Master Thesis

Findings and significance of Multistix urinalysis testing in a population survey

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INTRODUCTION

Two main functions of the kidneys are to clean body fluids from several waste metabolites and keep the hydro-electrolytic balance by producing urine which contains body endogenic and exogenic wastes (1). Testing urine can help screen, diagnose and monitor a variety of diseases and metabolic conditions such as diabetes or liver diseases (2). The urine dipstick test is a simple diagnostic tool commonly performed in standard urinalysis in medical practice to assess selected metabolites (e.g. urobilinogen, glucose, etc.), markers (erythrocytes, leucocytes, etc.) and other characteristics of urines (e.g. pH, density, etc.) in urine (3).

To realize the test, a strip with small squared colored fields (up to ten and each field is dedicated for one substance) is dripped into the collected clean midstream urine sample for a few seconds. Results can be inferred from the color changes occurring within seconds or minutes, which are compared with a reference color table, which usually appears on the urine test package (4).

Dipstick urinalysis is often performed as part of a routine medical examination. It can be done by any health professional at the doctor's office, in the hospital or at home by patients for self-monitoring (2). Dipstick urinalysis is simple to perform, results are obtained quickly (about 1 minute), at a low cost (less than 1 US $ for one test in most instances) and the test, which is non-invasive, is not associated with side effects (5).

Dipstick testing can be specific enough to detect a variety of abnormal conditions (e.g. proteinuria, glycosuria, ketonuria, microscopic hematuria) that correspond to actual diseases (diabetes, kidney disease). However, it remains generally useful to confirm dipstick results with other testing and clinical information (4).

Like most screening tests, dipstick testing can also result in falsely positive or falsely negative results(4). False positives may lead to labeling a healthy person as sick (6), including doing subsequent unnecessary investigations such as kidney biopsy, cystoscopy, unnecessary antibiotic treatment, long term follow-up for inconsequential abnormalities and psychological stress in healthy persons (7). The sensitivity of the dipstick test is variable according to the tested substance, from 19-48% for the nitrite to 91-100% for the hematuria (Table1), and many other conditions may lead to false negative results (22). False negative results may lead to missed diagnosis and delayed management of underlying conditions. The adequate use of the dipstick test is further complicated because it assesses multiple substances (up to 10), which increases the potential detection of both false positives and false negatives.

A number of studies have been conducted to analyze the benefit of urine dipstick screening (**Table 1 and Table 2**). It has been recommended to screen for protein or albumin for persons with certain risk factors, such as hypertension or diabetes (4,8). In contrast, the Canadian Task Force on the Periodic Health Examination, the American Cancer Society and other authoritative organizations do not recommend the screening for hematuria and proteinuria in asymptomatic persons, but screening for hematuria may be appropriate for men and women over 60 years of age (5). Few studies have assessed the usefulness of screening for hemoglobin, protein or glucose in urines and even fewer have assessed the benefits and harms to test for pH, density, leukocytes, urobilinogen and nitrite (7). Some studies suggest that the clinical benefits of multistix testing are small (7). The question arises, then, whether the test is useful for mass screening in healthy individuals.

In this study, we examine 1) the frequency of abnormal conditions detected by the multistix when applying the test to a random sample of adults; 2) whether positive tests inter-correlate; and 3) the association of positive tests with selected socio-demographic and clinical variables. We also reviewed the literature in relation to recommendations for the use of multistix testing.

The study is based on results of a multistix test that was applied to all participants of a national population survey in the Republic of Seychelles (i.e. a random sample of the general adult population). Implicit to the objectives of this study described above is the question of whether it can be useful to use a multistix screening test in participants to population-based surveys, which are generally attended mainly by apparently healthy individuals.

Methods and analysis

We used data from a population-based health survey conducted in the Seychelles in 2013-2014. Selection of the eligible participants was made using a random selection of all adults aged 25-64 years, from the electronic register of the whole population aged 25-64 years. A total of 1240 men and women participated in the survey (participation rate of 73%). Lifestyle and health behaviors were assessed by questionnaire and several clinical variables (e.g. blood pressure, body mass index, etc.) and laboratory variables were measured (e.g. fasting blood glucose, lipids, CRP, creatinine).

A spot sample of urine was collected between 7 and 10 am (hence most often from a second morning urine) and immediately tested with a multistix urinalysis strip (Bayer, Mutistix 10 SG), which tests for the presence of glucose, protein, ketones, blood, leucocytes, nitrites, bilirubin, urobilinogen, pH and density. And the results were read by trained health personnel.

We tabulated the distribution of the tests. We analyzed results two times: once considering “trace” and “1+” results as a positive test (i.e. a stringent criterion for assessing a test as positive) and the second time by considering “trace” and “1+” results as a negative tests (noise). We preformed correlation analysis between all the urinary tests. We then examined the multivariate associations of dichotomized multistix tests according to age, sex, smoking, alcohol drinking, BMI, blood pressure, blood glucose, CRP, creatinine using logistic regression. We used the statistical software STATA version 14.

RESULTS

In total, 1240 men and women aged 25-64 years participated in the study (a 73% participation rate).

Table 3 shows that the large majority of the participants had negative (normal) results for each of the dipsticks parameters with a frequency varying from 90-99.7 %. Considering trace as positive augment the frequency of about 5% for ketone, protein and blood. In descending order of positive results, we found protein, blood and ketone.

Table 4 shows several correlations between the parameters. The strongest correlation is between glucose and protein and between nitrite and bilirubin. There are also correlations between leucocyte and protein, and between blood and glucose.

Table 5 shows several statistically significant associations between urine tests and the selected variables, including between:
- blood and elevated CRP and creatinine,
- leukocyte and physical activity, hospital admission in the last 12 months and high CRP and female sex.
- nitrite and female sex.
- glucose with diabetes.
- ketone with daily smoking and diabetes.
- protein with high blood pressure and diabetes.

DISCUSSION

The findings show that most of the participants in a population-based survey have normal results using a dipstick test. The test most often found to be positive was protein. We found several correlations between the dipstick parameters. We also found several associations between dipstick tests and selected socio-demographic and biological conditions, particularly with glucose, ketones, and proteins.

1. Blood (hematuria)

Hematuria can be caused by many diseases and conditions. In the small percentage of patients for whom an etiology is identified, causes may include urinary tract infection, benign prostatic hyperplasia, medical renal disease, urinary calculi, urethral stricture disease, and urologic malignancy (9).

Blood was the second most prevalent positive test (6.44%) in our study after protein. This is not a surprise as transient microscopic hematuria is a common problem in adults. It was shown that a third of individuals with an initially positive urinalysis has transient hematuria (10,11). Hematuria is common in young patients and is frequently benign in this age group, with no pathological cause being identified (10). It is also known that dehydration, even low, can lead to concentrated urines and can cause false positive test of hematuria (22,24).

We found a correlation between blood and glucose. In patients with normal kidney function, significant glycosuria does not generally occur until the plasma glucose concentration exceeds 180 mg/dL (10 mmol/L). In general, in diabetes mellitus we have glucosuria especially when not controlled (12). Hematuria is often related to inflammation or infection of urinary tract. It is widely accepted that diabetic persons have an increased risk to develop infections (13). It has also been shown that an occult blood may be found in patients with diabetes mellitus and that this suggests progress of renal damage(14). Hence, the correlations between blood and glucose in our study were expected based on these two mechanisms.

We also found an association between blood and CRP. This is consistent with a relation between inflammation/infection and hematuria. This may reflect the presence of a symptomatic or asymptomatic inflammation of the urinary tract in some participants. However, there was no correlation between hematuria and leukocytes or nitrite, which would be expected in case of infection.

We did not find a correlation between blood and protein, which could have suggested the presence of a glomerular disease in some persons (that would rise CRP). Indeed, proteinuria is found in most patients with renal disease (15,16).

The presence of blood in urine may also suggest a urinary tract cancer (primary or metastasis). It has been advised that patients with microscopic hematuria who have no evidence of glomerular disease, infection, or other known cause of hematuria such as strong physical exercise, and who are at increased risk for malignancy, should undergo cystoscopy (17,18). Risk for urinary tract malignancy includes smoking (18,19). It has been reported that malignancies are found in as many as up to 5% of patients with asymptomatic microscopic hematuria (9).

We found an association between blood and creatinine. This could suggest the presence of a glomerular disease in some of the persons with hematuria. However, we did not find an association between creatinine and protein, an association that would be expected if renal disease was a frequent cause of hematuria. It is therefore likely that hematuria does not reflect renal disease in a large proportion of persons with hematuria in our sample.

It has been advocated that the presence of microscopic hematuria and other signs of renal diseases (e.g. dysmorphic red blood cells, cellular casts, proteinuria, elevated creatinine levels or hypertension) should lead to further diagnostic examination (9). It would have been interesting to conduct such further diagnosis in all our participants with hematuria to assess the frequency of benign vs severe conditions underlying blood in urine in a random sample of the population. This would inform whether testing blood in apparently healthy persons may be a useful screening test for renal disease. One must keep in mind that urine dipstick may misdiagnose hemoglobinuria or myoglobinuria as hematuria (8), and also that there is a significantly increased prevalence of erythrocyturia after exercise (24).

2. Leukocytes (leukocyturia)

Urinary infection is strongly associated with leukocytes in urine although presence of leukocytes does not necessarily signify urinary infection, particularly if there are no symptoms, while asymptomatic bacteriuria is possible (20).

We found that 1.86% of participants were tested positive for leukocytes. This may not be a surprise since some apparently healthy persons can have some urinary infection (symptomatic or not) and others have leukocyturia unrelated to urinary infection. Sterile leukocyturia can be found in a few situations including contamination of the urine sample from vaginal secretions, chronic interstitial nephritis, nephrolithiasis, infection with atypical organisms such as chlamydia, ureaplasma urealiticum or tuberculosis (21).

Of note, there was no correlation between leukocytes and nitrite, which would typically occur in case of urinary infection. We did also not find a correlation between leukocyte and protein, an association that would typically occur in presence of urinary tract infection. There may also have proteinuria in patients with nephrolithiasis or tumors(21). Hence, the correlation could be expected. Overall, it is difficult to explain the presence of leukocytes in participants in our study as we did not ask them if they had urinary symptoms.

We found an association between leukocyturia and female sex. This association is expected since women, especially those sexually active, are more prone to urinary tract infections than men (23). Since the combination nitrituria-leukocyturia has 98-99.5% specificity to predict urinary infection (22), this supports the finding of an association between female sex and nitrituria.

We found an association between leukocyte and physical activity. This was expected since physical activity increases significantly the prevalence of proteinuria, leukocyturia and hematuria (24). An association between jogging and leukocyturia is well known (25).

We found an association between leukocyte and admission in the hospital in the past 12months. This could reflect that people recently admitted to hospital may have different abnormal conditions, including more or less chronic infection or inflammation of the urinary tract.

The association between leukocyte and CRP could reflect the fact that an inflammation of the urinary tract could be associated with leukocyturia. A number of other situations may lead to a leukocyturia including them sterile pyuria (21).

3. Nitrites

This test has a high specificity (97%) to identify a bacteriuria and the test tends to suggest a UTI, even in absence of leukocyturia (22).
However, it takes normally 4 hours for germs with nitrate reductase to produce nitrites, hence the test is more reliable to diagnose an infection with the first morning urine (22).

0nly 0.85% of the population sample were tested positive with nitrite in our study. Urinary tract infections are most commonly related to bacterial infections (26). The prevalence of positive nitrite test has been found to vary largely between countries, ranging from 0.7% in a study from Algeria, 4.5% from Senegal, to 12.3% in Nigeria (27).

We found that nitrituria did not correlate with other dipsticks parameters. However, we found that nitrituria correlated with female sex. This is consistent with women experiencing an UTI more often than men (26) and the higher prevalence of bacteriuria in adult men (0.1%) than women (10%) (23). UTIs are rare in males younger than 50 years (29) and, when occurring in males, they often underlie an urological pathology. However it must be acknowledged that urinary infections can occur in the absence of nitrite positivity with some bacteria that do not express nitrate reductase (e.g. enterococcus) or when urine is collected with insufficient time of incubation of bacteria to produce nitrite in the bladder(28).

4. Glucose (glucosuria)

Glucosuria happens when the rate of filtrated glucose is beyond the tubules resorption capacity (10-11mmol/L). We found that 1.78% of participants in our study had glucosuria. The prevalence of type 2 diabetes mellitus varies from 3.8 to 10.2% worldwide and may be as high as 50% in some areas (30). In Seychelles, the prevalence of diabetes as high as 12% in adults aged 25-64 years. This may explain the finding of glucosuria in the same survey and an expected substantial proportion of adults with blood glucose levels higher than 10 mmol/l.

We found a correlation between glucose and blood and discussed this issue in the section on blood (above). The association between diabetes and glucosuria is expected since the sensitivity of dipsticks test increases with blood glucose level (3).

5. Ketones (ketonuria)

Ketonuria is often associated with uncontrolled diabetes, fasting or a poor carbohydrate regime.

In our study, we found ketonuria to have the third highest frequency (6.02%) after protein and blood. It is likely that this high frequency reflects that participants were requested to be fasting to attend the survey.
Indeed, only very few participants had blood glucose levels in this study that were high enough (e.g. >20 mmol/l) to be the cause of ketonuria and most persons with high glucose levels were treated, consistent with fairly high prevalence of diagnosis and treatment of glucose in the Seychelles. It is customary in Seychelles that adults are tested at regular intervals for blood glucose when they attend primary health care and treatment is provided at no cost to all patients, which explains that only few diabetic persons would have extremely high blood glucose values in the country.

We found a correlation between ketone and glucose. This is expected since for physiological reasons.

We also found an association between ketone and doctor visit in the past 12 months. This is expected since ketonuria is associated with diabetes and diabetes with medical visits, particularly in Seychelles where diabetes is commonly screened in all adults and the proportion of people with known diabetes in the population is high (31).

We found an association between ketone and smoking. This may relate to some association between smoking and diabetes mellitus (32) and increased risk for adverse health consequences in diabetic

patients(33). It was reported that patients who quit smoking tend to adhere more to hypoglycemic agents (34), which is a factor of blood glucose control. Inversely active smoking was reported to be associated with poor glycemic control (35).

6. Protein (proteinuria)

With urinary dipstick, proteinuria is generally apparent for excretion above 150 mg/day.

We found that proteinuria was the most common positive urinary test in our survey (9.15%). Proteins in the urines usually reflect glomerular proteinuria since the dipstick test has low sensitivity to non-albumin proteins (21). In our study, proteinuria likely reflects the high prevalence of diabetes and hypertension, with concomitant renal impairment. However, proteinuria can also occur in benign situation such as exercise-induced proteinuria or orthostatic proteinuria. Unfortunately, we did not have complementary clinical or history information in the survey to further distinguish benign or more serious causes for proteinuria.

We found a correlation between protein and leucocyte, already discussed above. We also found an association between protein and hypertension, which is expected since high blood pressure is main cause of a chronic kidney disease. It has been reported that screening of proteinuria among high-risk groups (older age, hypertension) can be a cost-effective way for detecting and improving control of chronic kidney disease (36).

In general, the protein test in the dipstick has a high negative predictive value (>90%) which makes the test useful to exclude a renal disease, but positive results should still be confirmed by standard laboratory analysis (37). This explains why, in clinical practice, a quantitative dosage of microalbuminuria is used more often even if the latter test is more expensive (around 5-10 US$) than the simple dipstick (less than 1US$). However, the usefulness to use a simple dipstick test to test for urine protein may be raised in population surveys in view of the simplicity and low cost of dipstick assessing proteinuria and the importance of adequately diagnosing and managing kidney disease.

7. Bilirubin (bilirubinuria)

The presence of bilirubin in urine is a sign of biliary obstruction or hepatitis, hence further investigations would be necessary in case of positive test.

The correlation between bilirubin and augmented CRP (≥10mg/L and 5-9.9 mg/L) suggests a state of inflammation. Normally, bilirubinuria alone would require further investigation, and an association with CRP would further stress investigation.

8. Density

Density of urine reflects hydration of the person. It is expected that persons fasting may have a high density of urine because of dieting, including restriction of drinking. We found no associations of density with other dipstick parameters of other characteristics.

STRENGHTS AND LIMITATIONS OF THE STUDY

Strengths of this study include the fairly large sample size and the population-based random selection of participants. Limitations of the study are related to the fact that the collection of the urine was not the first morning one, as recommended for the dipstick test to have a reasonable specimen for analysis (38). We also did not consider in this analysis medications taken by the participants, which could have affected the tests (e.g. antibiotics, corticosteroids, et.). Positive tests were not repeated for

confirmation. Yet, overall, the study allows to assess the overall prevalence of positive dipstick testing in a random sample of a general population and provide insight on the potential usefulness of using dipstick testing in healthy individuals and, in particular, in population surveys.

CONCLUSIONS AND RECOMMENDATIONS

The dipstick test has the merit of being affordable, easy to perform, noninvasive with no side effect linked to the technique itself (5). In a supposed healthy population, we can expect a large majority of persons having negative findings. We found, however, a non-negligible frequency of positive tests (mainly protein, blood, ketones) and several correlations with other parameters and conditions, which could present interesting entry points that could justify further medical examination. Yet, one must be aware of the fairly high rates of false positives cases with urinary dipstick, which may lead to unnecessary worries and investigations (7). Inversely, false negative cases can lead to missed diagnosis and delayed management of underlying causes. If a urinary dipstick was used in routine screening of expectedly healthy persons (e.g. health surveys), one should consider ways to minimize the rate of false positive and false negative tests. This may include focusing on the first morning midstream urine (but this may not be easily feasible), enquiring on some further medical history (e.g. history of urinary infection, menstruation, etc.), and systematically organizing duplicate dipstick testing a few days later for persons with a positive result.

It would be useful that further studies are conducted to follow up outcomes in persons with a positive test in order to better determine the significance of positive tests, including their predictive value to identify selected medical conditions. Similarly, further studies should examine the significance, and the predictive value, of weakly positive tests (trace, 1+).

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Table 1: Accuracy of urine dipstick testing to detect diseases (1,2)

Dipstick test	Conditions	Results	Sensitivity or detectable level of the analyte	Specificity
Bilirubin and urobilinogen	Biliary obstruction, liver diseases, hemolysis		0.2-0.8 mg/dl bilirubin ≥0.2 mg/dl urobilinogen	
Blood	Microscopic hematuria (> 45 causes)	≥1+	91-100% 0.015-0.062 mg/dl hemoglobin	65-99%
Glucose	Diabetes mellitus		75-125 mg/dl glucose	
Ketones	Diabetes (uncontrolled), carbohydrate-free diet, starvation		5-10 mg/dl acetoacetic acid	
Leukocyte esterase	Renal diseases (UTI and inflammation)	Abnormal leukocyte esterase	72-97% 5-15 WBC/hpf in urine	41-86%
Nitrites	UTI by nitrate-reducing bacteria	Abnormal nitrites	19-48% 0.06-0.1 mg/dl nitrite ion	92-100%
Protein	Reno vascular, glomerular or tubulo-intestinal renal diseases, multiple myeloma	≥3+ (significant proteinuria)	96% 15-30 mg/dl albumin	87%
Specific gravity	Hydration status and concentrating ability of kidneys (pyelonephritis, renal failure, central and nephrogenic diabetes insipidus)		1.000-1.030	
Urobilinogen			≥0.2mg/dl urobilinogen	
pH	Reflect the blood PH		5-8.5	

Table 2. Review of the literature examining the usefulness of urinary disptick screening (2–8)

Year	First author	Journal	Title	Country / region / city / hospital	Study design / participants to study	Main results
1999	Van der sande M.B. A	Trop Med Int Health	Is there a role for glycosuria testing in sub-Saharan Africa?	Gambia, Africa	Survey, adults> 15 years	Glycosuria testing can identify a substantial number of undiagnosed diabetics patients specially when targeted at high-risk groups (≥y35yrs, BMI>25, BP≥160/95). Dipstick glycosuria testing is an appropriate, safe, and feasible test for sub-Saharan Africa, where the prevalence of diabetes is expected to increase in the near future.
2001	Lammer S. RL	Ann Emerg Med	Comparison of test characteristics of urine dipstick and urinalysis at various test cutoffs.	Borgess Medical Center ED, Bronson Methodist Hospital ED, and Woodbridge Intermediate Care Center.	Prospective, observational study. Adult women >18yrs presenting in the hospital with symptoms.	In this patient population, similar overtreatment and under-treatment rates were identified for various test cutoff points for urine dipstick tests and urinalysis. Although a urine dipstick may be equivalent to a urinalysis for the diagnosis of urinary tract infection, the limitations in the diagnosis accuracy of both tests should be incorporated into medical decision making.
2007	Konta T.	Clin Exp Nephrol	Clinical utility of trace proteinuria for micro-albuminuria screening in the general population.	Takahata, Japan	Community-based health check-up	Trace proteinuria can be useful indicator of microalbuminuria in the general population, especially in subjects at high risk of cardiovascular disease.
2009	Nielen M.	BMC Public Health	The usefulness of a free self-test for screening albuminuria in the general population	Netherland	Cross-sectional survey. Adults volunteer	Using a free self-test for screening albuminuria in the general population resulted in a large response and identified substantial number of newly detected diseases. However very high percentage of positive testers of which probably a large part is false positive. Only a small part of the positive testers visited a GP for additional examination and/or treatment. The efficiency of such a campaign could be increased by embedding the testing in health care to reduce the number of false-positive results and to ensure follow-up and treatment in case of a positive test result.
2010	White SL	Am J Kidney Dis	Diagnostic accuracy of urine dipstick for detection of albuminuria in the general community.	Australia	Survey adults≥ 25yrs	A dipstick test result <1+ or less than trace has a high negative predictive value in the general community setting, with minimal risk of missed diagnosis of microalbuminuria. High false-positive rates emphasize the need for laboratory confirmation of positive results.
2011	Brown RS	JAMA	Has the time come to include urine dipstick testing in screening asymptomatic young adults?	Israel	Longitudinal study, young adult Israeli Jews (16 to 25yrs) entering military service and followed up for 21 years	Routine urine dipstick may be useful for screening in adolescents and adults, at least at all initial examinations and perhaps every 5 to 10 years thereafter. The assessment of the available evidence by the US preventive Task Force should help provide clinicians with additional guidance about the role of urine dipstick screening in prevention of CKD.
2016	Bataille A.	BMC Reas Notes	Evidence of dipstick superiority over urine microscopy for detection of hematuria.	France	Survey, healthy volunteer young males	Urinary dipstick qualified as a better test for hematuria than urine microscopy analysis or flow cytometry, as it is sensitive and performs better in unstandardized conditions. It is universally available and also faster and cheaper than cytometric techniques.

Table 3. Distribution of urinary disptick parameters according to test results

	Blood (neg, trace, +, ++, +++)	Leukocytes (neg, trace, +, ++, +++)	Nitrite (neg, positive)	Glucose (neg, trace, 250 [+], 500 [++], 1000+ [+++] mg/dl)	Ketone (neg, trace, small, moderate, large)	Protein (neg, trace, +, ++, +++, ++++)	Bilirubin (neg, +, ++, +++)	Urobilinogen (normal, positive, 2, 3, 4)
Negative or normal	93.56	98.14	99.15	98.22	93.98	90.85	98.06	99.75
Trace	1.69	1.1		0.85	4.66	6.44		
+, small or "positive"	1.44	0.25	0.85	0.34	1.36	2.46	1.86	0.08
++, moderate	0.34	0.34		0.59	0	0	0.08	0.17
+++ or more, large	2.97	0.17		0	0	0.25	0	0
Positive incl. trace	6.44	1.86		1.78	6.02	9.15		
Positive excl. trace	4.75	0.76	0.85	0.93	1.36	2.71	1.94	0.25

Women with menstruations were excluded.

Table 4. Correlation between urinary disptick parameters

	Density	pH	Blood	Leukoyctes	Nitrite	Glucose	Ketone	Protein	Bilirubin	Urobilinogen
Density	1									
pH	**-0.14***	1								
Blood	0.05	0.02	1							
Leukocytes	0.05	0.05	0.08*	1						
Nitrite	**-0.08***	0.00	0.03	-0.01	1					
Glucose	0.06	0.01	**0.13***	-0.01	-0.01	1				
Ketone	0.03	0.03	0.05	0.05	-0.02	0.08*	1			
Protein	0.03	**0.07***	0.06	**0.11***	0.01	**0.10***	0.47*	1		
Bilirubin	**0.10***	**0.11***	0.08*	**0.11***	-0.01	**0.21***	**0.06***	0.04	1	
Urobilinogen	-0.04	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	1

Women with menstruations were excluded

Table 5. Multivariate associations between dipstick urine parameters and selected variables

		Age 45-64 vs 25-44	Male vs female	Smoking daily	Alcohol >60 ml/day	Physical activity >3000 METS	BP 140-159/ 90-99	BP ≥160/100	Diabetes	Health reported less than "good"	Hospital in last 12 months	Medical visit in last 12 months	CRP 5.0-9.9	CRP ≥10	Creatinine ≥110 µmol/l
Density >1.03	**OR**	0.86	1.19	1.27	0.84	0.82	1.12	1.16	1.19	1.22	0.95	1.03	0.87	0.81	1.26
	SE	0.11	0.16	0.22	0.18	0.11	0.18	0.22	0.21	0.19	0.20	0.14	0.13	0.20	0.39
	P	0.25	0.20	0.18	0.42	0.14	0.46	0.45	0.32	0.21	0.81	0.83	0.35	0.38	0.46
Blood	**OR**	0.84	0.72	1.01	0.42	1.17	1.62	1.01	0.81	1.16	1.30	1.18	**3.19**	**2.45**	**2.95**
	SE	0.23	0.21	0.40	0.26	0.32	0.49	0.42	0.30	0.34	0.50	0.33	0.84	1.00	1.40
	P	0.52	0.25	0.97	0.16	0.58	0.11	0.98	0.57	0.62	0.48	0.55	**0.00**	**0.03**	**0.02**
Leukocytes	**OR**	1.37	**0.22**	2.78	0.98	**3.03**	1.09	1.56	2.48	1.85	**3.74**	0.86	**10.12**	**4.60**	1.00
	SE	0.73	0.15	2.11	0.87	1.50	0.69	1.00	1.36	0.90	2.16	0.44	5.54	3.56	-
	P	0.55	**0.03**	0.18	0.98	**0.03**	0.90	0.49	0.10	0.21	**0.02**	0.77	**0.00**	**0.05**	-
Nitrite	**OR**	1.57	**0.07**	1.43	3.93	0.37	1.17	1.89	1.08	0.79	0.83	0.91	0.79	1.32	4.47
	SE	1.23	0.09	1.64	4.88	0.40	1.01	1.70	0.93	0.68	0.97	0.65	0.67	1.48	5.33
	P	0.57	**0.03**	0.76	0.27	0.36	0.86	0.48	0.93	0.78	0.88	0.90	0.78	0.80	0.21
Glucose	**OR**	**0.36**	1.96	2.48	1.17	1.17	0.60	**0.15**	**16.6**	1.51	1.62	0.54	**2.49**	-	1.22
	SE	0.20	1.10	1.41	0.84	0.61	0.38	0.17	9.14	0.84	1.16	0.26	1.20	-	1.04
	P	**0.06**	0.23	0.11	0.82	0.77	0.42	**0.09**	**0.00**	0.46	0.50	0.21	**0.06**	-	0.82
Ketone	**OR**	1.00	1.30	**2.25**	1.14	0.93	0.81	0.62	**3.59**	1.33	1.06	**1.88**	0.97	0.62	**2.37**
	SE	0.29	0.38	0.71	0.46	0.27	0.27	0.26	1.05	0.40	0.42	0.61	0.30	0.35	1.08
	P	0.99	0.38	**0.01**	0.76	0.80	0.52	0.26	**0.00**	0.35	0.88	**0.05**	0.93	0.39	**0.06**
Protein	**OR**	1.11	1.52	1.27	1.49	0.93	1.03	**1.90**	**2.56**	1.46	0.98	1.28	1.17	1.60	1.63
	SE	0.27	0.37	0.36	0.48	0.22	0.28	0.53	0.63	0.37	0.34	0.31	0.30	0.60	0.67
	P	0.67	0.08	0.40	0.21	0.75	0.91	**0.02**	**0.00**	0.14	0.96	0.31	0.53	0.21	0.23
Bilirubin	**OR**	2.61	2.30	1.92	1.48	1.36	0.59	0.87	1.68	2.13	1.39	0.46	**22.6**	**8.83**	0.43
	SE	1.51	1.27	1.15	0.98	0.67	0.38	0.56	0.93	1.06	0.99	0.23	14.68	8.40	0.47
	P	0.10	0.13	0.27	0.55	0.53	0.41	0.83	0.35	0.13	0.65	0.12	**0.00**	**0.02**	0.44

For each urinary test, all co-variates were included in the logistic regression models.