID-19 epidemic, our findings of an increase in the prevalence of frequent low daily steps raise concerns about unintended effects on physical activity.
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ABSTRACT: Background: COVID-19 is a droplet-transmitted potentially fatal coronavirus pandemic affecting the world in 2020. The WHO recommended social distancing and human-to-human contact was discouraged to control the transmission. It has put many countries in a state of lockdown and sporting events (including the 2020 Olympics) have been affected. Participation in sports and exercise, typically regarded as healthy activities, were also debated. The local professional football leagues, governed by the Hong Kong Football Association, ultimately postponed all matches after much deliberation on the transmission risk for the spectators and on-field players. Large spectating crowds are well-known to be infectious hazards, but the infection risk for on-field players is less recognized. Aside from watching professionals exercise, many people opted to hike in the countryside during the weekends to avoid city crowds. This led to a widespread discussion on the issue of wearing a facemask during outdoor activities. Methods: A small sample of video footage of professional football players were analysed to track each players' time of close body contact and frequency of infection-risky behaviours to investigate the risk of virus transmission during football games. To investigate the physiological effect of wearing a facemask during exercise, we conducted a controlled laboratory, within-subject, repeated measures study of 23 healthy volunteers of various sporting backgrounds. They underwent graded treadmill walking at 4 km per hour for 6 min with and without wearing a surgical mask in a randomized order with sufficient resting time in between trials. The heart rate and the rate of perceived exertion (RPE) were recorded. Results: In a 90 min match, the average duration of close contact between professional football players was 19 min and each player performed an average of 52 episodes of infection-risky behaviours. The heart rate and RPE of subjects wearing a facemask was 128 beats per minute and 12.7 respectively. In those without a facemask, the results were a heart rate of 124 beats per minute and a RPE of 10.8. Conclusion: This suggests that the infection risk was high for the players, even without spectators. The laboratory study to investigate the physiological effect of wearing a facemask found that it significantly elevated heart rate and perceived exertion. Those participating in exercise need to be aware that facemasks increase the physiological burden of the body, especially in those with multiple underlying comorbidities. Elite athletes, especially those training for the upcoming Olympics, need to balance and reschedule their training regime to balance the risk of deconditioning versus the risk of infection. The multiple infection-control measures imposed by the Hong Kong national team training centre was highlighted to help strike this balance. Amidst a global pandemic affecting millions; staying active is good, but staying safe is paramount.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32821648
DOI: 10.1016/j.asmart.2020.07.006

61. Xiao R, Workman AD, Puka E, et al. Aerosolization During Common Ventilation Scenarios. Otolaryngol Head Neck Surg. 2020;163(4):702-4. DOI: 10.1177/0194599820933595
ABSTRACT: Otolaryngologists are at increased risk for exposure to suspected aerosol-generating procedures during the ongoing coronavirus disease 2019 (COVID-19) pandemic. In the present study, we sought to quantify differences in aerosol generation during common ventilation scenarios. We performed a series of 30-second ventilation experiments on porcine larynx-trachea-lung specimens. We used an optical particle sizer to quantify the number of 1- to 10-micron particles observed per 30-second period (PP30). No significant aerosols were observed with ventilation of intubated specimens (10.8 +/- 2.4 PP30 vs background 9.5 +/- 2.1, P = 1.0000). Simulated coughing through a tracheostomy produced 53.5 +/- 25.2 PP30, significantly more than background (P = .0121) and ventilation of an intubated specimen (P = .0401). These data suggest that undisturbed ventilation and thus intubation without stimulation or coughing may be safer than believed. Coughing increases aerosol production, particularly via tracheostomy. Otolaryngologists who frequently manage patient airways and perform tracheostomy are at increased risk for aerosol exposure and require appropriate personal protective equipment, especially during the ongoing COVID-19 pandemic.
URL: https://www.ncbi.nlm.nih.gov/pubmed/32539661
DOI: 10.1177/0194599820933595

62. Yang R, Gui X, Xiong Y. Patients with respiratory symptoms are at greater risk of COVID-19 transmission. Respir Med. 2020;165:105935. DOI: 10.1016/j.rmed.2020.105935
URL: https://www.ncbi.nlm.nih.gov/pubmed/32308203

DOI: 10.1016/j.rmed.2020.105935

Appendix 1: Evidence Search Details

Filters, Limits & Exclusions:	English only 2019-Current	
Sources Searched:	Agency for Clinical Innovation & New South Wales Government CADTH CDC Center for Infectious Disease Research and Policy (CIDRAP) Centre for Evidence-Based Medicine Embase Google / Google Scholar HSE Ireland Imperial College London McMaster Health Forum	Medline MedRXiv National Collaborating Centre for Environmental Health National Collaborating Centre for Methods and Tools Newfoundland & Laborador Centre for Applied Health Research PubMed/LitCOVID Strategy for Patient-Oriented Research (SPOR) WHO
Librarian(s):	**Lukas Miller, Clinical Librarian, Saskatchewan Health Authority** **Brianna Howell-Spooner, Clinical Librarian, Saskatchewan Health Authority**	

Appendix 2: Search Strategies

Search Strategies

Database: Ovid MEDLINE(R) ALL <1946 to January 25, 2021>

Search Strategy:

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1 (coronavirus/ or betacoronavirus/ or coronavirus infections/) and (disease outbreaks/ or epidemics/ or pandemics/) (39868)

2 (nCoV* or 2019nCoV or 19nCoV or COVID19* or COVID or SARS-COV-2 or SARSCOV-2 or SARSCOV2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona Virus 2).ti,ab,kf,nm,ox,rx,px. (98225)

3 ((new or novel or "19" or "2019" or Wuhan or Hubei or China or Chinese) adj3 (coronavirus* or corona virus* or betacoronavirus* or CoV or HCoV)).ti,ab,kf. (32102)

4 ((coronavirus* or corona virus* or betacoronavirus*) adj3 (pandemic* or epidemic* or outbreak* or crisis)).ti,ab,kf. (6296)

5 ((Wuhan or Hubei) adj5 pneumonia).ti,ab,kf. (310)

6 or/1-5 (101235)

7 limit 6 to yr="2019 -Current" (99771)

8 (exp *Respiration/ and (exp Exercise/ or Physical Exertion/)) or *Cough/ or *Sneezing/ or *Singing/ (14522)

9 ((breathing? or breath* or respiration or respiring or respiratory or inhal* or exhal*) adj2 (heavy or heavily or labo?red or labo?rious or strained or strenuous* or effort?)).ti,kf. or ((breathing? or breath* or respiration or respiring or respiratory or inhal* or exhal*) adj2 (heavy or heavily or labo?red or labo?rious or strained or strenuous* or effort?)).ab. /freq=2 (583)

10 ((high or prolonged or extended or intense or sustained or labo?red) adj3 respirat*).tw,kf. (5006)

11 ((high or prolonged or extended or intense or sustained or labo?red) adj3 breath*).tw,kf. (1786)

12 (sport? or aerobic* or athletic* or exercise? or exercising or physical exertion or physical activit* or physical effort? or physical conditioning or strength training or body conditioning or play* or weightlift* or physical fitness or jog or jogging or run or running or swim or swimming or dance or dancing or high-intensity interval train* or

HIIT or high intensity train* or soccer or football or baseball or basketball or rugby or hockey or volleyball or gymnastic* or martial art? or boxing or cycling or marathon or ski or skiing or wrestling).ti,kf. or (sport? or aerobic* or athletic* or exercise? or exercising or physical exertion or physical activit* or physical effort? or physical conditioning or strength training or body conditioning or play* or weightlift* or physical fitness or jog or jogging or run or running or swim or swimming or dance or dancing or high-intensity interval train* or HIIT or high intensity train* or soccer or football or baseball or basketball or rugby or hockey or volleyball or gymnastic* or martial art? or boxing or cycling or marathon or ski or skiing or wrestling).ab. /freq=2 (594084)
13 (singing or sings or choir? or talking or talk? or yelling or yell? or laughter or laughing or laugh? or cough* or speak* or sneez*).ti,kf. or (singing or sings or choir? or talking or talk? or yelling or yell? or laughter or laughing or laugh? or cough* or speak* or sneez*).ab. /freq=2 (73420)
14 (train* adj3 (sport or fitness or anaerobic or muscle or muscular or conditioning or endurance or stamina or agility or high-intensity or interval or aerobic or athletic or athlete? or cardio or cardiovascular or cardiorespiratory)).ti,kf. or (train* adj3 (sport or fitness or anaerobic or muscle or muscular or conditioning or endurance or stamina or agility or high-intensity or interval or aerobic or athletic or athlete? or cardio or cardiovascular or cardiorespiratory)).ab. /freq=2 (18273)
15 ((high or prolonged or extended or intense or sustained) adj2 exercise?).tw,kf. (10849)
16 ((high or prolonged or extended or intense or sustained) adj2 exercising).tw,kf. (80)
17 ((high or prolonged or extended or intense or sustained) adj2 physical activity).tw,kf. (2258)
18 ((high or prolonged or extended or intense or sustained) adj2 physical exertion).tw,kf. (117)
19 ((high or prolonged or extended or intense or sustained) adj2 sport*).tw,kf. (1967)
20 ((high or prolonged or extended or intense or sustained) adj2 athletic*).tw,kf. (400)
21 or/8-19 (680074)
22 exp *Environmental Exposure/ or exp *Risk/ or exp Risk Factors/ (1040928)
23 (risk? adj2 (transmission or exposure or infect* or spread* or factor?)).tw,kf. (678205)
24 ((exposure or exposed) adj2 (environment or virus or viral or infect* or pathogen* or close-contact or contact or disease? or coronavirus)).tw,kf. (16994)
25 22 or 23 or 24 (1415934)
26 7 and 21 and 25 (288)
27 (mask* or facemask* or prevent* or PPE or personal protective equipment or "n95" or "n 95" or respirator? or protect*).ti,kf. and 26 (63)
28 from 26 keep 17,23,26,40,43,47,49,60,63,65,72,77,81,88,90,96,101,109,114,116-118,125-126,140,143,150-151,153,160,164,172,181,198,203,207,213,225,234,248,258,270,272,276,279,284 (46)
29 remove duplicates from 28 (41)
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Database: Embase <1974 to 2021 January 25>
Search Strategy:
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1 sars-related coronavirus/ (466)
2 (coronavirinae/ or betacoronavirus/ or coronavirus infection/) and (epidemic/ or pandemic/) (11275)
3 (nCoV* or 2019nCoV or 19nCoV or COVID19* or COVID or SARS-COV-2 or SARSCOV-2 or SARS-COV2 or SARSCOV2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona Virus 2).ti,ab,kw,hw,ot. (89447)
4 ((new or novel or "19" or "2019" or Wuhan or Hubei or China or Chinese) adj3 (coronavirus* or corona virus* or betacoronavirus* or CoV or HCoV)).ti,ab,kw,hw,ot. (84242)
5 ((coronavirus* or corona virus* or betacoronavirus*) adj3 (pandemic* or epidemic* or outbreak* or crisis)).ti,ab,kw,ot. (5730)
6 ((Wuhan or Hubei) adj5 pneumonia).ti,ab,kw,ot. (345)
7 or/1-6 (97134)
8 limit 7 to yr="2019 -Current" (95813)
9 (exp *breathing/ and exp *exercise/) or exp *coughing/ or *sneezing/ or *public speaking/ or *singing/ (25263)

10 ((breathing? or breath* or respiration or respiring or respiratory or inhal* or exhal*) adj2 (heavy or heavily or labo?red or labo?rious or strained or strenuous* or effort?)).ti,kw. or ((breathing? or breath* or respiration or respiring or respiratory or inhal* or exhal*) adj2 (heavy or heavily or labo?red or labo?rious or strained or strenuous* or effort?)).ab. /freq=2 (901)
11 ((high or prolonged or extended or intense or sustained or labo?red) adj3 respirat*).tw,kw. (6777)
12 ((high or prolonged or extended or intense or sustained or labo?red) adj3 breath*).tw,kw. (2478)
13 ((high or prolonged or extended or intense or sustained or labo?red) adj3 breath*).tw,kw. (2478)
14 (sport? or aerobic* or athletic* or exercise? or exercising or physical exertion or physical activit* or physical effort? or physical conditioning or strength training or body conditioning or play* or weightlift* or physical fitness or jog or jogging or run or running or swim or swimming or dance or dancing or high-intensity interval train* or HIIT or high intensity train* or soccer or football or baseball or basketball or rugby or hockey or volleyball or gymnastic* or martial art? or boxing or cycling or marathon or ski or skiing or wrestling).ti,kw. or (sport? or aerobic* or athletic* or exercise? or exercising or physical exertion or physical activit* or physical effort? or physical conditioning or strength training or body conditioning or play* or weightlift* or physical fitness or jog or jogging or run or running or swim or swimming or dance or dancing or high-intensity interval train* or HIIT or high intensity train* or soccer or football or baseball or basketball or rugby or hockey or volleyball or gymnastic* or martial art? or boxing or cycling or marathon or ski or skiing or wrestling).ab. /freq=2 (756256)
15 (singing or sings or choir? or talking or talk? or yelling or yell? or laughter or laughing or laugh? or cough* or speak* or sneez*).ti,kw. or (singing or sings or choir? or talking or talk? or yelling or yell? or laughter or laughing or laugh? or cough* or speak* or sneez*).ab. /freq=2 (88090)
16 (train* adj3 (sport or fitness or anaerobic or muscle or muscular or conditioning or endurance or stamina or agility or high-intensity or interval or aerobic or athletic or athlete? or cardio or cardiovascular or cardiorespiratory)).ti,kw. or (train* adj3 (sport or fitness or anaerobic or muscle or muscular or conditioning or endurance or stamina or agility or high-intensity or interval or aerobic or athletic or athlete? or cardio or cardiovascular or cardiorespiratory)).ab. (44447)
17 ((high or prolonged or extended or intense or sustained) adj2 exercise?).tw,kw. (13385)
18 ((high or prolonged or extended or intense or sustained) adj2 exercising).tw,kw. (111)
19 ((high or prolonged or extended or intense or sustained) adj2 physical activity).tw,kw. (3107)
20 ((high or prolonged or extended or intense or sustained) adj2 physical exertion).tw,kw. (140)
21 ((high or prolonged or extended or intense or sustained) adj2 sport*).tw,kw. (2613)
22 ((high or prolonged or extended or intense or sustained) adj2 athletic*).tw,kw. (495)
23 or/9-22 (872365)
24 exp *environmental exposure/ or exp *risk factor/ (117248)
25 (risk? adj2 (transmission or exposure or infect* or spread* or factor?)).tw,kw. (1001977)
26 ((exposure or exposed) adj2 (environment or virus or viral or infect* or pathogen* or close-contact or contact or disease? or coronavirus)).tw,kw. (20885)
27 24 or 25 or 26 (1060406)
28 8 and 23 and 27 (210)
29 limit 28 to medline (41)
30 28 not 29 (169)
31 remove duplicates from 30 (168)
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Other Search Strategies Used
Transmission Risk*