

ARC '18

مؤتمر مؤسسة قطر
السنوي للبحوث

QATAR FOUNDATION
ANNUAL RESEARCH CONFERENCE

البحث والتطوير: التركيز على
الأولويات، وإحداث الأثر

R&D: FOCUSING ON PRIORITIES,
DELIVERING IMPACT

20-19 مارس
19-20 MARCH



مؤسسة قطر
Qatar Foundation

إطلاق قدرات الإنسان.
Unlocking human potential.

Energy and Environment - Poster Display

<http://doi.org/10.5339/qfarc.2018.EEPD1078>

Levels of Airborne Bacteria in a School Classroom Environment in Doha Qatar

Jeffrey P Obbard*

Qatar University
* jeff.obbard@qu.edu.qa


Airborne bacteria represent a potential risk to human health upon inhalation in both outdoor and indoor environments. Outdoors, bacteria may be derived from a variety of sources including soils, vegetation and animals, whilst indoors sources include both healthy and infected individuals, as well as pets, furnishings and food sources. The aim of this study was to investigate the quantity and size distribution of airborne bacteria inside a school classroom, as well as the outdoor environment, in Doha, Qatar. Air samples were collected from the indoor classroom and outdoor environment at the German International School in the south of Doha, Qatar during two separate sampling periods in 2017 i.e. summer time (15 June) and autumn time (17 October). An Anderson Six-Stage Impactor was used to collect airborne bacteria. The impactor aerodynamically sizes collected microbes in an airstream over six stages (i.e. 7.0 to 4.7; 4.7 to 3.3; 3.3 to 2.1; 2.1 to 1.1; and 1.1 to 0.65µm diameter, respectively). Bacteria in each size stage are collected on nutrient agar (NA) plates in the impactor. Air samples were collected in triplicate both indoors and outdoors prior to commencement of class at 6:30 AM, and immediately after end of classes at 2:30 PM. Each sample was collected over a 5 minutes period at an airflow rate of 28.3 liters of air/minute i.e. total 141.5 liters of air collected per sample. After sampling, NA plates were then incubated for 24 hours at 37°C. After incubation the number of colony forming units (CFU) of bacteria on the NA plates were counted, and the average of triplicate samples for the morning and afternoon samples were calculated as the mean number of airborne bacteria per cubic meter of air (CFU/m³). The prevalence and concentration of bacteria varied both spatially (indoors versus outdoors), and temporally (morning

© 2018 The Author(s), licensee HBKU Press. This is an open access article distributed under the terms of the Creative Commons Attribution license CC BY 4.0, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

دار جامعة حمد بن خليفة للنشر
HAMAD BIN KHALIFA UNIVERSITY PRESS



Cite this article as: Obbard J. (2018). Levels of Airborne Bacteria in a School Classroom Environment in Doha Qatar. Qatar Foundation Annual Research Conference Proceedings 2018: EEPD1078
<http://doi.org/10.5339/qfarc.2018.EEPD1078>.



versus afternoon). In both sample periods i.e. 15 June 2017 and 17 October 2017, the levels of airborne bacteria in classroom air were lowest in the morning i.e. before class (a maximum 204 CFU/m³ in June, and a maximum 35 CFU/m³ in October) than in the afternoon after class (a maximum 348 CFU/m³ in June, and a maximum 543 CFU/m³ in October). As the classroom was continuously occupied between the morning and afternoon, then human influence is the most likely factor affecting prevailing CFU levels. Other factors likely affecting CFU levels may include: airflow dynamics and exchange between the indoor and outdoor environment; the influence of the classroom air-conditioning and ventilation system (positive or negative) and; the presence of non-human bacterial sources in the classroom (food debris, carpeting, soft furnishings etc.). Outdoor air samples showed the opposite profile to the classroom, where morning samples had higher numbers of airborne bacteria in the morning (a maximum 640 CFU/m³ in June, and a maximum 111 CFU/m³ in October) compared to the afternoon samples (a maximum 299 CFU/m³ in June, and a maximum 82 CFU/m³ in October). This contrast supports the indication that airborne bacteria in the classroom are derived from internal sources rather than as a result of infiltration of bacteria from outside. The most prevalent size range of airborne bacteria present in the classroom were in the 1.1- 3.3 µm diameter range for both sample periods (June and October). Such bacteria are typically associated with aerial emission from individuals via coughing, sneezing, and exhalation, and typically represent the greatest potential pathogenic risk in terms of re-inhalation and penetration into the respiratory-lung system. Qatar does not currently have occupational health guidelines for airborne bacteria, but guidelines are available for other countries where similar work has been conducted by the project LPI, Professor Obbard - notably in Singapore. Here, the recommended guideline level for total airborne microbes in indoor air is 500 CFU/m³ for both airborne bacteria and fungal spores. The measurement of 543 CFU/m³ measured for bacteria alone in classroom air in Doha (October 2017), suggests that classroom air quality can exceed such health guidelines for both students and teachers - particularly as the most prevalent size range of the airborne bacteria are in the size range for penetration into the respiratory-lung system. The results of the study show that levels of airborne bacteria in classrooms in Doha become elevated over the course of the teaching day - most likely due to the presence of teachers and students that serve as natural reservoirs of bacteria (both non-pathogenic and pathogenic). Inadequate ventilation of the classroom and/or the air conditioning serving as a source of bacteria could also be a contributor to elevated levels of airborne bacteria in the school classroom. It is also clear that the size distribution of the airborne bacteria is predominated by bacteria in the smaller size ranges that have the greatest potential to penetrate the respiratory-lung system. In the event that airborne pathogenic bacteria are present (perhaps from aerolized from an infected person via coughing, sneezing) then this represents an increased infection risk. The study is on-going, and will investigate methods to reduce levels of airborne bacteria in the classroom via improved ventilation, air-exchange and/or filtration.