THE EFFECT OF WEATHER CONDITIONS ON THE SEASONAL VARIATION OF PHYSICAL ACTIVITY

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Physical inactivity is considered the fourth top risk factor for death worldwide. Approximately 3.2 million of world's population die each year due to insufficient physical activity[1]. Regular physical activity can decrease the risk of developing non-communicable diseases such as hypertension, type 2 diabetes, some types of cancers and depression[2]. Prevalence of insufficient physical activity was highest in the World Health Organization regions of the Americas and the Eastern Mediterranean (50% of women, 40% of men)[2].

Physical environmental factors have been considered contributing determinants of health and factors that enable or disable individuals from participating in daily physical activity. Such environmental factors include facilities, access to parks, safety and methods of transportation. These factors are unlikely to influence physical activity participation on a daily basis[3]. However, weather plays a considerable role on physical activity in regions with a temperate climate – even on day-to-day basis[4].

Several studies have investigated obstacles to participation in physical activity. These studies have identified adverse weather conditions such as extreme temperatures, hours of daylight, snow, rain and wind as major barriers for participation in physical activity. Further, adverse weather conditions are responsible for the seasonal variation observed in physical activity for all individuals regardless of age[5]. The aim of this review is to summarise the relationship between weather conditions and level of physical activity.

WEATHER CONDITIONS AND PHYSICAL ACTIVITY

Epidemiological studies from different areas of the world have identified seasonal variation for physical activity in different communities. Outdoor activities such as walking, cycling and outdoor sports have been identified as the main source for accumulating the recommended amount of daily physical activity. Studies have found that time spent outdoors is highly

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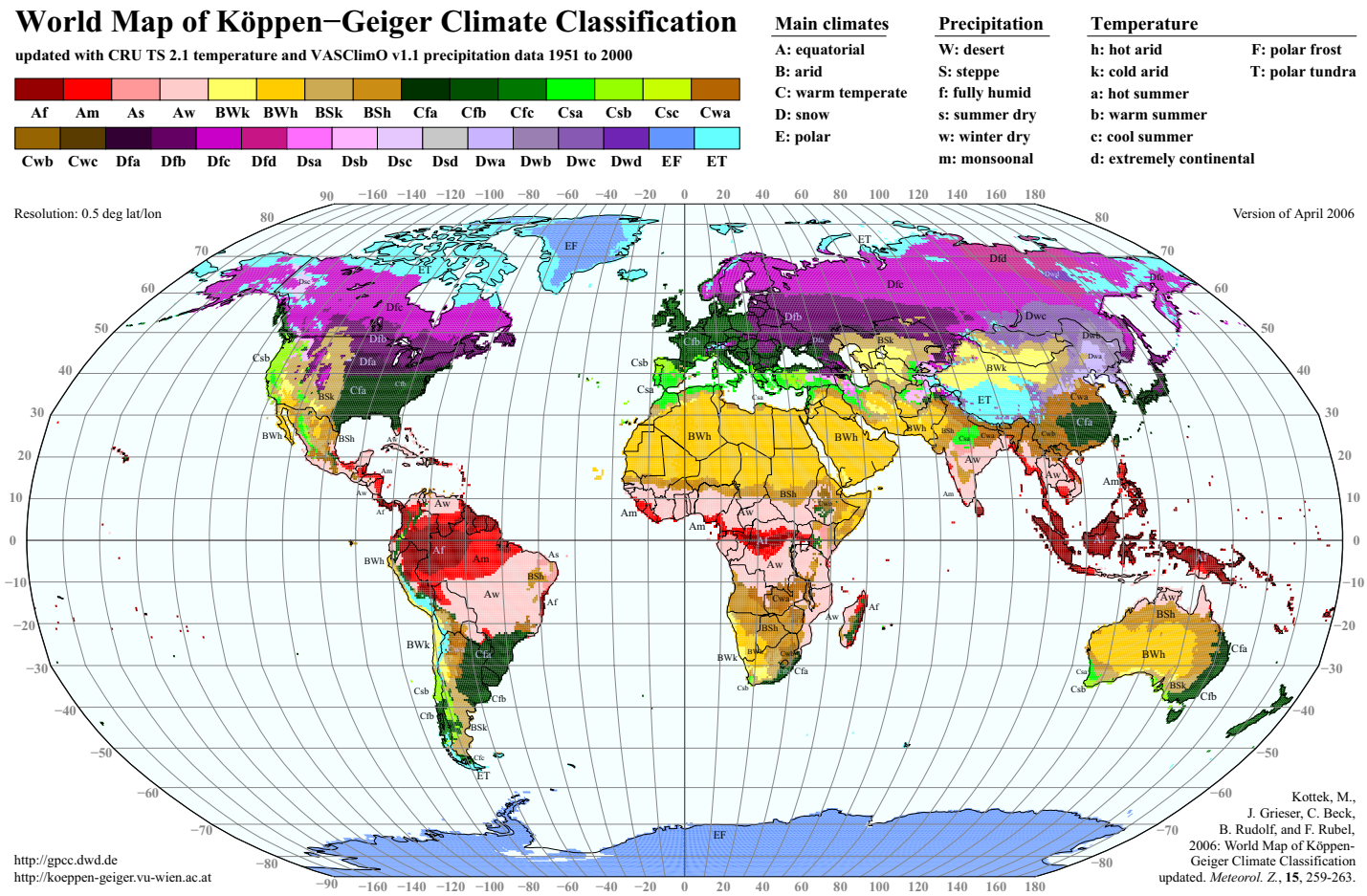


Figure 1: World map of Köppen-Geiger climate classification updated with mean monthly CRU TS 2.1 temperature and VASClimO v1.1 precipitation data for the period 1951 to 2000 on a regular 0.5 degree latitude/longitude grid[23].

correlated with certain weather conditions such as high or low temperature, humidity, air dust, wind, rain and snow[5].

As presented in Figure 1, weather may vary according to diverse climate zones, even within the same country. This may apply to certain large countries such as Canada, the USA and Australia. For example, epidemiological studies demonstrate that levels of physical activity increases in summer in the northern states of the United States, while they decline in the southern states, which have hot and humid summers[5].

This seasonal-variation pattern is associated with specific environmental factors such as the amount of daylight and extreme temperatures, which can strongly promote or deter physical activity[5]. Most studies conducted on people living in temperate and cold regions (e.g. North America and European countries) have demonstrated a similar pattern of physical activity levels during warm seasons (spring and summer), and more specifically during the longer and dry days[5,6]. For example, the Canadian Community Health Survey demonstrated that the prevalence of physical inactivity increased from 49% in summer to 64% in winter. This epidemiological pattern in Canada can be attributed to long hours of darkness and adverse weather conditions in winter[7], which have been identified as influencing even simple forms of physical activity such as walking. Studies conducted in the USA and UK found a 10 to 13% reduction in steps in winter[8,9]. A study on the seasonal variation of walking in the Netherlands found a decrease of 1300 steps per day during cold months[10].

The effect of weather on outdoor physical activity may extend to indoor activities such as exercise classes. In a study investigating the effects of weather conditions on indoor sports, Tu et al[10] found that attendance to indoor exercise classes on sunny days increased by 10 to 25% compared to days with adverse weather conditions such as wind, rain and snow.

The effect of weather on physical activity may interact with certain personal characteristics such as age or medical conditions. For example, individuals with bronchial asthma need to consider weather conditions when they decide whether or not to engage in an outdoor activity to prevent exacerbation of asthma attacks[4].

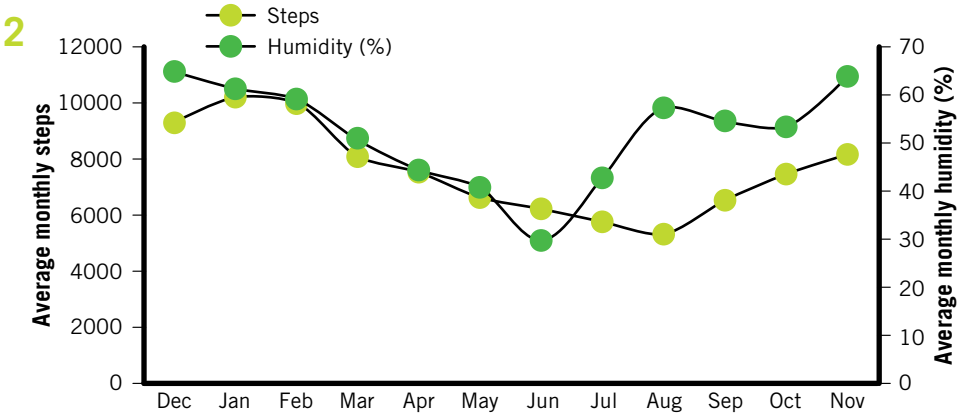
The interaction of age and weather on physical activity has been investigated in a number of studies that found consistency in all ages with more prominent effects observed among preschool children and the elderly[4,5]. A review of 35 studies found the presence of seasonal variation in daily physical activity of children and adolescents[12]. Two Canadian studies found a slight decline in physical activity among Canadian children and adolescents in autumn[13,14]. This decline becomes more obvious in winter and specifically on days with snowfall. In addition, one of the Canadian studies found that the level of physical activity declined by 2 to 4% with

every 10 mm of rainfall[13]. Such a pattern has also been found in the southern part of the world among children in New Zealand[15] and in climates with hotter summers such as Cyprus. Loucaides et al[16] found that physical activity among Greek-Cypriot children ranged from 42% in winter to 51% in summer.

Few studies have highlighted the role of school summer holidays in providing more opportunities for physical activity for children and adolescents through the increase in the time available for play. This may be considered as a confounding factor explaining the sharp increase in physical activity in this age group during summer[5].

Moreover, schools may play role in minimising the sharp decline in physical activity levels in winter found among preschool children compared to primary school children. This is because preschool children are highly dependent on outdoor play and have no structured activities similar to that provided by the primary school[5].

Physical activity patterns that have been found among children have also been described among older people in the UK and Japan[17,18], with studies demonstrating that day length, sunshine duration and maximum temperature were positive predictors for an increase in physical activity level. It was also found that rain negatively correlated with outdoor physical activities such as walking[17].



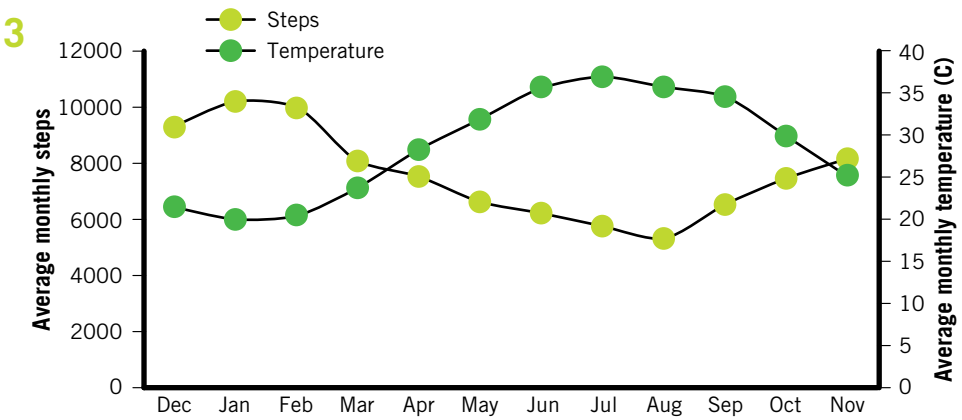


Figure 2: Seasonality of humidity and physical activity of participants in community health programme 'Step Into Health' in the State of Qatar[21].

Figure 3: Seasonality of temperature and physical activity of participants in community health programme 'Step Into Health' in the State of Qatar[21].

SEASONAL VARIATION OF PHYSICAL ACTIVITY IN THE MIDDLE EAST AND THE CASE OF QATAR

The effect of weather in temperate climates changes extensively from season to season, and even on a daily basis depending on changes in rainfall or snowfall and temperature[4]. Similar effects can be seen (with different distribution) in the dry, hot climatic regions such as in countries in the Middle East, where extreme heat (reaching to 45 to 50°C), humidity and sand-stirring winds provide an environmental barrier to outdoor physical activity for many people for at least 5 months of the year (from the beginning of May to the end of September). However, there are very few studies and no clear data about the relationship between this seasonal variation and physical activity in this region. A study of 58 adolescent females (aged 11 to 16 years) in the UAE investigated patterns of physical activity and levels of inactivity using a 3-day activity diary[19]. The study revealed that the amount of physical activity undertaken by adolescent females in the UAE was very low and suggested that the extremely hot weather is not conducive to physical activity and plays a major role in levels of physical inactivity; however, a seasonal data analysis was not undertaken.

In Qatar 50% the local population does not accumulate the daily recommended amount of physical activity[20]. An epidemiological study was conducted at Aspetar[21] to determine the effect of weather on average daily steps each month in a community-based online pedometer programme named 'Step Into Health'. A randomly selected ethnically diverse sample of 185 adult participants (101 men and 84 women; aged 37.7±10.9 years) were followed up every month over a 1 year period (from December 2012 to November 2013) to determine their average daily steps. Monthly temperature and humidity data (monthly minimum, maximum and average) were extracted from a meteorological agency (www.wunderground.com). The effects of temperature and humidity on physical activity were analysed after controlling for age, gender and ethnicity using a mixed-effects linear regression model.

As presented in Figure 2, the average monthly humidity percentage ranged from 30 to 60% during the study period. The humidity percentage was higher in the winter months. The monthly average of daily steps of the participants was not affected by the humidity percentage. For example, in July and August when humidity rises, the physical activity levels remained stable. As a result, humidity was not associated with physical activity level.

In contrast, Figure 3 presents a clear effect of temperature on physical activity level. As the temperature increased during hot months, physical activity decreased and as the temperature cooled in the winter months, the monthly average of daily steps increased. The daily mean temperature ranged from 20 to 37°C during the study period. The mean number of steps, was significantly associated with temperature after controlling for other factors such as age, gender and ethnicity.

LIMITATIONS IN MEASURING EFFECT OF WEATHER

Most epidemiological studies measure the effect of specific weather conditions on recreational activities by measuring the amount of physical activity using quantitative tools such as structured physical activity questionnaires or more objective tools such as accelerometers and pedometers. However, very few researchers have observed how specific weather conditions can increase opportunities for certain outdoor activities such as swimming in summer, or skiing or skating in winter[22]. Obstacles for physical activity in winter such as the accessibility and costs of winter activities need to be investigated.

Moreover, research should measure weather conditions carefully, as most studies have presented the weather parameters and conditions averaged over 24 hours. However, in reality, weather conditions at night will not affect physical activity, as most physical activity is performed during the day[4].

IMPLICATIONS ON PHYSICAL ACTIVITY PROMOTION

It is highly important to understand the effects of weather conditions on physical activity before setting physical activity promotion plans. For example, most of the major physical activity surveys in Middle Eastern countries are conducted at one point in time without describing the effect of the seasons on the population's physical activity level. Information on the effect of weather could be valuable for planning interventions and events in the seasons with weather conditions that increase participation in physical activity in all age groups. Such interventions should be combined with mass-communication campaigns to convey health messages in an enabling environment.

Health planners should work to reduce decreases in physical activity levels in seasons with adverse weather conditions by increasing availability and accessibility of indoor sports facilities. In addition, health and exercise experts need to provide more information about how to choose suitable physical activities for each season to allow individuals to remain physically active throughout the year. This may help exercise and sports organisations to design climate-appropriate programmes.

References

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