Physical activity and the common cold in undergraduate university students:
Implications for health professionals

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Abstract

Objective The common cold, known as upper respiratory tract infection (URTI), is the world’s most prevalent illness. The purpose of this study was to determine if physical activity is linked to the incidence and/or duration of the common cold.

Method Undergraduate university students (n=200) were asked to complete two questionnaires. The Paffenbarger Physical Activity Questionnaire (PPAQ) estimated physical activity levels of participants in the previous year. The second questionnaire required participants to record the number and length of URTIs experienced over the previous year. Pearson product-moment correlation coefficients were used to analyse the relationships between physical activity (kcal/week) and the incidence and duration of URTIs.

Results There was no relationship between the number of kilocalories expended per week through physical activity and the incidence (r=-0.042, p=0.304) or duration (r=-0.014, p=0.434) of URTIs.

Conclusion In the specific population of undergraduate university students, physical activity was not significantly related to the incidence or duration of the common cold.

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Key words: colds, physical activity, duration, incidence

Introduction
Caused by over 200 strains of viruses, the common cold, also known as an upper respiratory tract infection (URTI), represents the world’s most prevalent and expensive illness. Cold-causing viruses are airborne and can be spread via touch and are therefore easily transmitted from one individual to another. After defeating an exposed person's immune system, a cold-causing virus is usually successful in rendering that individual ill enough to compromise physical and/or mental functioning for several days. Young children experience the most number of colds averaging 6 to 8 per year. By adulthood, the number of colds experienced decreases to an average of 2 to 5. Not surprisingly, URTIs are linked to increased direct and indirect health care costs with excessive numbers of lost work and school days, medications, physician visits and health complications.

Technically speaking, the common cold is not actually caused by a virus but rather by the immune system’s ineffective or inefficient response to the virus. Exposure to a cold-causing virus does not necessarily result in infection and the contraction of a URTI. It is only after one or two days of battling with the body’s immune system that the virus causes the infected person to experience symptoms of the common cold including a cough, runny nose and/or sore throat. These symptoms are typically endured for 5 to 10 days with the infected person contagious to others from 24 hours prior to and up to 5 days after symptoms initially appear. Although no one is technically immune from these symptoms, there are certain groups for whom they can be dangerous. Populations directly at risk for potentially fatal complications include infants, the elderly, the chronically ill and others with weakened immune systems.

In light of these statistics, it is evident that a cure for the common cold would contribute to significant positive health and economic impacts. Unfortunately, researchers have not yet been successful in finding such a cure. Alternatively, there is great demand by health professionals for research focusing upon the control of URTIs. Studies of this sort tend to involve two approaches. Rehabilitation characterises the first approach and typically involves efforts to discover strategies for alleviating and/or abolishing the various symptoms associated with the common cold. The second approach involves the quest for strategies that might be adopted in an effort to prevent the contraction of the common cold. In other words, rehabilitative efforts seek to discover strategies for decreasing the duration of URTIs whereas preventative efforts seek to reveal methods for decreasing the frequency or incidence of the common cold.

Immune system functioning represents the single most important influence on the frequency and duration of URTIs. It is believed that having a healthy immune system translates to a reduction in the incidence and/or duration of the common cold whereas a weakened immune system lends to an increase in these measures. The existence of this inverse relationship suggests that health professionals might attempt to ground...
URTI rehabilitative and preventative efforts in strategies intended to strengthen immune system functioning while avoiding behaviours and situations that may weaken it. Of course, such efforts are dependent upon the identification of factors central to immune system functioning, some of which include environment, nutrition, sleep, psychological stress, age and physical activity\textsuperscript{2,7,8,9}. The purpose of this paper is to examine one factor central to immune system functioning: the relationship of physical activity to the incidence and duration of the common cold.

**Review of the literature**

Physical activity has been defined as any bodily movement resulting in energy expenditure above basal metabolic rate\textsuperscript{10,11}. This definition suggests that, depending upon the frequency, duration and intensity of bodily exertion within a lifestyle, physical activity can be of various levels. Within the literature specific to the relationship between physical activity and the incidence and/or duration of the common cold, these levels have been divided into several categories including sedentary, low, moderate, and high.

Moderate-level physical activity involves the weekly expenditure of at least 2000 kilocalories via physical activity\textsuperscript{12}. This corresponds to a daily expenditure of approximately 300 calories via bodily activity or physical exertion perceived as somewhat difficult for a duration of 30 accumulated minutes (continuous or intermittent in 10 minute intervals) per day\textsuperscript{11}. An exercise routine involving significantly more daily energy expenditure classifies as high-level physical activity, whereas a lifestyle with little to no bodily exertion qualifies as low-level or sedentary.

Low participation rates for physical activity may be due in part to the common belief that people must engage in vigorous and continuous exercise to reap health benefits. In fact, scientific evidence has shown that moderate-level physical activity provides substantial health benefits\textsuperscript{13,11}. Several studies examining the relationship between physical activity and the incidence or frequency of the common cold have been conducted in recent years. Some of these found that the risk of cold infection in a person who engages in moderate-level physical activity may be less than that of a sedentary person\textsuperscript{14,15,16,17}. Others demonstrated that the risk of infection is greater than average for those involved in high levels of intense physical activity\textsuperscript{18,19}. In general, these studies support the hypothesis that the relationship between physical activity and the incidence of the common cold is appropriately modelled in the form of a J-curve\textsuperscript{8,20}. This theory purported that those who participate in moderate-level physical activity on a regular basis experienced a lower incidence of cold infection as compared to those who are sedentary. In addition, those who participated regularly in high-level physical activity experienced a higher incidence of infection as compared to those who were sedentary as well as those who participated in moderate-level physical activity\textsuperscript{5,7}. In other words, the highest URTI incidence numbers were associated with lifestyles involving high-level physical activity, followed by those that are sedentary with lifestyles including moderate-level physical activity demonstrating the lowest URTI incidence numbers.
There have been fewer studies conducted with the intent of examining the relationship between physical activity and duration of URTIs. Conflicting results are apparent. Studies by Schouten et al\textsuperscript{17} and Weidner et al\textsuperscript{21} found no evidence that URTI duration correlates with level of physical activity. On the other hand, Nieman et al\textsuperscript{15} found a negative correlation suggesting that the duration of common cold infection decreases as the level of daily physical activity increases. Finally, there is some literature suggesting that moderate levels of physical activity increase the efficiency of immune system functioning\textsuperscript{22,23,24,25}. This implies that a decrease in URTI duration should occur with increases in moderate-level physical activity.

To summarise, the literature does seem to provide some grounds for the suggestion that a J-curve relationship exists between level of physical activity and the incidence of the common cold. On the other hand, the literature is less than clear as to whether or not a relationship exists between physical activity and URTI duration, let alone what that relationship might be. In response to this state of affairs, it has been suggested that there is a need for more research examining the relationship between physical activity levels and URTIs in the greater population\textsuperscript{3,10,26,27}. Herein lies the significance of this study.

**Objective**

This study examined the relationship between physical activity and the common cold within a university student population which represents a group for whom the cold is most prevalent as a health problem\textsuperscript{28}. More specifically, the main objective of this study was to examine the relationship between physical activity and the incidence and duration of cold infection. Paralleling this research objective was the hypothesis that as the level of physical activity increased, the number and duration of colds experienced would be less.

**Methods**

Two hundred nonfreshman undergraduate students were recruited for this study. First year students were excluded in order to ensure that subject responses were based upon the university lifestyle rather than on a time period prior to university enrolment. In an effort to obtain a representative sample of university students, participants were chosen from a variety of academic programmes and classes. During class time, participants were asked to sign an informed consent form and then to spend approximately 20 minutes completing two questionnaires. Participants were assured of their confidentiality, advised that their participation was completely voluntary and should they choose to abstain or withdraw from the study they may do so at any time and without the fear of negative consequences. Before beginning, participants were informed about the purpose of the study as well as provided with an opportunity to ask questions of the researchers.

The Paffenbarger Physical Activity Questionnaire (PPAQ) was utilised to obtain
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Health Education Journal 63(2) 2004 0–0

an estimate of the physical activity level of each participant for the year prior to being questioned. The questionnaire itself is considered self-explanatory and is comprised of both specific and open-ended questions relevant to physical activity patterns within a day, week and year. General questions about levels of regular physical activity with respect to frequency, intensity and duration are included as well as more explicit questions specific to walking and stair climbing as common modes of mobility required of almost all able-bodied individuals. Other questions are characterised as open-ended and request information about the frequency and duration of subject participation in sports and other recreational activities, barriers to physical activity as well as the duration of time spent sleeping, sitting, and participating in various levels of physical activity on a regular weekday and weekend day.

The PP AQ was chosen for three reasons. First of all, it represented a one-year tool which was deemed essential given the large fluctuations in daily physical activity patterns of university students and the desire to study the frequency and duration of cold infection specifically within a one year time frame. Second, via caltrac activity monitors (0.29–0.30), large scale integrated activity monitors (0.23), measurements of maximal oxygen uptake (0.29–0.60), per cent body fat (-0.30 – -0.44), body mass index (-0.13) and high-density lipoprotein cholesterol (0.14) as well as comparisons with other physical activity questionnaires (Baeke = 0.56; Paffenbarger University of Penn Alumni = 0.50; Five City Project = 0.09; Framingham = 0.36; Minnesota Leisure-Time = 0.54; Health Insurance Plan = 0.53; Lipid Research Clinics = 0.81), this questionnaire had previously been demonstrated to represent a valid assessment of usual physical activity. Third, via one, eight and nine month test–retest coefficients (0.34 to 0.73), the Paffenbarger Physical Activity Questionnaire was also demonstrated to represent a reliable questionnaire.

Using self-diagnosis, the second questionnaire simply asked the subjects to record the number and duration of colds experienced within the past year. For this purpose, a cold was defined as having a sore throat, runny nose and/or cough for at least two consecutive days.

Statistical analysis

Of the 200 sets of questionnaires distributed and returned, 47 were excluded due to completion errors thereby yielding 153 appropriate for analysis. Data from the two questionnaires was analysed using SPSS version 11.0 (SPSS Inc, Chicago, Illinois) with p ≤ 0.05 chosen as the maximum probability level denoting statistical significance.

Before statistical analyses could take place, the PPAQ had to be scored in an effort to reveal an overall physical activity score for each of the subjects. To arrive at an average daily physical activity score (that is kilocalories/day) over a one year period, a three part calculation was employed. The first part involved subject responses to three specific questions relevant to walking, stair climbing as well as for various other sports, play and/or recreational activities with the responses entered into the following equation:
The second portion of the calculation involved subject responses to one open-ended question requiring an estimation of time spent on an average weekday and weekend day in sleep, sitting or reclining, light activity, moderate activity and vigorous activity. Examples of each type of activity were provided on the questionnaire to help subjects with their estimations. The responses were entered into the following equation:

\[
(\text{hours in sleep} \times 1 \text{ MET}) + (\text{hours sitting} \times 1.5 \text{ METs}) + (\text{hours in light activity} \times 4 \text{ METs}) + (\text{hours in moderate activity} \times 6 \text{ METs}) + (\text{hours in vigorous activity} \times 10 \text{ METs})
\]

The third part of the calculation involved a combination of the first two scores with each given a value of 0.5 to obtain an overall physical activity score for each subject.

After obtaining individual physical activity scores via the scoring methodology described, the data from both the PPAQ as well as the Cold Questionnaires was analysed using Pearson product-moment correlation coefficients. With the 0.05 level chosen as the maximum probability level denoting statistical significance, analyses revealed two sets of results indicating the relationship between daily caloric expenditure and the incidence of cold infection (Figure 1) as well as the relationship between daily caloric expenditure and the average duration of cold infection (Figure 2) experienced by subjects within a one year period.

### Results

The average daily energy expenditure for participants was 208 ± 141 calories. The average number of colds per year reported was 2.9 ± 2.1 and the average duration of a cold infection was reported by subjects to be 6.3 ± 4.4 days. Statistical analysis revealed a nonsignificant correlation \((r=-0.042, p=0.304)\) between daily caloric expenditure via physical activity and the incidence of cold infection (Figure 1). Therefore, there was no relationship between kilocalories expended through daily physical activity and the number of URTIs experienced within this sample. The correlation obtained between the duration of cold infection and physical activity also revealed nonsignificant \((r=-0.014, p=0.434)\) correlation coefficients. As a result, there was no relationship revealed between kilocalories expended through daily physical activity and the duration of URTIs experienced by subjects.

### Discussion

The literature review conducted for this study revealed that the number of colds experienced during adulthood ranges from two to five with each cold typically lasting for 5 to 10 days. The average number of colds experienced by the subjects in this study
FIGURE 1 Daily Energy Expenditure via Physical Activity and Number of URTIs
FIGURE 2 Daily Energy Expenditure via Physical Activity and Duration of URTIs

Duration of URTIs (days) vs. Daily Caloric Expenditure via Physical Activity (kcal/day)
was 2.9 ± 2.1 with the average duration of a cold infection reported to be 6.3 ± 4.4 days with both values falling within the ranges reported within the literature.

The specific purpose of this paper was to examine the relationship between physical activity and the incidence and duration of the common cold in undergraduate university students. This intent stemmed from the identification of physical activity as one factor central to immune system functioning which is held to be the single most important influence on the frequency and duration of cold infection. It was hypothesised that an inverse relationship would be revealed between physical activity and the incidence of cold infection as well as between physical activity and the duration of cold infection. Nevertheless, statistical analysis deemed that both correlations were nonsignificant within the specific population of undergraduate university students.

The trendlines revealed in Figure 1 and Figure 2 suggest that no relationships exist between physical activity and the incidence or duration of URTIs. This finding is likely a function of several interrelated factors including a clustering of low-level physical activity patterns within this particular sample, the multifaceted nature of immune system functioning and the typical university student lifestyle.

It is important to note that the average daily energy expenditure for participants in this study was only 208 ± 141 kilocalories per day which is well below the recommended 300 for optimal health and immune system functioning. This suggests that the majority of subjects in this study had lifestyles allowing for only low-level physical activity with fewer participating in moderate-level physical activity and even fewer participating in high-level physical activity. This clustering of activity patterns likely influenced the finding that no relationship exists between physical activity and the incidence or duration of the common cold in this population of undergraduate university students.

The failure of this study to reveal a significant relationship for undergraduate university students likely also stems from the multifaceted nature of immune system functioning as well as from the typical lifestyle associated with this particular population. It is important to keep in mind that the immune system is influenced by a wide variety of factors including environment, nutrition, sleep, psychological stress, age, and physical activity such that deterioration of one or more factors might compromise the benefits typically associated with positive behaviours relevant to other influencing conditions.

With regard to the specific population of undergraduate university students, it is likely that several factors central to immune system functioning may be compromised by the typical student lifestyle. In particular, university students endure high stress levels, depression, excessive consumption of alcohol, smoking tobacco and cannabis, and sexually transmitted diseases resulting from an inconsistent or nonuse of condoms. Additionally, nutritional and sleeping habits are typically poor within a student population with physical activity levels reported as being below that recommended for optimal health. Independently, each one of these unhealthy lifestyle behaviours can
serve to compromise immune system functioning with multiple risks arising from the clustering of these lifestyle factors. That is, since each unhealthy behaviour on its own represents a risk factor for increased incidence and/or duration of the common cold, it is intuitive that several unhealthy behaviours have a confounding effect. It is also logical to expect that unhealthy behaviours might negate positive effects associated with healthy behaviours relevant to immune system functioning.

Given the complexity of this situation, it is not surprising that significant correlations were not found between physical activity and the incidence and duration of the common cold in the undergraduate university students examined. Paralleling this insight, a limitation of this study is that subjects were not asked questions relevant to other lifestyle habits such that a more complete examination of immune system weakening and strengthening behaviours might have been included in the analysis. Furthermore, undergraduate university students represent inappropriate subjects for a study limited to the relationship between physical activity levels and the common cold due to the fact that they typically demonstrate a propensity toward multiple unhealthy behaviours integral in weakening immune system response. These two limitations prompt the recommendation that future research involving the PPAQ be complemented with measures reliable in discerning health behaviours beyond physical activity known to be relevant to immune system functioning. Beyond the benefit of enlightening the specific risk factors prevalent with youths, this information can only serve to enhance data revealed by the PPAQ in its use with alternative populations.

Two additional limitations are apparent with this study. The first is that the statistical analysis (that is Pearson product-moment correlation coefficient) conducted with respect to physical activity and the number of URTIs is not able to discern a J-curve relationship within the relevant data. In order to be able to examine the existence of such a relationship, a trendline must be relied upon. Accordingly, it is suggested that future research involve subjects displaying a wider range of physical activity levels. The final limitation stems from memory difficulties inevitably associated with questionnaires asking subjects to recall events over a time period of one year. To alleviate this potential difficulty, future research might include a prospective examination of physical activity and the incidence and duration of the common cold.

**Conclusion**

Despite the fact that this study failed to reveal significant relationships between physical activity levels and the incidence or duration of the common cold in the specific population of undergraduate university students, it does not discount or oppose the suggestion in the literature that moderate-level physical activity is a factor in immune system functioning integral in decreasing the number and/or duration of colds experienced. Accordingly, it is suggested that health professionals ought to encourage the integration of moderate-level physical activity into lifestyles via the adoption of positive health behaviours. This study certainly suggests that undergraduate university
students could be encouraged to increase levels of daily physical exertion since average
physical activity was well below the recommended level of 300 kilocalories per day.

A cure for the common cold has not yet been identified, forcing health professionals
to discover and implement rehabilitative approaches directed toward the control of
symptoms associated with cold infections as well as preventative measures intended to
limit cold contraction and distribution. Physical activity is one factor relevant to immune
system functioning and linked through research to the incidence and duration of the
common cold. Furthermore, physical health is a dimension of wellness that anyone can
improve and there is no cost involved or resources needed to do so. Increasing the level
of physical activity within a lifestyle can be as easy as the choice to take the stairs instead
of the elevator, walking to the store instead of driving, or doing one's own yard-work
and household chores instead of paying someone else to do so. In this regard, the choice
to adopt a lifestyle inclusive of moderate-level daily physical activity does not have to
entail a set exercise programme as it can also be achieved via an active attitude and
approach to life. The encouragement of this attitude as well as the knowledge, motivation
and empowerment to see it through in the adoption and maintenance of positive lifestyle
behaviours are important elements of success able to be influenced by all health
professionals.

Notes
1 Paffenbarger et al\textsuperscript{30} are credited for defining the kilocalorie scores for city blocks.
2 Paffenbarger et al\textsuperscript{30} are also credited for defining the kilocalorie scores for flights of
stairs climbed.
3 Passmore and Durnin\textsuperscript{32} are acknowledged for the identification of activity specific
MET values.
4 The final component of the equation was employed for every activity reported by
the subject as having been participated in during the year prior to completing the
questionnaire.
5 MET values for the second part of the calculation were identified by Pereira et al\textsuperscript{30}.

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