Physical activity in a multi-ethnic population: measurement and associations with cardiovascular health and contextual factors

de Munter, J.S.L.

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Chapter 1

General introduction
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This thesis is about ethnic differences in physical activity and the association between physical activity and cardiovascular disease (CVD) and CVD-related risk factors across ethnic groups. The general introduction is divided into four main sections. Part 1 describes the background information of two large ethnic minority groups from Suriname of South Asian and African descent living in the Netherlands, as well as some key concepts of studying health and ethnicity. Part 2 describes ethnic differences in CVD, with a focus on these two large ethnic minority groups from South Asian and African origin compared to European-origin populations. Part 3 describes ethnic differences in physical activity and the relationship between physical activity and CVD. The final section, part 4, describes the conceptual model that guided the analyses as well as the aim and objectives of this thesis, and also gives an overview of the subsequent chapters.

Part 1 - Ethnic minority groups in the Netherlands

About 11% of the total population of the Netherlands has a non-Western background, which is approximately 1.9 million people in absolute numbers.¹ This definition includes people living in the Netherlands who were born in Turkey or in a country in Africa, Latin America, or Asia (with the exception of the former Dutch East Indies (present-day Indonesia) and Japan). The second generation (i.e., children born in the Netherlands but with at least one parent from one of these countries) is also included in this definition of non-Western. The number of people with non-Western backgrounds is expected to increase in the coming years due to continuing immigration.²

About one-fifth of the non-Western population in the Netherlands is made up of people from the Republic of Suriname (the former Dutch Guyana in South America), which makes them one of the largest non-Western groups living in the Netherlands.¹ More than half the Surinamese population in the Netherlands lives in one of the four largest Dutch cities: Amsterdam, Rotterdam, The Hague, and Utrecht.³ In contrast to other large ethnic minority groups in the Netherlands (e.g., people from Turkey or Morocco who originally came to the Netherlands as labor migrants), the people from Suriname came to the Netherlands because of the colonial history. Aside from the steady flow of people from Surinamese ethnic groups who settle in the Netherlands every year, two large waves can be identified. The first wave (consisting of about 40,000 people) was around 1975, when Suriname became independent from the Netherlands; this was followed by a second wave around 1980 due to the political situation in Suriname.⁴

In the Netherlands, country of birth is the primary operationalization of ethnicity. For Suriname, however, country of birth does not capture the heterogeneity in ethnicity in the population in this country. Therefore, for the population from Suriname, additional
indicators are necessary to distinguish between the ethnic groups, which include people from Hindustani, Creole, Javanese, and Chinese backgrounds. Most definitions of ethnicity include that ethnic groups should share at least a combination of the following characteristics: similar ancestry, migration history, language, religion, culture, traditions that are passed down from generation to generation, and a feeling of identity. The two largest ethnic groups from Suriname currently living in the Netherlands have ancestral migration histories from West Africa and the Indian subcontinent. More specifically, the Surinamese of African origin are mainly descendants of West Africans who were taken to Suriname during the slave trade era. The Surinamese of Indian origin are descendants of people from northern India (Uttar Pradesh, Uttarakhal, and West Bihar) who were taken to Suriname as indentured laborers between 1873 and 1917. In the Netherlands, these ethnic groups are commonly referred to by their self-assigned ethnicity as Creole or Hindustani. Although this captures the ethnic diversity between the groups, these “labels” are not very common in the international study of ethnicity and health. In this thesis, therefore, these populations will be referred to as African-Surinamese or South Asian-Surinamese ethnic minority groups to better reflect their ancestral origins and more recent migration history as well as for international comparability with equivalent ethnic minority groups.

**Part 2 - Ethnic differences in CVD**

CVD is currently a major public health burden affecting many people in the general population. However, CVD risk is not similar across population groups. Compared to the European-Dutch, the African-Surinamese and South Asian-Surinamese ethnic minority groups in the Netherlands are characterized by higher levels of CVD, CVD-related hospital admission, and CVD-related mortality. The higher level of CVD-related mortality seems more apparent in men than in women. Additionally, higher rates of CVD risk factors such as hypertension and diabetes mellitus have been observed in both the African-Surinamese and South Asian-Surinamese ethnic groups compared to the European-Dutch. Furthermore, compared to the European-Dutch, African-Surinamese women and South Asian-Surinamese men and women have been found to have raised levels of low HDL (high-density lipoprotein) and fasting blood glucose. Metabolic syndrome (defined according to both the National Cholesterol Education Program and the International Diabetes Federation criteria) was also observed at higher levels in South Asian-Surinamese and African-Surinamese women compared to the European-Dutch. In other industrialized countries, higher levels of CVD and CVD risk factors have also been observed in African- and South Asian-descent ethnic minority populations compared to the majority populations.
The risk transition of CVD

Higher levels of CVD in the general population were first indicated by a sharp increase in the prevalence of heart attack at the start of the twentieth century. Major societal and medical breakthroughs have led to a decreased burden of infectious diseases in the population by lowering the traditional risk factors for these diseases (such as poor sanitation), resulting in a longer life expectancy and a relatively higher burden of noncommunicable diseases. Additionally, continuing industrialization changed society through a wide range of interconnecting technological, professional, and cultural shifts that introduced various modern risk factors (e.g., low physical activity), shaping an increased risk for noncommunicable diseases such as CVD. These processes of a changing environment within society that lead to shifts in behavior and disease risks can be described by the epidemiological risk transition (Figure 1).

Figure 1. The risk transition. Over time, the traditional risk factors (e.g., poor sanitation, indoor air pollution) are being substituted by more modern risk factors (e.g., tobacco, low physical activity) in society. Modern risks can vary between countries, depending on the risk and context (source: World Health Organization, Global Health Risks, 2009).

This risk transition as indicated in the figure above also provides some indications about the high risk of CVD in migrant populations living in high-income countries. Many migrants who migrated from low- and middle-income countries are still in an earlier phase of the epidemiological transition, which means that, as a result of migration, they are living in countries with different risk profiles. Migration introduces a variety of challenges regarding the new social, socioeconomic and structural environment potentially resulting in acculturation stress. One of the mechanisms by which stress affects health is through unhealthy behavior. Migrants often seem to adopt health-damaging behaviors such as smoking and low physical activity in leisure time, which can potentially explain some of the ethnic differences in disease risk. Variations in ethnicity-specific disease risk and risk factors have previously been conceptualized as being due to specific characteristics.
of the ethnic group under study, such as genetics, but also specific cultural traditions, ethnic identity, socioeconomic factors, discrimination, social participation, and migration history.24

**Part 3 - Ethnic differences in physical activity and relationship with CVD**

This thesis will focus on physical activity as one of the possible explanations for the higher CVD risk observed in the South Asian-Surinamese and African-Surinamese ethnic minority groups compared to the European-Dutch. This section will present a short overview of the current evidence regarding physical activity and CVD in ethnic groups.

**Physical activity and CVD**

The amount of physical activity that is beneficial for health (i.e., the minimum amount of activity necessary to observe positive effects on health) has been researched quite extensively in populations from industrialized countries. Please see Box 1 for the definition and measurement of physical activity. Most recent international public health recommendations for adult physical activity state that individuals should be active on at least 5 days per week (preferably all days of the week) in a moderate-intensity activity for at least 30 minutes per day.25-27 The additional benefit of more strenuous or vigorous intense physical activity is also mentioned in these recommendations. The duration of the activity can be gathered in shorter bouts throughout the day, and further benefits on health are observed in individuals who are more physically active than the recommendation.25

Low physical activity is estimated to be the principal cause in 27% of the diabetes and 30% of the ischemic heart disease burden.18 Additionally, low physical activity is the fourth largest risk factor for mortality in middle- and high-income countries.18 The beneficial effect of physical activity on CVD is complex, and interrelated with various biological mechanisms. The most important mechanism is energy expenditure, and when this is balanced with energy intake it results in weight control.28 Basically, low physical activity in an environment with plenty of nutrition causes individuals to store energy and become overweight or obese. Underlying this is the association between physical activity and a more healthy blood lipids balance.29 Low physical activity, in turn, is associated with development of atherosclerosis,30 and impaired glucose regulation and the development of type 2 diabetes.31;32 The aforementioned higher level of CVD in the African-Surinamese and South Asian-Surinamese ethnic minority groups means that physical activity, due to its potential to lower CVD risk, is an important modifiable risk factor to study within these populations compared to the general population.
Physical activity and CVD in ethnic groups

Previous evidence indicates that participation in sports is lower in a population sample of Surinamese groups living in Rotterdam compared to the European-Dutch living in the same city. In another population study including a sample of South Asian-Surinamese and African-Surinamese groups compared to the European-Dutch sample living in Amsterdam, adherence to at least the recommended level of physical activity (30 minutes, 5 times per week) was found to be higher in European-Dutch women, though no differences were

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**Box 1. Definition and measurement of physical activity**

Physical activity is a complex behavior to study, and can easily lead to confusion if not first properly defined. The term physical activity includes all bodily movements that contract skeletal muscles as a result of a wide range of activities (including work, leisure time, commuting, and other everyday activities such as household activities and child care). The term exercise describes the planned, structured, and repetitive activities undertaken in leisure time that have the primary function of increasing physical fitness. From this definition it is clear that while all exercise is physical activity, not all physical activity is exercise. The term physical fitness can be seen as something achieved by physical activity and exercise, and is therefore more appropriate as a measurement of recent physical activity (e.g., in intervention studies). This thesis will focus on physical activity only.

The most accurate way to assess an individual’s level of physical activity is by measuring energy expenditure. In addition to body composition (fat-free mass), physical activity is the most important factor relating to differences in energy expenditure between individuals. Total energy expenditure can be measured either directly (by measuring body heat) or indirectly (estimated by gas exchange or isotope turnover rate). Both of these methods require specific laboratory conditions or expensive field methods, which make them less practical in a large epidemiological setting. Another method of obtaining objective physical activity levels is by using electronic monitors. Some disadvantages of electronic monitors include the inability to register specific upper- or lower-body movements and some specific types of activities, such as water-related activities. Another method frequently used in epidemiological research is obtaining level of physical activity through a structured physical activity questionnaire. Questionnaires can differ in complexity, period of inquiry, and type of activity. Earlier questionnaires investigated physical activity within a certain domain (e.g., measuring work-related or leisure-time physical activity). The more recent physical activity questionnaires try to assess activities from a wide range of domains (i.e., work, leisure time, household, and commuting) in which individuals can be active. These detailed questionnaires often incorporate multiple dimensions of physical activity, and include frequency (e.g., times/day, days/week), duration (e.g., minutes/day, hours/week), and intensity (e.g., type of activity and/or self-reported intensity of activity) of the activity.

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**Physical activity and CVD in ethnic groups**

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found in men. Furthermore, in a qualitative study, culturally specific inhibitors of physical activity were identified for cycling and swimming in African-Surinamese hypertensive patients compared to the European-Dutch. 

While the relationship between physical activity and CVD and CVD risk factors has been well-researched in European-origin groups, there have been no comprehensive population studies that present the relationship between physical activity and CVD and CVD risk factors in the Dutch ethnic minority groups of South Asian-Surinamese and African-Surinamese origin. Previous population studies in these ethnic minority groups presented mainly summary statistics for all-cause or CVD-related mortality gathered from the Dutch national hospital registries and cause of death registry. Another study among South Asian-Surinamese and African-Surinamese sampled from the city of Amsterdam assessed ethnic differences in hypertension and adjusted, among other factors, for the confounding influence of recommended level of physical activity, which resulted in little effect on ethnic differences in blood pressure. One important limitation from these earlier studies is that the African and South Asian ethnic groups were combined into one group based on country of origin, which might hide important clues about ethnic differences in CVD risk. Another limitation of previous studies is the use of only a summary measure of physical activity to adjust for ethnic differences in physical activity, which might not identify specific ethnic differences in physical activity, and can underestimate the true potential of physical activity.

As described in Box 1, physical activity is a broad concept with several important dimensions. There may very well be ethnic differences in specific dimensions of physical activity that could result in ethnic differences in the association between physical activity and CVD or CVD risk factors. For example, in England some favorable correlations were found between a physical activity score and body mass index (BMI) and two-hour blood glucose and insulin in ethnic groups of South Asian descent, while these correlations seemed less strong in the European sample and not significant for two-hour insulin. In the United States, quintiles of energy expenditure from recreational activities were associated with lower CVD risk in both white and black women, while quintiles of energy expenditure from walking were only related to lower CVD in white people. However, data on a wide range of domains are limited, including on the specific dimensions of physical activity in ethnic groups. Additionally, it should be noted that African-Americans in the US differ in many respects from those of the African-descent populations in Europe in terms of socioeconomic position, migration history, and geographical location. Few epidemiological data are available on South Asian populations in Europe. It is therefore unclear how measures of physical activity are associated with CVD and risk factors in the Dutch South Asian-Surinamese and African-Surinamese ethnic minority groups compared to the European-Dutch, and whether the strength of these associations are similar in the different ethnic groups. Further insight into these levels of physical activity and relationship with CVD is also necessary to guide public health efforts and policy measures.
Part 4 - This thesis

Figure 2 presents the conceptual model that guided the studies presented in this thesis. It takes an ecological perspective on the general factors that influence physical activity at the individual level. This model is adapted from the one developed by Dahlgren and Whitehead. In this thesis we focus on the three parts that can be identified from the model. The first part of the thesis focuses on the arrow leading from ethnicity to individual lifestyle factors, in this case, the large rectangular block that encompasses the broad domains of physical activity from which we can identify summary scores. This part is used to identify ethnic differences in the measurement and operationalization of physical activity, and whether ethnic minority groups have an excess risk of a certain type or domain of physical activity compared to the majority population. It may well be that ethnic minority groups have different physical activity patterns compared to the majority population that may lead to ethnic differences in physical activity depending on the operationalization of the physical activity measure.

The second part of the thesis focuses on the relationship between physical activity and CVD and CVD risk factors across ethnic groups and compared to the European-Dutch population. As a consequence of the operationalization of physical activity described above, there might be ethnic differences in the relationship between physical activity and CVD or CVD risk factors compared to the majority population. In this thesis we will explore a total score of physical activity, and identify whether there are ethnic differences in the relationship between low levels of physical activity and CVD-related hospital discharge. Similarly, we will explore whether this is observed for type 2 diabetes. Furthermore, when there are ethnic differences in physical activity, ethnic groups might differ in an underlying dimension (duration, intensity). We will explore this in this thesis by investigating ethnic differences in the relationship between blood lipids and a total score of physical activity and underlying dimensions (duration and intensity) of activity.

The third part of this thesis focuses on the outer layer, which contains the general socioeconomic and environmental factors that influence the individual level of physical activity. Socioeconomic position has been found to be positively related to leisure-time physical activity in European-origin populations. Earlier we explained that migration is challenging, especially when countries are in a different phase of the epidemiological transition. It is known that the socioeconomic pattern of risk factors and related diseases might differ between phases in the epidemiological transition. Therefore, we have to investigate whether socioeconomic position is similarly related to physical activity in ethnic minority groups of South Asian-Surinamese and African-Surinamese origin compared to European-origin populations. Risk factors for CVD in particular (including smoking and low physical activity) are in general more prevalent in the higher socioeconomic groups in the phase in which these diseases are on their rise. When the incidence of these diseases starts
to decrease the socioeconomic gradient in general reverses, resulting in a higher prevalence of risk factors in lower socioeconomic groups. We will explore the socioeconomic gradient in physical activity in the Surinamese ethnic groups as compared to that in the European-Dutch population.

In addition, we will also explore the influence of the context of the country migrants are migrating to. It is hypothesized that the host country plays an important role in ethnic inequalities in health- and lifestyle-related factors. If this is true, one would expect the physical activity pattern of migrants to reflect the pattern more closely of the majority population in the host country than migrants with similar ancestry in another country (i.e., we can observe convergence of health-related behavior towards the majority population). Therefore, in this thesis a comparison of physical activity level will be made between two European countries with ethnic minority groups with similar ancestral origins, from Africa.

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**Figure 2.** The conceptual model. The outer layer contains the general factors (socioeconomic, ethnicity, environmental) that influence the individual lifestyle factors, while the focus of all studies in this thesis is on ethnic differences in physical activity and the relationship between physical activity and CVD. Black arrows indicate the studied associations covered in this thesis. (Adapted from: Dahlgren and Whitehead.)
and the Indian subcontinent to their current host countries, namely the Netherlands and England. More specifically, we will explore differences in the prevalence of leisure-time physical activity between the countries’ majority populations, and identify whether this difference in prevalence is reflected between the countries in the ethnic minority groups with similar ancestral origins.

The intermediate layers in this conceptual model (which include working and living conditions and social and community networks) are conceptually interrelated with the described general factors, but are not the focus of a detailed assessment in this thesis.

Aim and objectives

The main aim of this thesis is to investigate ethnic differences in physical activity and its association with CVD and cardiovascular risk factors. More specifically, this thesis will assess ethnic differences in physical activity, as well as the association between physical activity and CVD and CVD risk factors in South Asian-Surinamese, African-Surinamese, and European-Dutch ethnic groups. The considered CVD risk factors are blood lipids (HDL cholesterol and triglycerides) and blood glucose across the ethnic groups. We also consider the association between physical activity and contextual factors in terms of socioeconomic position and environment. The thesis is structured in three parts, and has the following objectives:

1. To describe ethnic differences in the prevalence of physical activity across domains and culturally specific types of physical activity as well as to assess the ethnic differences in the association between domains and types of physical activity, and recommended level of physical activity.

2. To assess the relationship between physical activity and CVD and CVD-related biomedical risk factors in South Asian-Surinamese and African-Surinamese populations compared to European-Dutch populations.

3. To assess the influence of two contextual factors (i.e., national context and socioeconomic factors) on physical activity in South Asian-Surinamese and African-Surinamese populations compared to European-Dutch populations.

Subsequently, the main research questions that will be addressed and correspond to the above objectives are:

1. How are physical activity domains and culturally specific types of physical activity related to differences in recommended levels of physical activity in the South Asian-Surinamese and African-Surinamese compared to the European-Dutch?
2. a) Are there differences in the association between low physical activity and CVD-related hospital discharge in the South Asian-Surinamese or African-Surinamese compared to the European-Dutch?

b) Are there differences in the association between low physical activity and type 2 diabetes in the South Asian-Surinamese or African-Surinamese compared to the European-Dutch?

c) Are dimensions of physical activity (intensity, duration) more consistently associated with HDL cholesterol and triglycerides than a total score of physical activity in the South Asian-Surinamese, African-Surinamese, and European-Dutch?

3. a) Are there differences in the association between socioeconomic position and active commuting and leisure-time physical activity in the South Asian-Surinamese and African-Surinamese compared to the European-Dutch?

b) Do differences in leisure-time physical activity between the European-Dutch population living in the Netherlands and the European-English population living in England reflect similar differences in the South Asian- and African-descent populations living in these two countries?

Table 1. Overview of the studies covered in this thesis

<table>
<thead>
<tr>
<th>Ch.</th>
<th>Title</th>
<th>Variable of interest</th>
<th>Outcome</th>
<th>Data source</th>
</tr>
</thead>
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<tr>
<td>2</td>
<td>Large ethnic variations in recommended physical activity according to activity domains in Amsterdam, the Netherlands</td>
<td>ethnic groups men women</td>
<td>recommended PA</td>
<td>SUNSET</td>
</tr>
<tr>
<td>3</td>
<td>Association of physical activity, smoking, and alcohol intake with CVD-related hospital discharge in people of European, South Asian, or African descent</td>
<td>low physical activity smoking alcohol intake</td>
<td>CVD-related hospital discharge follow-up</td>
<td>SUNSET</td>
</tr>
<tr>
<td>4</td>
<td>The association of physical inactivity with type 2 diabetes among different ethnic groups</td>
<td>low physical activity type 2 diabetes</td>
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<td>SUNSET</td>
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<tr>
<td>5</td>
<td>Total physical activity might not be a good measure in assessing relationship with HDL cholesterol and triglycerides in a multi-ethnic population</td>
<td>physical activity score intensity score duration score HDL cholesterol triglycerides</td>
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<tr>
<td>6</td>
<td>The association of leisure-time physical activity and active commuting with measures of socioeconomic position in a multi-ethnic population living in the Netherlands: results from the cross-sectional SUNSET study</td>
<td>socioeconomic position active commuting men women</td>
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<td>SUNSET</td>
</tr>
<tr>
<td>7</td>
<td>Cross-national study of leisure-time physical activity in Dutch and English populations with ethnic group comparisons</td>
<td>national environment LTPA Dutch English ethnic groups</td>
<td></td>
<td>SUNSET HSE</td>
</tr>
</tbody>
</table>

PA: physical activity. LTPA: leisure time physical activity.
Data and methods

Table 1 gives a brief summary of the studies covered in this thesis. We used three sources of datasets. Our main source of information was the SUNSET (Surinamese in the Netherlands: Study on Health and Ethnicity) study, which used an extensive questionnaire to describe physical activity levels in the different ethnic groups. Another source of information was the “SUNSET follow-up.” After the baseline period, SUNSET participants were followed administratively in the Dutch central hospital registry to identify CVD-related hospital discharge. To assess whether national context in the two countries similarly influences levels of leisure-time physical activity in the ethnic minority groups, we compared data from the SUNSET study with the Health Survey for England (HSE). For this comparison we included ethnic groups living in England from the HSE: Indian, African-Caribbean, and European-English groups.

Outline

In the next chapters we will provide the results from our studies. Chapter 2 (research question 1), the first part, will present physical activity patterns in South Asian- and African-descent ethnic minorities and the European-Dutch. Prevalence, intensity, and duration of different types of physical activity in the ethnic groups are presented for each of the domains of physical activity. The influence of each domain on the recommended level of physical activity is calculated for each ethnic group in relation to the European-Dutch. The second part (research questions 2a, 2b, and 2c) will present the relationship between physical activity and CVD and cardiovascular risk factors. Associations between physical activity and CVD-related hospital discharge are presented in Chapter 3. The relationship between low physical activity and type 2 diabetes is presented in Chapter 4. Whether dimensions of physical activity are more consistently related to blood lipids than a total score of physical activity is presented in Chapter 5. The third part (research questions 3a and 3b) will present the association between physical activity and contextual factors. The relationship between active commuting and leisure-time physical activity and socioeconomic position is presented for each ethnic group in Chapter 6. In Chapter 7 we present the influence of national context on leisure-time physical activity in ethnic minority groups with similar ancestral origins in two countries and compare the differences between countries with the differences in leisure-time physical activity in the European-origin majority populations in these countries. Finally, Chapter 8 will summarize the main findings from these studies. It will also contain a general discussion together with a main conclusion, and implications for further research.
References


