Chronic Skin Disease and Levels of Physical Activity in 17,777 Spanish Adults: A Cross-Sectional Study

Running head: Chronic Skin Disease and Physical Activity

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What's already known about this topic?

- To date there is limited literature on the prevalence of chronic skin conditions and the levels of physical activity among people who have these conditions in Spain.

- Regular participation in physical activity is beneficial for the prevention of most non-communicable diseases.

What does this study add?

- The prevalence of chronic skin disease in Spain was low.

- Levels of physical activity in men with chronic skin conditions, but not in women, were lower than those without.

Chronic Skin Disease and Levels of Physical Activity in 17,777 Spanish Adults: A Cross-Sectional Study

ABSTRACT

Background: To date there is limited literature on the prevalence of chronic skin conditions and levels of physical activity (PA) in Spain.

Aim: The present study aims to (i) determine the prevalence of chronic skin disease and (ii) compare levels of PA in those with chronic skin disease to those without in a large representative sample of Spanish adults aged 15-69 years.

Methods: Data from the Spanish National Health Survey 2017 were analysed. Chronic skin disease was assessed using a yes-no question. PA was measured using the short form of the International Physical Activity Questionnaire (IPAQ). Total PA metabolic equivalent of task (MET)-minutes/week were calculated, and PA was included in the analyses as a continuous and a five-category variable.

Results: This cross-sectional study included 17,777 participants [52.0% women; mean (standard deviation) age 45.8 (14.1) years]. There were 940 (5.3%) adults with chronic skin disease. After adjusting for several potential confounders, there was a negative association between chronic skin disease and PA [odds ratio (OR)=0.87, 95% CI=0.76–1.00]. The association was significant in men (OR=0.76, 95% CI=0.62-0.93) but not in women (OR=0.97, 95% CI=0.81-1.16).

Conclusions: In this large representative sample of Spanish adults, the prevalence of chronic skin disease was low. Levels of PA in men with chronic skin conditions, but not in women, were lower than those without.

Keywords: chronic skin disease; physical activity; adults; Spain; cross-sectional study

1. INTRODUCTION

Long-term (chronic) conditions of the skin include conditions such as psoriasis, eczema, acne, vitiligo, leg ulcers, and chronic sun damage that may result in skin cancer.[1] Globally, the prevalence of skin disorders is high. For example, in a sample of 12,377 adults aged 18 to 74 years from five European countries (Germany, Italy, the Netherlands, Portugal and Sweden), the most commonly self-reported skin disorders (lifetime prevalence) in 2018 included warts (41.3%), acne (19.2%), and contact dermatitis (15.0%).[2] Worldwide, skin conditions were the fourth leading cause of nonfatal disease burden in 2010.[3] Importantly, there is limited prevalence data for all chronic conditions of the skin in some countries and this is true for Spain. However, it should be noted that prevalence data does exist for some skin conditions in Spain such as severe atopic dermatitis (all age prevalence 0.10%) [4] and acne (adolescent and young adult prevalence 60.4%).[5]

One behavioral correlate that may exacerbate skin conditions is physical activity (PA), likely owing to a significant increase in skin temperature and activation of sweat glands.[6] The skin temperature when exercising in the external environment is likely to rise substantially and at a faster rate in higher temperatures. People with skin diseases may defer from participating in PA for fear that their skin disease may exacerbate. Indeed, in a sample of 34,525 adults aged 18 to 85 years residing in the US, it was found that adults with a history of eczema had lower odds of daily vigorous activity [adjusted odds ratio (OR)=0.79, 95% confidence interval (CI)=0.63–0.99] and lower frequency of vigorous activity in the past week (adjusted β=-0.46, 95% CI=-0.72–-0.21).[7]

Literature shows that regular participation in PA is beneficial for the prevention of most non-communicable diseases (e.g. cardiovascular disease[8], diabetes[9] and mental disorders [e.g.

stress][10]), and PA may be particularly beneficial for people with chronic skin disorders as they are at an elevated risk for cardiovascular and cerebrovascular diseases.[11] However, for those with skin disease, PA may exacerbate the condition owing to increased sweating [12] and this exacerbation may increase the associated psychological distress of skin disease.[13] Distress may further contribute to or exacerbate skin diseases, as distress is a known risk factor for a variety of skin diseases,[14] while it can also increase risk for other health conditions (e.g., cardiovascular diseases) for which psychological distress has been reported to be a risk factor.[15] It is therefore important to promote PA that does not exacerbate skin conditions in the discussed population. It is also important to note here that PA has been linked to the immune system (B- and T-Cell function, cytokine responses) and may exert anti-inflammatory effects,[16,17] and this may lead to lower risk for skin diseases.[18] However, before PA interventions can be implemented, it is important to know the prevalence of long-term skin conditions and levels of PA in specified populations.

To date there is limited literature on the prevalence of chronic skin conditions and the levels of PA among people who have these conditions in Spain. Therefore, the present study aims to (i) determine the prevalence of chronic skin disease and (ii) compare levels of PA in those with and without chronic skin diseases in a large representative sample of Spanish adults. We hypothesize that skin conditions may be less prevalent in Spain than in other parts of Europe due to the higher levels of sun exposure. In addition, we hypothesize that people with skin disease in this country may be less likely to engage in PA due to the warm climate and higher levels of sun exposure.

2. MATERIALS AND METHODS

2.1. The survey

Data from the Spanish National Health Survey 2017 were analysed. This survey was undertaken in Spain between October 2016 and October 2017. Details of the survey method have been previously published.[19] In brief, for the data collection, a stratified three-stage sampling was used in which the census sections were first considered, then the family dwellings, and then an adult (15 years or more) was selected within each dwelling. The sections were selected within each stratum with probability proportional to their size. The dwellings, in each section, were selected with equal probability by systematic sampling, prior arrangement by size of the dwelling. This procedure leads to self-weighting samples in each stratum. For the selection of the person who had to complete the Adult Questionnaire, the random Kish method was used, which assigns equal probability to all adults in the household. The sample was representative of the adult population resident in Spain, and consisted of 17,777 adults aged 15-69 years. The age group of adults ≥70 years was not considered in this study, as they did not complete the International Physical Activity Questionnaire (IPAQ) short form. IPAQ short form is an instrument designed primarily for population surveillance of PA among adults, and it has been developed and tested for use in adults (age range of 15-69 years), and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended.[20] The method of data collection used was computer-assisted personal interviewing (CAPI), conducted in the homes of the selected participants. The interviewers, previously trained, completed the questionnaires with the information provided by the participants. The interviewers clarified any problem of understanding that the participants could have. All participants signed an informed consent form before responding to the survey questions. This research was conducted in accordance with the WMA (World Medical Association) Declaration of Helsinki – Ethical Principles for Medical Research Involving

Human Subjects. As data from the Spanish National Health Survey are public and anonymous, no ethical approval was required in accordance with the regulation of the European Union, which states that the data for public use do not require the approval of an accredited ethics committee for statistical or research purposes.[19]

2.2. Chronic skin disease (independent variable)

Those who answered affirmatively to the yes-no question ''Have you ever been diagnosed with chronic skin disease?" were considered to have chronic skin disease.

2.3. Physical activity (dependent variable)

IPAQ short form was used to measure PA. Total PA metabolic equivalent of task (MET)-minutes/week were calculated through the following formula: *sum of walking + moderate + vigorous MET-minutes/week scores*. Participants were divided in five (i.e., <300, ≥300-<967, ≥967-<1,637, ≥1,637-<3,253, and ≥3,253 MET-minutes/week) and two categories (i.e., <1,386 and ≥1,386 MET-minutes/week). IPAQ has been validated in adult populations from different countries showing acceptable validity (ρ=0.30, 95% CI: 0.23-0.36) and reliability (Spearman's ρ=0.81, 95% CI: 0.79-0.82).[21]

2.4. Control variables

The selection of the control variables was based on past literature.[22-24]

Sociodemographic variables included sex, age, marital status (married vs single/widowed/divorced/separated) and education (≤primary, secondary, ≥tertiary). Smoking status was self-reported and categorized as never, past and current smoking. Alcohol consumption in the last 12 months was self-reported and categorized as yes (any) and no (none). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters

squared based on self-reported weight and height. Using the standard WHO definition, obesity was defined as BMI≥30 kg/m^2, and BMI<30 kg/m^2 was considered no obesity.

2.5. Statistical analysis

The statistical analysis was performed with R 3.5.2 (The R Foundation, Vienna, Austria).[25] Differences in PA and sample characteristics by chronic skin disease status were assessed by Chi-squared tests for all variables except age and the continuous PA variable (t-tests). Chi-squared tests were further used to assess whether there was a significant trend in the prevalence of chronic skin disease with increasing levels of PA. Logistic regression analyses were conducted to assess the association between chronic skin disease (independent variable) and PA (dependent and dichotomous variable). PA was dichotomized using the median number of MET-minutes per week [low (<1,386 MET-minutes per week) and high PA (≥1,386 MET-minutes per week)]. Regression assumptions were met, while there was no collinearity between the independent variables (i.e., variance inflation factor of each variable lower than 2). Furthermore, the goodness of fit of the regression model was assessed using the Hosmer-Lemeshow test, and p-value was not significant, suggesting that there was no evidence of poor fit. Given that there are major sex differences in the severity and consequences of chronic skin disease [26,27] and in the levels of physical activity,[28] interaction by sex was also assessed by including the term "chronic skin disease X sex" in the regression models. Of note, an interaction occurs when an independent variable has a different effect on the dependent variable depending on the values of another independent variable. Models were adjusted for sex (except the sex-stratified analyses), age, marital status, education, smoking, alcohol, and obesity. Independent variables were included in the models as categorical variables with the exception of age which was included as a continuous variable. There were missing data only on the following variables: marital status (N=33; 0.19%), smoking (N=11; 0.06%), alcohol (N=14; 0.08%), and obesity (N=504; 2.84%). Complete-case analysis was performed, and participants with missing data

were not included in the regression models. Results from the logistic regression analyses are presented as ORs (with 95% CIs). P-values <0.05 were considered statistically significant.

3. RESULTS

This cross-sectional study included 17,777 participants [52.0% of women; mean (standard deviation) age 45.8 (14.1) years; **Table 1**]. There were 940 (5.3%) adults with chronic skin disease. Being female, being single/widowed/divorced/separated, past and current smoking, and obesity were more frequent in individuals with chronic skin disease than in those without, while age was significantly higher in the chronic skin disease than in the no chronic skin disease group. Mean PA was significantly lower in participants with than in those without chronic skin disease (1967 versus 2280 MET-minutes; p-value<0.001), while the prevalence of chronic skin disease significantly decreased with increasing PA levels in the overall sample and men but not in women (**Figure 1**). The results of the regression analyses are displayed in **Table 2**. After adjusting for several potential confounders (i.e., sex, age, marital status, education, smoking, alcohol, obesity), there was a negative association between chronic skin disease and PA [odds ratio (OR)=0.87, 95% CI=0.76–1.00]. Although there was no significant sex interaction, the association was significant in men (OR=0.76, 95% CI=0.62-0.93) but not in women (OR=0.97, 95% CI=0.81-1.16).

4. DISCUSSION

The present study aimed to (i) determine the prevalence of chronic skin disease and (ii) compare levels of PA in those with chronic skin disease to those without in a large representative sample of Spanish adults aged 15-69 years.

In this large representative sample of Spanish adults, it was found that 5.3% of adults suffered from chronic skin disease, and PA was found to be significantly lower in individuals with than in those without chronic skin disease. Moreover, after adjusting for several potential confounders, there was a negative association between chronic skin disease and PA in the overall sample and in men but not women. These findings are not only statistically significant but also clinically significant, as there is a difference of 313 MET-minutes between individuals with and those without chronic skin conditions.

Interestingly, the lifetime prevalence of chronic skin disease in Spain identified in this study is lower than what has been identified in other cross-sectional studies with self-reported measures in other countries.[2] This difference could be related to the warm climate and higher levels of sun exposure in Spain in comparison to other European countries. While warm and high sun exposure may exacerbate existing skin conditions, it may offer some protection against the development of such conditions. For example, adequate sun exposure is associated with higher levels of vitamin D [29] and vitamin D deficiency has been related to several skin conditions including skin cancer, autoimmune skin disorders, photodermatoses, atopic dermatitis, and psoriasis.[30] Another explanation for the lower prevalence of skin conditions in the present study is the Mediterranean diet. Indeed, it has been shown that consumption of the Mediterranean diet (indeed popular in Spain) is able to prevent cellular senescence in human epithelial cells [31] and has been shown to be protective against some skin cancers.[32] Finally, it may be that chronic skin conditions were underreported in the present study or assessing the presence of a chronic skin disease by a yes/no question may not be precise enough to measure the underlying real-world prevalence. Future research investigating prevalence of chronic skin disease in Spain should aim to implement more robust measures considering duration of specific skin disease, severity of specific skin disease, and past skin diseases.

The finding that those with chronic skin disease participate in lower levels of PA than those without supports the findings from another study in the US that showed that those with eczema had lower levels of PA than those without[7] and adds to this by showing that the association exists with multiple skin conditions in Spain. There are several plausible pathways that may explain lower levels of PA in those with skin conditions. First, when one participates in PA, skin temperature rises[6] and a rise in skin temperature can exacerbate skin conditions.[33] Therefore, those suffering from skin conditions may avoid PA to avoid exacerbations. Next, PA often requires wearing shorts and T-shirts that leave the skin exposed. If an individual has a skin condition affecting these exposed areas, he/she may feel self-conscious about the appearance of the skin conditions and avoid PA owing to negative feelings (e.g. embarrassment, fear, anxiety). Next, particularly in adults, those with skin conditions have a high prevalence of other comorbid conditions (e.g. cardiovascular disease, metabolic syndrome, diabetes) that may limit PA participation.[34] Finally, it is also possible that low levels of PA may lead to chronic skin conditions. Specifically, exercise has been linked to the immune system (B- and T-Cell function, cytokine responses) [16,17,35] and may exert anti-inflammatory effects, and this may lead to lower risk for skin diseases. Importantly, limited research exists on the role of PA in the development of chronic skin disease.[36] Future research is needed utilizing multiple time points to investigate if participation in PA aids in the protection against developing skin conditions.

It should be noted that, although there was no significant interaction with sex, the associations were significant in men but not in women. This may be due to the different types of PA men and women pursue in Spain. For example, women may be more likely to attend a gym or fitness center where the internal temperature may be controlled via air conditioning and thus less likely to exacerbate skin conditions; whereas men may be more likely to participate in outdoor

activities such as soccer where the temperature is not controlled and thus more likely to exacerbate skin conditions. Therefore, men with skin conditions may be more likely to avoid PA than women. However, this hypothesis remains untested and future research of a qualitative nature is required.

The large representative sample of the Spanish population and the adjustment of models for important covariates are clear strengths of the present study. However, findings from this study must be interpreted in light of its limitations. First, participants were asked if they had ever been diagnosed with chronic skin disease, and it was therefore not possible to investigate the relationship between specific chronic skin diseases and levels of PA. Indeed, it is possible that specific skin diseases may be more strongly associated with PA than others. Future research is required to investigate relationships between specific chronic skin diseases and PA to identify within this group who are at greatest risk. Moreover, a participant could have had a chronic skin disease in the past, but the condition may have resolved by the time the participant answered the survey. Thus the response may not necessarily correspond to the same time period of reported PA levels. Furthermore, a participant completing the survey with a chronic skin condition may not had reported having the condition and thus some level of self-reporting bias may exist. Second, regression models were not adjusted for several frequent comorbidities (e.g., hypertension and hypercholesterolemia), and this may have impacted the study results. Third, the present analysis was cross-sectional in design; thus, it is not known whether chronic skin conditions lead to lower levels of PA or vice versa. It is likely to be bi-directional. Future research investigating the relationship between chronic skin disease and levels of PA should utilize longitudinal designs with measures that establish the temporal order of events (including two or more time points), duration, and natural histories of conditions, while focusing on the relationships between PA and specific skin conditions. It may be prudent to include measures

of chronic skin disease and PA in existing cohort studies as well as incorporating measures when designing new cohort studies. Nevertheless, the mere co-existence of chronic skin disease and low levels of PA is an important finding. As previously mentioned, chronic skin disease is associated with an elevated risk for cardiovascular and cerebrovascular diseases[9] and PA can aid in the prevention of these conditions. Identifying that those with chronic skin disease have low levels of PA provides important information in that this population should be targeted for PA promotion. Fourth, the present study did not collect data on treatment of one's chronic skin conditions and it is likely that some participants would have well managed symptoms. Therefore, estimates generated in statistical models may be more conservative than what is true.

In conclusion, in this larger representative sample of Spanish adults, the prevalence of chronic skin disease was 5.3%, a prevalence that is lower than has previously been published for other European countries.[2] Levels of PA in men with chronic skin conditions, but not women, were lower than those without. Encouraging Spanish males with skin conditions to participate in indoor PA where the temperature can be controlled to reduce skin exacerbations is needed. Other strategies may include the encouragement of PA during the early morning or late evening when the external environment is cooler.

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TABLES AND FIGURES

Table 1. Sample characteristics (overall and by self-reported chronic skin disease status)

| Characteristics | Category | Overall (N=17,777) | Chronic skin disease | | P-value |
			No (N=16,837)	Yes (N=940)	
Sex	**Male**	**48.0**	**48.2**	**43.2**	**0.002**
	Female	**52.0**	**51.8**	**56.8**	
Age (years)	**Mean (SD)**	**45.8 (14.1)**	**45.8 (14.1)**	**46.9 (14.2)**	**0.018**
Marital status	**Single/widowed/divorced/separated**	**43.6**	**43.4**	**47.1**	**0.030**
	Married	**56.4**	**56.6**	**52.9**	
Education	≤Primary	18.7	18.8	17.7	0.604
	Secondary	50.6	50.7	50.5	
	≥Tertiary	30.7	30.6	31.8	
Smoking	**Never**	**46.1**	**46.6**	**38.4**	**<0.001**
	Past	**25.3**	**25.0**	**30.5**	
	Current	**28.5**	**28.4**	**31.1**	
Alcohol	No	30.2	30.2	30.0	0.917
	Yes	69.8	69.8	70.0	
Obesity[a]	**No**	**83.5**	**83.7**	**80.1**	**0.005**
	Yes	**16.5**	**16.3**	**19.9**	

Abbreviation: SD standard deviation; BMI body mass index; WHO World Health Organization.

Significant results are in bold.

Chronic skin disease was assessed with a question with "yes" and "no" options.

The results are expressed as % except for age.

[a] BMI was calculated as weight in kilograms divided by height in meters squared based on self-reported weight and height. Using the standard WHO definition, obesity was defined as BMI≥30 kg/m^2, and BMI<30 kg/m^2 was considered no obesity.

Table 2. Associations between self-reported chronic skin disease (independent variable) and physical activity (dependent variable) in adults residing in Spain

Characteristics	Category	Unadjusted model			Adjusted model[a]		
		Odds ratio	95% confidence interval	P-value	Odds ratio	95% confidence interval	P-value
Overall							
Chronic skin disease	No	Reference			Reference		
	Yes	**0.85**	**[0.75, 0.97]**	**0.016**	**0.87**	**[0.76, 1.00]**	**0.046**
Sex	Male				Reference		
	Female				**0.66**	**[0.62, 0.71]**	**<0.001**
Age	Per one-year increase				1.00	[1.00, 1.00]	0.135
Marital status	Single/widowed/divorced/separated				Reference		
	Married				**0.85**	**[0.79, 0.90]**	**<0.001**
Education	≤Primary				Reference		
	Secondary				**1.37**	**[1.26, 1.50]**	**<0.001**
	≥Tertiary				**1.41**	**[1.28, 1.55]**	**<0.001**
Smoking	Never				Reference		
	Past				1.00	[0.93, 1.08]	0.941
	Current				**0.76**	**[0.71, 0.82]**	**<0.001**
Alcohol	No				Reference		
	Yes				**1.09**	**[1.02, 1.17]**	**0.012**
Obesity[b]	No				Reference		
	Yes				**0.66**	**[0.60, 0.71]**	**<0.001**
Men							
Chronic skin disease	No	Reference			Reference		
	Yes	**0.75**	**[0.61, 0.92]**	**0.005**	**0.76**	**[0.62, 0.93]**	**0.009**
Age	Per one-year increase				**0.99**	**[0.99, 1.00]**	**<0.001**
Marital status	Single/widowed/divorced/separated				Reference		
	Married				**0.87**	**[0.79, 0.96]**	**0.006**
Education	≤Primary				Reference		
	Secondary				**1.36**	**[1.20, 1.54]**	**<0.001**
	≥Tertiary				**1.35**	**[1.18, 1.55]**	**<0.001**
Smoking	Never				Reference		
	Past				1.01	[0.90, 1.13]	0.907
	Current				**0.74**	**[0.66, 0.82]**	**<0.001**
Alcohol	No				Reference		
	Yes				**1.13**	**[1.01, 1.26]**	**0.027**
Obesity[b]	No				Reference		
	Yes				**0.65**	**[0.58, 0.73]**	**<0.001**
Women							
Chronic skin disease	No	Reference			Reference		
	Yes	0.97	[0.81, 1.15]	0.724	0.97	[0.81, 1.16]	0.719
Age	Per one-year increase				1.00	[1.00, 1.01]	0.143
Marital status	Single/widowed/divorced/separated				Reference		
	Married				**0.84**	**[0.77, 0.91]**	**<0.001**
Education	≤Primary				Reference		
	Secondary				**1.38**	**[1.22, 1.57]**	**<0.001**
	≥Tertiary				**1.46**	**[1.28, 1.68]**	**<0.001**
Smoking	Never				Reference		
	Past				1.03	[0.92, 1.15]	0.657
	Current				**0.79**	**[0.72, 0.88]**	**<0.001**
Alcohol	No				Reference		
	Yes				1.08	[0.98, 1.18]	0.118
Obesity[b]	No				Reference		
	Yes				**0.66**	**[0.58, 0.75]**	**<0.001**

Abbreviations: PA physical activity; MET metabolic equivalent of task.
Significant results are in bold.

Chronic skin disease was assessed with a question with "yes" and "no" options.

Physical activity was measured in MET-minutes per week, and was included in the logistic regression models as a dichotomous variable [low (<1,386 MET-minutes per week, i.e. median value) and high PA (≥1,386 MET-minutes per week)].

[a] Models were adjusted for sex (except the sex-stratified analyses), age, marital status, education, smoking, alcohol, and obesity.

[b] BMI was calculated as weight in kilograms divided by height in meters squared based on self-reported weight and height. Using the standard WHO definition, obesity was defined as BMI≥30 kg/m^2, and BMI<30 kg/m^2 was considered no obesity.
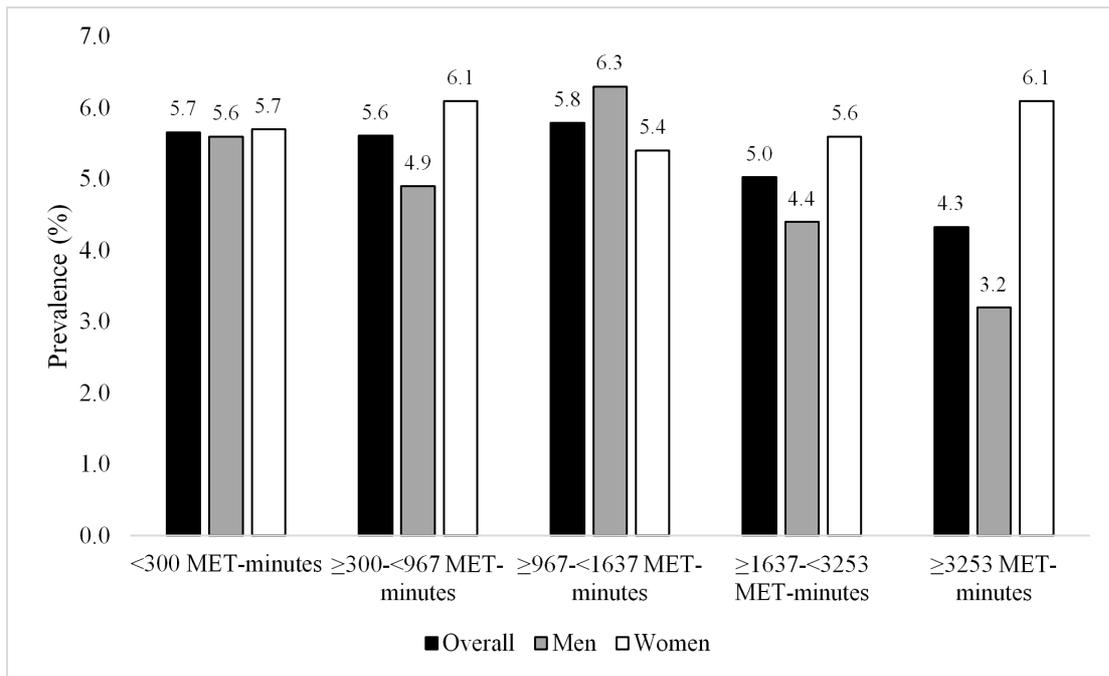
Figure 1. Self-reported chronic skin disease by physical activity in the overall sample, men and women

Physical activity was measured in Metabolic Equivalent of Task (MET)-minutes per week and was categorized as a five-category variable (i.e., <300, ≥300-<967, ≥967-<1637, ≥1637-<3253, ≥3253 MET-minutes).

Chronic skin disease was assessed with a question with "yes" and "no" options.

Chi-squared tests were used to assess whether there was a significant trend in the prevalence of chronic skin disease with increasing levels of physical activity. P-values were lower than 0.01 for the overall sample and men.