The prevalence of Metabolic Syndrome among law enforcement officers in the Netherlands.

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Objective: the objective of our study was to investigate the relation between sedentary professions within the police force and the metabolic syndrome (MetS). In addition, the effect of MetS on health - related quality of life (HQOL) was investigated.

Methods: cross-sectional data from the Utrecht Police Lifestyle Intervention Fitness and Training study (UP-LIFT), a voluntary fitness and lifestyle test for employees of the Utrecht police department (the Netherlands) were analysed. From December 2004 to November 2008, 1349 participants (915 men and 434 women, aged 18-62 years) were tested.

Results: the prevalence of MetS in sedentary law enforcement officers (LEOs) was significantly higher (21.3% vs. 13.5%, $p<0.01$) than in active LEOs. Logistic regression showed increasing prevalence of MetS with increasing age, decreasing peak oxygen uptake and being male. The SF-12 Physical health summary score (PCS) was significantly lower in LEOs with MetS (51.58 (6.39) vs. 53.60 (5.30),$p<0.001$).

Conclusion: over 17% of LEOs have MetS, especially older male LEOs (34% diagnosed with MetS) have multiple risk factors. Despite these numbers MetS has only little effect on HRQOL. The intensity of sedentary behaviour during work and the relation with MetS should be investigated and incorporated in physical activity (PA) guidelines.

Master thesis

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Introduction:

Daily activity levels are declining as transportation and work is automated [1]. More than ever the working population nowadays spends time sitting [2], however guidelines do not address the hazard of sedentary behavior in the occupational setting [1]. Several studies have shown that long periods of sedentary behavior, especially prolonged sitting, is negatively associated with chronic diseases, independent of leisure time physical activity [2, 3]. Inactivity has shown to be related to reduced insulin sensitivity [4]. Insulin resistance reduces the glucose uptake, thus reducing the storage of glycogen and tri-glycerides, resulting in elevated blood glucose levels and diabetes mellitus type 2. Since sedentary behavior can cause metabolic changes, it could in turn cause the metabolic syndrome (MetS). MetS is a combination of metabolic derangements, such as: central obesity, hypertension, hypercholesterolemia, high triglyceride level and high blood glucose and is a multiplex risk factor for CVD[5].
Several epidemiological studies in the past have found law enforcement officers (LEOs) to have increased risk of cardiovascular disease (CVD) mortality and morbidity [6-9], moreover LEOs were also reported to have higher prevalence of overweight, hypertension and hypercholesterolemia when compared to other populations [10].
The work of LEOs might primarily consist of sedentary tasks[11], with occasionally a maximal or near maximal physical strain, involving a struggling subject during an arrest. [12] Not all officers are out on the streets, many LEOs have office jobs. In general five groups of functions can be differentiated within the police force in the Netherlands: executive operational, executive supportive, management executive, administrative or technical and management administrative or technical. The first groups of LEOs (executive operational) are officers that work on the streets doing basic police work, specialized police work and desk work. The remainder has supportive or management jobs, principally desk work. More sitting and performing less non-exercise activity could theoretically increase the risk on having MetS [2].
Previous studies have shown a direct relationship between MetS and impaired HQOL [13]. It is important to understand the impact on HQOL in workers with MetS, as they might report more physical, emotional and psychosocial problems [13]. Chambers et al. [14] found a cumulative effect of cardiovascular disease risk factors on decreasing HQOL in a small group of adults. Although there is extensive evidence for the deleterious impact of CVD on HQOL, less is known about the impact of CVD risk factors on HQOL [15].
The aim of this cross-sectional study was to investigate the relation between sedentary behavior during work with MetS within the Utrecht police department (Netherlands). We differentiated LEOs with sedentary tasks and LEOs with more active tasks, and investigated the presence of MetS. Sedentary tasks were recognized by their low metabolic equivalent (Met < 2) [16], with desk work as the most important sedentary task (1.5 Met) [17].
In addition we investigated the impact of MetS on health related quality of life (HQOL).
Research question: 1. Is the profession (work function) within the police force associated with the metabolic syndrome? 2. Do workers with the metabolic syndrome report lower levels of health related quality of life? It was hypothesized that: 1. The prevalence of MetS was higher in sedentary LEOs when compared to LEOs that are more active during work time, and; 2 workers with MetS report lower levels of HQOL.

Methods and measurements:

Cross-sectional data of this study was retrieved from the Utrecht Police Lifestyle Intervention Fitness and Training study (UP-LIFT), a voluntary fitness and lifestyle test for employees of the Utrecht police department (the Netherlands). All participants included in this study worked in the Utrecht area, a central part of The Netherlands. Employees were tested from December 2004 to November 2008. The population consisted of 915 men and 434 women, aged 18 to 65 years. This study was approved by the Ethical Committee of the University Medical Centre Utrecht, all participants signed an informed consent.

Demographic measurements were age-classes (18-29 years, 30-39 years, 40-49 years and 50-59 years), gender and smoking habits.
Metabolic syndrome: the definition of MetS was based on criteria established by the National Cholesterol Education Program Adult Treatment Panel III (ENCAP ATP III 2001)[18]. Individuals require three out of five metabolic derangements for diagnosis of MetS: (1) High triglyceride level (> 1.70 mmol/l); (2) elevated blood pressure (SBP > 130 mmhg and/or DBP > 85 mmhg) or on antihypertensive drug treatment; (3) increased waist circumference (men waist circumference > 102 cm; women > 88 cm); (4) low HDL-cholesterol (HDL-C, men <1.03 mmol/l; women <1.30 mmol/l) or on drugs treatment for reduced HDL-C; and (5) high blood glucose (>6.1 mmol/l) or on drugs treatment for elevated glucose. Waist circumference was measured at the level of the umbilicus with a plastic anthropometric tape. Blood pressure was measured two times, at rest in seated position, with a sphygmomanometer. The mean values of both systolic and diastolic measures were used. Concentrations of HDL-C, triglycerides and glucose were measured with the automatic Cholestech LDX cassettes (Cholestech, Hayward, California, USA). A blood sample was taken from the fingertip after a 4 hour fast.
Health related quality of life was measured with the standard medical outcome study short form-12 version 2 (SF-12). The SF-12 was originally designed as a shorter version of the SF-36 and covers eight domains (General health, Physical functioning, Role physical, Bodily pain, Vitality, Social functioning, Role emotional and Mental health) [19]. All item scores were transformed to a 0-100 scale, with higher scores denoting better self-perceived quality of life. The SF-12 was divided in two subscales, Physical Health (PCS) and Mental Health (MCS). The reliability of the scale has reported to be adequate and validity of the scale has reported to be good [19].
Functions within the police force: Five groups of functions were differentiated: executive operational, executive supportive, management executive, administrative or technical and management administrative or technical. For the purpose of this study the executive operational group was considered to be the active group of workers and coded as Active. Active workers were LEOs who were supposed to be active during work time (on patrol, walking, cycling or in vehicles).
The other functions were clustered and were considered to be sedentary workers, and coded as Sedentary. Sedentary workers were LEOs with sedentary work, sitting behind the desk during most of their working time. To examine whether distinctions based on professions were validly, LEOs were asked for daily activities during work; do you primarily work in open air? Do you regularly walk during work? Do you commonly sit during work? Do you often stand during work? Do you often sit in vehicles? All questions were answered with yes or no.
For the assessment of physical fitness (PF), peak oxygen uptake (VO_2 peak) as the golden standard for exercise capacity was measured[20]. All volunteers were tested on a bicycle ergometer (Siemens-Elema 380B; Ergometrics 800S, Ergometrics, Bitz, Germany), in a laboratory with stabilized room temperature. The initial workload of 20 W was increased

every minute by 20 W until volitional exhaustion. During the test, a 12-lead electrocardiogram and respiratory data through breath-by-breath analysis (Oxyxon Pro, Jaeger, Mijnhardt, The Netherlands) were continuously measured. Heart rate was determined from the electrocardiogram. The gas analysers and the flowmeter were calibrated before each test according to the manufacturer's instructions. VO_2 and carbon dioxide output (VCO_2) were determined from the continuous measurement of oxygen and carbon dioxide concentration in the inspired an expired air. The respiratory gas exchange ratio (RER) was calculated as VCO_2/VO_2 [21].
Physical activity was measured using the short questionnaire to assess health enhancing physical activity (SQUASH)[22]. The SQUASH consists of four domains of physical activity, e.g., commuting activities, occupational physical activity, house-hold activity and leisure-time physical activity, and it includes questions of frequency, duration and intensity. Participants were asked to take in mind a normal week during the last month, and then were asked how many days per week they were involved in physical activity, how many minutes on average and how strenuous these activities were. For our study we selected one question to classify participants' leisure time physical activity (LTPA) levels. We differentiated two groups, scoring yes or no as they met the criteria of being active at least 150 minutes per week in moderate to vigorous activity, as recommended in the Dutch guideline for healthy physical activity[23]. The SQUASH was validated with a CSA-activity monitor. The correlation coefficient for validity was $r = 0.45$ (95% CI 0.17 to 0.66), reproducibility for all questions separately ranged from $r = 0.44$ to 0.96. [22].

Statistical analysis:

Data were analyzed using SPSS version 17. Descriptive statistics were computed for the prevalence of MetS and HQOL. Results are provided as means and standard deviations (SD). Unpaired T-tests were used to compare group means, for non-parametric data the Mann-Whitney U-test test was used. We used stepwise backward likelihood ratio logistic regression analysis to predict the probability of the occurrence of MetS in active LEOs vs. sedentary LEOs. Multiple comparisons were computed using ANOVA (Post Hoc: Bonferroni's method) to compare all variables stratified by age, or the nonparametric Kruskal-Wallis was used. Statistical significance was set at $P < 0.05$.

Results:

Table 1 reports the characteristics of the active group versus the sedentary group and their total. The age range of the participants was 18 to 65 years, and data was available for 1349 participants. As shown in the table the only non-significant group differences were found for smoking. Mean age was significantly higher for the sedentary group, which also was significant less physical active during leisure time (LTPA). Although the active and sedentary groups both reported high percentages of commonly sitting during work, the active group reported they often sit in vehicles. This group also reported higher percentages of standing and walking during work. The point prevalence of MetS in sedentary LEOs was 21.3% versus 13.5% in active LEOs, and both PSC and MSC scores were significant lower in sedentary LEOs. These results confirmed both our hypotheses; the prevalence of MetS in sedentary LEOs was higher than in active LEOs, and PSC and MSC was significant lower in sedentary LEOs.

Table 1 Differences of characteristics between active and sedentary LEOs, and characteristics of total population

	Active (N=706)	*Sedentary (N=643)*	*Total (N=1349)*	*Diff.*
Age (years/SD)	34.23(10.33)	42.19(10.35)	38.02(11.09)	.001a
Gender (%men)	75.8	59.1	67.8	.001b
Smoker (%)	23.5	22.0	22.8	.53b
VO_2 peak (ml/min/kg.)	38.2(7.6)	33.2(8.0)	35.8(8.2)	.001a
PSC (mean/SD)	53.8(5.1)	52.6(5.9)	53.3(5.6)	.001a
MSC (mean/SD)	53.5(6.7)	52.7(7.2)	53.2(7.0)	.02a
LTPA (% yes)	53.8	39.6	47.0	.001b
MetS (% yes)	13.5	21.3	17.2	.001b
Primarily work in open air? (%)	74.1	15.6	46.1	.001b
Regularly walk during work? (%)	76.2	33.4	55.8	.001b
Commonly sit during work? (%)	85.6	93.5	89.4	.001b
Often standing during work? (%)	71.6	19.5	46.7	.001b
Often sitting in vehicles? (%)	70.7	21.3	47.1	.001b

Data are numbers, percentages or mean ± SD, diff. = p value,
a= t-test, b= Mann- Whitney test.

After differentiating both the active and sedentary group for gender, the prevalence of MetS differed significantly with 15.8% for men versus 5.8% for women ($p<0.001$) in the active group (table 2). Furthermore, variables of the active group were significant different for age and VO_2 peak, and the daily activities during work; sitting during work and sitting in vehicles. For sedentary the prevalence of MetS was also significant higher in men (26.6%) than women (13.7% $p<0.001$). The variables age and VO_2 peak were significant different and for PCS and MCS there was a small significant difference. More men reported to be active during work than women.

Table 2 Differences of characteristics between active and sedentary LEOs by gender

	Male (Active, N=533)	*Female (Sedentary, N=172)*	*Male (Active, N=380)*	*Female (Sedentary, N=263)*
Age (years/SD)	35.8(10.6)**	30.6 (8.4)**	46.0 (9.0)**	36.8 (9.7)**
Smoker (%)	22.6	26.3	21.1	23.3
VO_2 peak(ml/min/kg.)	39.6(7.7)**	33.9(5.7)**	35.3(7.8)**	30.0(7.3)**
PSC (mean/SD)	53.9 (5.2)	53.2 (5.6)	53.0 (5.4)*	52.0 (6.5)*
MSC (mean/SD)	53.8 (6.6)	52.7 (6.4)	53.7 (6.6)**	51.1 (7.9)**
LTPA (% yes)	54.7	50.7	41.6	36.9
MetS (% yes)	15.8**	5.8**	26.6**	13.7**
Primarily work in open air? (%)	74.5	72.7	20.6**	8.4**
Regularly walk during work? (%)	76.2	76.2	38.5**	26.0**
Commonly sit during work? (%)	87.9*	78.5*	92.6	94.7
Often standing during work? (%)	71.5	71.5	24.8**	11.8**
Often sitting in vehicles? (%)	73.0*	63.4*	30.8**	7.6**

Values are numbers, percentages or mean ± SD, t-test differences between men and women * $p < 0.05$, ** $p<0.001$

Table 3 shows the results of the logistic regression analysis, which predicts the chance for MetS. Data was available for 1166 participants. All independent variables (gender, VO_2 peak, age-classes, professions, smokers and LTPA) were included in the model. For the variable age-classes, the first group (18-29 years old) was the reference category. For gender, female LEOs were the reference category. The variables that were independently associated with MetS are included in table 2. We tested the model for logistic regression assumptions. There was no multi-collinearity between the entered variables. Testing for linearity of the logit, age-classes and VO_2 peak met the assumption.

Table 3 Results of logistic regression by backward LR selection

	B (SE)	*Lower (95% CI)*	*Odds Ratio*	*Upper (95% CI)*
Included				
Constant	.90(0.50)		2.47	
VO_2 peak	-.12*(0.01)	.87	.89	.92
Gender	1.33*(0.23)	2.40	3.77	5.92
Age-Classes				
Age-Class 1	.35(0.30)	.79	1.42	2.53
Age-Class 2	.64†(0.28)	1.10	1.90	3.30
Age-Class 3	.78†(0.30)	1.21	2.19	3.96

*P<0.001,†P<0.05, .13 (Cox & Snell R Square), .21 (Nagelkerke R Square),
Model $X^{2(4)} = 155.83$ $p < 0.001$, .15 (Hosmer & Lemeshow)

Table 4 shows the main characteristics of the total group of LEOs when was stratified for age. The point prevalence of MetS increased with age from 6.7% (18-29 years) to 34.3% (50-59 years).With increasing age the VO_2 peak from the oldest group was significant lower when compared to the three subgroups. With aging also fewer participants met the criteria for LTPA. Furthermore, with increasing age fewer participants reported engagement in daily activities performed during work. Fewer participants regularly walked, stood and more participants reported they commonly sat during work.

Table 4 characteristics of total group of LEOs by age

Age classes in years	*18-29 (N=206)*	*30-39 (N=202)*	*40-49 (N=284)*	*50-59 (N=218)*	*P*
Age (years/SD)	24.4 (2.9)	34.3(2.8)	44.9(2.8)	53.7(2.5)	<0.001
Gender (%men)	56.6c	57.1cd	76.3abd	86.7abc	<0.001
Smoker (%)	26.6b	19.3a	22.3	22.8	<0.02
VO_2 peak (ml/min/kg.)	39.4(7.7)bcd	36.3(7.9)ad	35.0(8.1)ad	31.3(7.1)abc	<0.05
PSC (mean/SD)	54.2(4.7)cd	53.8(5.3)cd	52.5(6.1)ab	52.1(6.0)ab	<0.05
MSC (mean/SD)	53.7(6.1)	52.4(7.6)	53.3(7.0)ab	53.2(7.1)	<0.05
LTPA (% yes)	51.1	44.7	46.2	46.3	NS
MetS (% yes)	6.7bcd	11.9acd	21.0abd	34.3abc	<0.01
Primarily work in open air?(%)	74.5bcd	46.7acd	32.9abd	24.2abc	<0.02
Regularly walk during work?(%)	77.2bcd	55.6acd	44.9ab	42.1ab	<0.001
Commonly sit during work?(%)	82.4b	91.5a	91.5a	93.1a	<0.001
Often standing during work?(%)	72.9bcd	46.6acd	36.5abd	24.7abc	<0.01
Often sitting in vehicles?(%)	62.6bcd	48.9acd	41.2abd	31.9abc	<0.04

Abbreviations: p-value; a = different from the age-group 18-29 years, b = different from the age-group 30-39 years, c = different from the age-group 40-49 years, d = different from the age-group 50-59 years. NS= not significant,

Table 5 reports the prevalence of MetS when was stratified for age and split by gender. MetS is increasing with age in both males and females. In men the increase of prevalence looks gradually compared to women where the increase is enormous in the age-class of 50-59 years (39.4%).

Table 5 prevalence of MetS in the total population, by age and gender

prevalence of MetS in %	*18-29 years (N=206)*	*30-39 years (N=202)*	*40-49 years (N=284)*	*50-59 years (N=218)*
Male (N=914)	7.6 (n=16)	14.4 (n=29)	23.3 (n=67)	33.5 (n=72)
Female (N=435)	5.6 (n=9)	8.6 (n=13)	13.5 (n=12)	39.4 (n=47)
Total (N=1349)	6.7 (n=25)	11.9 (n=42)	21.0 (n=79)	34.3 (n=119)

To compare HQOL between the groups having MetS and not having MetS, t-tests were performed (Table 5). The mean PCS was significant lower in the group with MetS when compared to those without. No significant differences were found between the mean MSC of both groups. After stratifying for age and controlling for gender and having Mets or No MetS, significant differences were found between males and females not having MetS aged between 18 to 29 years, and 30 to 39 years for PSC. Also significant differences were found between males and females, between 30 to 39 years old, not having MetS for MSC.

Table 5 HQOL differences between MetS and No Mets by age and gender

Table 5	*MetS*		*No MetS*		*P*
	Male	Female	Male	Female	
18-29	(N=16)	(N=9)	(N=192)	(N=152)	
PSC	53.96(4.68)	49.95(7.0)	55.04(4.06)*	53.40(5.07)*	0.23
MSC	53.78(4.98)	51.54(7.39)	54.80(5.41)	52.33(6.64)	0.93
30-39	(N=28)	(N=13)	(N=170)	(N=135)	
PSC	53.43(5.40)	46.36(10.04)	54.23(4.72)*	54.11(4.75)*	0.001
MSC	54.31(6.85)	50.70(7.36)	53.24(6.96)*	51.15(8.44)*	0.57
40-49	(N=65)	(N=11)	(N=214)	(N=75)	
PSC	51.65(6.43)	53.18(3.72)	53.39(5.30)	50.64(7.54)	0.04
MSC	52.12(4.80)	52.12(4.80)	53.57(7.36)	51.76(6.75)	0.84
50-59	(N=73)	(N=12)	(N=142)	(N=20)	
PSC	51.36(6.23)	50.65(6.12)	52.84(5.79)	50.64(6.21)	0.53
MSC	52.76(7.39)	53.73(6.20)	53.56(6.97)	52.05(8.06)	0.38
Total	(N=229)		(N=1104)		
PSC	51.58(6.39)		53.60(5.30)		0.001†
MSC	53.38(6.68)		53.10(7.06)		0.57†

Abbreviations: MetS = diagnosed with Metabolic syndrome, No Mets = not diagnosed with metabolic syndrome, PSC= physical health, MSC= mental health,* = p<0.05 between gender, P = different between MetS or No Mets, † = t-test.

Discussion:

The aim of this study was to investigate whether the function within the police force was associated with the metabolic syndrome. The prevalence of MetS for active LEOs was 13.5% compared to 21.3% for sedentary LEOs and the difference was significant. This confirmed the hypothesis that the prevalence of MetS was higher in the sedentary function group. This might be explained by the age difference between active and sedentary LEOs, where sedentary were on average 8 years older than active. When our total population was stratified by age (table 3) the prevalence of MetS increased from 6.7% (18-29 years) to 34.3% (50-59 years). Bos et al. (2007) also found increasing prevalence of MetS with increasing age in the Dutch population in the nineteen nineties. The prevalence of MetS in their study for male and female, 50 years plus, ranged from 20-25% [24]. In our population the prevalence of MetS among women was significantly lower than men in both groups. Previous studies have found the prevalence of MetS generally the same for men and women [8]. However, most recent research, carried out between 2009 and 2010, for monitoring risk factors among the Dutch general population showed large differences of prevalence of MetS between men and women with increasing age. Blokstra et al. (2012) found a prevalence of 10% in Dutch women, aged 30-39 years, to 28%, aged 50-59 years, compared to 20% in 30-39 years old men to 41% in 50-59 years old men[25]. When our results were examined for the prevalence of MetS in the stratified age-groups split by gender, we found female LEOs to have lower prevalence of Mets during their thirties and forties compared to the general population and very high prevalence of MetS during their fifties compared to the general population [25]. The prevalence of MetS in male LEOs were all lower during their thirties, forties en fifties when compared to the general population.

In this report we distinguished between functions within the police force, to study which group was more at risk for MetS. We assumed the active group was more active than the sedentary group during work. When examining for details regarding activity levels during work we found that both groups reported they commonly sit during work. There is a large difference, however, when both groups were asked if they regularly walked and stand during work. From the active group 76.2% said they regularly walked against 33.4% of the sedentary group. Moreover 71.6% of the active group reports standing often during work against 19.6% in the sedentary group. These differences in prevalence of MetS might be explained by previous findings of Healy et al. (2008). They reported the importance of avoiding prolonged uninterrupted periods of sedentary behavior, especially sitting. In their population increased breaks in sedentary time decreased waist circumference, BMI, triglycerides and 2-hour plasma glucose independent of total sitting time [3]. Although the active group did report to sit often in vehicles, their breaks in sedentary time might explain the prevalence difference of MetS.

Even though we found significant differences in the prevalence of MetS between the two groups, no distinctions could be predicted based on functions. The regression analysis show increasing probabilities of MetS with increasing age, being male and decreasing peak VO_2 peak. Most middle aged LEOs, especially men have higher ranks that involve more sedentary work that might explain increasing prevalence of MetS with aging [8]. We found no independent associations between MetS and LTPA, suggesting that leisure time activities does not protect against the risk of MetS in our population of LEOs. Similar findings were reported earlier [2, 3]. Also for smoking no independent association was found with MetS.

The second research question was to investigate whether there were differences between the HQOL in participants having MetS or not. When comparing the scores of PSC, a small but significant difference was found between both groups. Despite the differences both groups scored on average above the Dutch normative score of 51.0[19]. For MSC the data for both

groups showed no statistically significant differences even though participants without MetS scored on average lower. When compared to the Dutch normative score of 53.5, participants with MetS scored on average 0.1 lower.
In the age-classes groups we found small age differences for PCS as they were declining with increasing age. This was almost the same when compared to the Dutch stratified age norms as presented by Mols et al.[26] . For the MSC scores there were small decreases with increasing age. It's striking that both groups report high levels of HQOL. This high standard might be characteristic of the Dutch population, where health care is available for everyone, and therefore becoming ill has small or no effect on HQOL [26].
Several limitations of this study need to be addressed. First, since this study had a cross-sectional design we should be cautious drawing conclusions. Aging, being male and lower VO_2 peak max were able to predict MetS in LEOs and not their function. However, the association between sedentary work and metabolic risk seems obvious when looking at the prevalence of MetS. Secondly, this study only focused on sedentary behavior during work and the relation with MetS. Our goal was to investigate if we could point out possible associations between MetS and type of work in LEOs. Yet, there are many factors, like sedentary behavior, unhealthy diet, obesity and genetic factors that are involved with MetS, and some researchers have found shift work and psychosocial stress to be related to MetS especially in policemen [10] [7, 27, 28].
Thirdly, the reliability of self-reported LTPA is of concern because of the potential recall bias [29]. In addition, the lack of an objective measurement for sedentary behavior during work is a limitation for drawing conclusions. Since we used dichotomous questions regarding daily activities during work to distinguish active and less active LEOs the results were less useful for comparing both groups. Nevertheless, we believe we had good indications to differentiate groups on daily activities since the differences were very large.

Conclusion:

The present study observed lower prevalence of MetS for most age-groups of LEOs of the Utrecht Police Force when compared to the general Dutch population. However, our results are still alarming. HQOL does not seem to be seriously affected by MetS and LTPA might not be sufficient to prevent the population from chronic diseases. Further research is necessary to understand the effects of sedentary behavior independent of leisure time physical activity. Objective measurement of sedentary behavior and the intensity of sedentary behavior during work should be investigated and used to develop guidelines for an (in)activity balance at work.

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