CHAPTER 4: RESULTS

GENERAL INFORMATION

4.1 Limitations of the study

4.1.1 Introduction

The THUSA study was designed to examine the effect of urbanisation on health profiles of Africans in transition. It has been mentioned in the previous chapter that random selection of participants was not possible. However, the sites from which subjects were recruited were randomly selected. Despite careful instructions, not all of the subjects were fasted. The inclusion of a sub-sample of only fasted subjects in this part of the study on the metabolic syndrome introduced some methodological weaknesses. To clarify the interpretation and discussions of the results obtained and which are presented in Chapters 5 to 7, it is important to address the effect of bias, the role of chance and the effect of other confounders in the outcome of the study.

4.1.2 Bias

According to Margetts and Nelson (1998) bias may be defined as: "Deviation of results or inferences from the truth, or processes leading to such deviation. Any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth". From this wide definition it is obvious that bias can occur at any stage of the research process. Many different types of bias have been defined, but according to Margetts and Nelson (1998) only two types of bias can effect the validity of a study namely "selection bias" and "information bias."

In this study (sub-sample of the larger THUSA-study) bias occurred in the selection of subjects. Although a stratified sampling technique was used to recruit subjects, the THUSA subjects were, as already mentioned, not "truly" randomised. In addition to logistic considerations, the concept of random selection is foreign to the culture of the African people. Previous experience showed that subjects not selected regard this as a personal insult and could jeopardise a study by their actions. The reason why some subjects were not fasted was that taking something to drink or even a small snack or meal

consisting of fruit, were regarded by the subjects as "not eating." Selection of only fasted subjects for this part of the study led to an unequal distribution of subjects between the different strata and also minimised numbers as indicated in Tables 4.1a & b to 4.7 a&b.

Bias in the analysis of the data also occurred. Although 1854 subjects participated in the THUSA-study, only 1817 subjects had complete data sets regarding the results presented in Tables 4.1 a&b to 4.7 a&b (excluding results on serum insulin values and skinfold thicknesses of the women). From the total THUSA-study the serum insulin values of 654 subjects (366 women and 288 men) were not analysed due to a lack of funds. The implication of the latter on this study on the metabolic syndrome is that the insulin sensitivity index could only be calculated for 309 subjects (133 men and 176 women) although a total of 426 subjects (193 men and 233 women) were fasted. Although 1040 women participated in the THUSA-study it was possible to measure the triceps skinfold thicknesses of only 818 and the abdominal skinfold of only 346 women due to severe obesity in these women. The calipers used to measure skinfold thicknesses were too small.

Taking the above mentioned into account, this study on the metabolic syndrome can retrospectively be described as a case control, rather than a cross sectional study. It is however, important to mention that only "healthy " subjects were recruited and that this study (as well as the larger THUSA-study) was not designed to provide information on the incidence nor the prevalence of disease in this population.

4.1.3 The role of chance

According to Margetts and Nelson (1998) and Fletcher *et al.* (1987) it should be born in mind that even if no real associations between variables exist, on average one in 20 such associations will be statistically significant by chance alone. To decide whether the results obtained could have occurred by chance alone, hypothesis testing, estimations and confidence intervals can be assessed. The effect of chance on associations between variables in a large sample is less than in studies with small numbers. No hypothesis testing was done on the data reported in this study, but confidence intervals were reported.

4.1.4 The effect of confounders

4.1.4.1 Definition of confounders

Confounders are associated with both exposure and outcome and can provide a true explanation for an apparent association (or lack of association) between the exposure of interest and the outcome (Margetts and Nelson, 1998). According to these authors for a variable to be a confounder it must:

- " be associated with, but not causally dependent upon the exposure of interest
- be a risk factor for disease, independent of its association with exposure of interest
- apply within the population under study ".

Possible confounders identified in this population were urbanization, HIV-infection, age and BMI. BMI was included as a risk factor for chronic diseases of lifestyle. It was therefore not used as a confounding variable in this study. However, lifestyle factors associated with BMI like physical activity, energy intake and household income were regarded as confounders.

4.1.4.2 HIV-infection as a possible confounder

Anonymous testing of the 1854 subjects revealed that 216 were HIV positive. In the fasted subjects 29 out of 192 men and 34 out of 231 women were HIV positive. Because only "apparently healthy" subjects were recruited, these positive subjects were asymptomatic and probably at a very early stage of HIV/AIDS. However, in the total sample, serum total and HDL-cholesterol levels as well as serum albumin levels of HIV positive subjects were significant lower, while serum globulin and liver enzymes were significantly increased (Vorster *et al.*, 2000). Although BMI did not differ significantly, it was thought that even in this early stage of the disease small reductions in BMI may influence insulin sensitivity. The lower BMI may have a positive effect on insulin sensitivity.

Another possible mechanism through which HIV-infection could influence insulin sensitivity is that the HI-virus contains a protein (Tat) which initiates

several intra- and extracellular reactions. For example, Tat protein activates protein kinase B (PKB) or the serine/threonine protein kinase (Akt) and forces the guest cell (in this case T cells) into an anti-apoptotic pathway in order to supply survival to the virus. Activation of PKB/Akt is associated with most of the metabolic effects of insulin and especially with insulin stimulated glucose uptake in peripheral tissue (Dudek *et al.*, 1997). It can be hypothesised that the Tat protein is not necessarily T- cell specific and may influence other cell types. If so, activation of PKB/Akt through the Tat protein, may enhance glucose uptake and increase insulin sensitivity.

4.1.4.3 Urbanisation as a possible confounder

The aim of this study was to investigate the existence and development of the metabolic syndrome in the African population in transition from rural to urban environments and lifestyles. The better way to investigate the effect of urbanisation on the development of the metabolic syndrome will probably be to stratify the investigated population for both urbanisation and insulin sensitivity and to report real differences between the stratified levels. Due to the occurring bias as already described, small subject numbers and an unequal distribution of subjects between urbanisation levels in the sub-sample of fasted subjects, stratification for urbanisation was not indicated. Urbanisation level was therefore only regarded as a confounder in this study. However, to give an indication of the differences and/or similarities between the fasted sub-sample used in this study compared to the larger THUSA-study, some descriptive statistics (including means and 95% confidence intervals) for measured variables for chronic diseases of lifestyle per stratum are given in Tables 4.1 a&b to 4.7 a&b for all the subjects in the THUSA-study as well as for those subjects who were totally fasted. Statistical significant differences between the levels of urbanisation (strata) for each variable in the total THUSA study are shown for the total sample.

In Table 4.8 the calculated insulin sensitivity index adjusted for age was shown per level of urbanisation for the fasted subjects. Due to the small numbers per stratum, stratum 4 and 5 were combined.

4.1.4.4 Other possible confounders

Known environmental risk determinants in the development of the metabolic syndrome such as age, physical inactivity and food energy intake were discussed in Chapter 2, and were controlled for where indicated.

4.2 Results: Data stratified by level of urbanisation

Relevant data to describe the metabolic syndrome in the next chapters of this thesis will be presented in Tables 4.1 a&b to 4.8. The results of the total sample of the THUSA-study will be presented in red (THUSA) and those of the selected fasted sub-sample in blue (Fasting), stratified for level of urbanisation.

4.2.1 Personal information

Personal information of the men and women of the THUSA-study as well as the selected fasted sub-sample are shown in Tables 4.1 a&b and 4.2 a&b.

Table 4.1a Age for the men per level of urbanisation

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total
Age (years) THUSA	mean	41.3 [a b c d]	35.8 [b e]	35.9 [c f]	37.0 [d g]	29.4 [a e f g]	37.4
	n	200	117	137	232	86	777
	95% CI	39.1 - 43.4	32.9 - 38.6	33.2 - 38.5	35.1 - 38.9	26.2 - 32.7	36.3 - 38.5
Age (years) Fasting sub-sample	mean	42.6	29.5	32.4	33.2	38.3	34.1
	n	26	19	59	81	8	193
	95% CI	36 3 - 48.9	24.7 - 34.3	29.1 - 35.7	30.2 - 36.1	30 - 46.5	32.2 - 35.0

CI = confidence intervals; Other abbreviations = referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

Table 4.1b Age for the women per level of urbanisation

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total
Age (years) THUSA	mean	39.8 [a f]	37.4 [b e]	36.5 [c f g]	39.0 [d e]	31.7 [a b c d g]	37.0
	n	502	269	318	536	192	1040
	95% CI	38.1 -41.4	35.1 - 39.7	34.3 - 38.7	37.4 -40.7	28.9 - 34.4	36.9 - 38.7
Age (years) Fasting sub-sample	mean	39.2	36.2	33.4	34.7	39.0	35.7
	n	49	38	56	86	4	233
	95% CI	35.7 - 42.7	32.6 - 39.8	29.9 - 37.0	31.8 - 37.7	17.4 - 60.6	34.0 - 37.4

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

The tables indicate that less volunteers in the upper urban stratum than in the other strata

were recruited. Subjects in the upper urban stratum were also younger than the rest of the sample. However, this was not the case for the fasted sub-sample. The subjects included in the larger THUSA-study were also stratified for age per stratum. The rest of the data given here will therefore be adjusted for age.

Tables 4.2a and 4.2b show that the women in both the larger THUSA-study and the fasted sub-sample were heavier but shorter than the men in each stratum. The men had a higher energy and much higher alcohol intakes than the women. The same trend was found in the fasted subjects.

Table 4.2a Personal variables for the men per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
Mass (Kg) THUSA	mean	58.5 [a e]	57.9 [b g]	57.3 [c h]	60.6 [a d g h]	66.1 [b c d e]	58.1
	n	200	117	137	237	86	777
	95% CI	56.8 - 60.1	55.8 - 60	55.4 - 59.3	59.2 - 62.1	63.7 - 68.6	56.7 -59.4
Mass (Kg) Fasting	mean	53.3	56.0	57.7	60.5	69.9	58.3
	n	26	19	59	81	8	193
	95% CI	49.4 - 57.2	52.0 - 60.0	55.3 - 60.1	58.5 - 62.5	63.4 - 75.8	56.9 - 59.6
Stature (cm) THUSA	mean	167.1 [a e]	167.6 [b]	168.2 [c]	168.6 [a d]	170.5 [b c d e]	167.6
	n	200	117	137	237	86	777
	95% CI	166.1 -168.2	166.2 - 169	167 - 169.5	167.6 -169.5	168.9 - 172	167.0 - 168.3
Stature (cm) Fasting	mean	169.3	167.4	169.0	169.3	170.1	168.8
	n	26	19	59	81	8	193
	95% CI	166.1 - 172.6	164.1 - 170.7	167.1 - 171.0	167.6 -170.9	165.0 - 175.2	167.6 - 170.0
Temp (°C) THUSA	mean	36.5	36.3	36.4	36.2	36.4	36.3
	n	200	117	137	237	86	777
	95% CI	36.4 - 36.6	36.2 - 36.4	36.3 - 36.5	36.1 - 36.3	36.3 - 36.5	36.3-36.4
Temp (°C) Fasting	mean	36.4	36.1	36.5	36.1	36.4	36.2
	n	26	19	59	81	8	193
	95% CI	36.1 - 36.7	35.8 - 36.4	36.3 - 36.7	35.9 - 36.2	35.9 - 36.9	36.2 - 36.3
Energy intake (KJ) THUSA	mean	9188.0	8624.7	8597.8	9184.3	9453.8	8971.4
	n	200	117	137	237	86	777
	95% CI	8671.1 - 9704.9	7953.0 - 9296.4	7971.7 - 9223.8	8717.0 - 9651.6	8685.4 - 10222.1	8654.2 - 9288.6
Energy intake (KJ) Fasting	mean	9426.6	8287.2	9127.8	9256.6	9185.5	9214.7
	n	26	19	59	81	8	193
	95% CI	7964.2 - 10888.9	6781.3 - 9793.2	8222.5 - 10033.0	8505.6 - 10007.6	6870.7 - 11500.3	8737.9 - 9691.5
Alcohol (g/day) THUSA	mean	16.5	10.7 [b d]	21.7 [b]	24.0 [d e]	12.7 [e]	21.8
	n	200	117	137	237	86	777
	95% CI	10.6 - 22.4	3 - 18.4	14.6 - 28.9	18.7 - 29.4	3.9 - 21.5	18.6 - 25.0
Alcohol (g\day) Fasting	mean	19.5	11.8	23.4	26.5	8.4	21.0
	n	26	19	59	81	8	193
	95% CI	-4.7 - 43.6	-13.1 - 36.7	8.4 - 38.3	15.1 - 38.9	-29.8 - 46.7	13.0 - 29.0

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

Table 4.2b Personal variables for the women per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
Mass (Kg) THUSA	mean	63.7 [a d e]	65 [b f]	67.5 [a]	70.1 [b d]	69.5 [e f]	66.6
	n	502	269	318	536	192	1040
	95% CI	61.7 -65.7	62.2 - 67.7	64.8 - 70.1	68 - 72.2	66.2 - 72.8	65.4-67.8
Mass (Kg) Fasting	mean	65.2	67.5	63.7	70.8	74.5	67.7
	n	49	38	56	86	4	233
	95% C	60.2 - 70.3	62.0 - 73.0	59.1 - 68.4	66.9 - 74.8	57.6 - 91.4	64.4-68.9
Stature (cm) THUSA	mean	157.4 [a e]	157 [b c]	158.5 [a c d]	156.9 [d f]	159.5 [e f b]	157.4
	n	502	269	318	536	192	1040
	95% CI	156.7 - 158.1	156 - 158	157.6 - 159.4	156.2 - 157.6	158.3 - 160.7	156.8 - 158.1
Stature (cm) Fasting	mean	156.9	157.8	159.4	156.7	156.9	157.5
	n	49	38	56	86	4	233
	95% CI	155.2 - 158.7	155.8 - 159.7	157.8 - 161.1	155.4 - 158.1	150.9 - 162.9	156.7 - 158.4
Temp (°C) THUSA	mean	36.5	36.5	36.4	36.4	36.4	36.5
	n	502	269	318	536	192	1040
	95% CI	36.5 - 36.6	36.4 - 36.6	36.3 - 36.5	36.3 - 36.4	36.3 - 36.5	36.4-36.5
Temp (°C) Fasting	mean	36.3	36.4	36.4	36.2	36.8	36.3
	n	49	38	56	86	4	233
	95% CI	36.2 - 36.5	36.2 - 36.5	36.3 - 36.6	36.1 - 36.4	36.3 - 37.0	36.3-36.4
Energy intake (KJ) THUSA	mean	7864.5	7838.3	7744.3 [a]	7955.6	8507 [a]	7906.8
	n	502	269	318	536	192	1040
	95% CI	7504.1 - 8225	7341 - 8335.7	7270.6 - 8217.9	7587.8 - 8323.4	7917.7 - 9096.3	7621.8 - 8191.8
Energy intake (KJ) Fasting	mean	7882.6	8816.8	8334.8	8270.2	7862.4	8224.0
	n	49	38	56	86	4	233
	95% CI	6969.0 - 8796.3	7820.7 - 9813.0	7487.1 - 9181.6	7560.4 - 8979.9	4790.5 - 10934.3	7825.5 - 8622.5
Alcohol (g/day) THUSA	mean	2.3	4.5 [a]	4.0 [b]	3.0	0.6 [ab]	2.8
	n	502	269	318	536	192	1040
	95% CI	1 - 3.6	2.7 - 6.2	2.3 - 5.6	1.7 - 4.3	-1.5 - 2.7	-0.12 - 5.7
Alcohol (g\day) Fasting	mean	2.3	4.2	4.9	3.1	-0.4	3.4
	n	49	38	56	86	4	233
	95% CI	-1.0 - 5.6	0.6 - 7.8	1.8 - 8.0	0.6 - 5.7	-11.5 - 10.8	1.9 - 4.9

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

4.2.2 Markers of NIDDM per level of urbanisation

Information on the markers of NIDDM for all the subjects from the THUSA-study and the fasted sub-sample are shown in Tables 4.3 a&b. These include the "fasting" (baseline) serum glucose and insulin levels, as well as the 120 min glucose level taken during the glucose tolerance test.

Table 4.3a Serum markers for NIDDM of the men per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
Glucose (mmol/L) THUSA	mean	4.8 [a]	4.8 [b]	5.0 [c]	4.8 [d]	4.2 [abcde]	4.8
	n	200	117	137	237	86	777
	95% CI	4.6 - 4.9	4.5 - 5	4.7 - 5.3	4.7 - 5	3.9 - 4.5	4.6 - 4.9
Glucose (mmol/L) Fasting	mean	4.7	4.7	5.0	4.8	4.8	4.8
	n	26	19	59	81	8	193
	95% CI	4.4 -4.9	4.4 -5.1	4.7 -5.3	4.6 -5	4.1 -5.4	4.7 - 4.9
Insulin (µU/ml) THUSA	mean	21.2 [ae]	17.3 [bg]	29.9 [abc]	22.5 [cd]	30.2 [egd]	19.8
	n	144	57	76	159	53	489
	95% CI	17.7 - 24.7	11.9 - 22.7	23.9 - 35.8	19 - 26.1	23.6 - 36.8	16.9 - 22.7
Insulin (µU/ml) Fasting	mean	13.8	11.3	21.9	18.2	18.7	17.3
	n	24	13	38	54	4	133
	95% CI	8.5 - 19.1	4.5 - 18.1	16.1 - 27.7	14.4 - 22	6 - 31.4	14.6 - 20.0
Glucose T120(mmol/L) THUSA	mean	5.8 [ade]	5.9 [bfg]	4.6 [abh]	5.2 [dfx]	7.0 [eghx]	5.3
	n	200	117	137	237	86	777
	95% CI	5.4 - 6.1	5.3 - 6.4	4 - 5.1	4.8 - 5.5	6.4 - 7.7	5.0 - 5.5
Glucose T120 (mmol/L) Fasting	mean	5.5	5.5	4.8	5.2	5.8	5.1
	n	26	19	59	81	8	193
	95% CI	4.9 - 6.1	4.7 - 6.3	4.1 - 5.4	4.7 - 5.6	4.3 - 7.3	4.9 - 5.4

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

Table 4.3b Serum markers for NIDDM of the women per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
Glucose (mmol/L) THUSA	mean	4.9	4.8	5.4 [a]	4.7 [a]	4.7	4.9
	n	502	269	318	536	192	1040
	95% CI	4.6 - 5.2	4.4 - 5.3	4.9 - 5.8	4.4 - 5	4.1 - 5.4	4.8 - 5.0
Glucose (mmol/L) Fasting	mean	4.6	4.8	4.8	4.8	4.5	4.7
	n	49	38	56	86	4	233
	95% CI	4.3 - 5	4.4 - 5.1	4.5 - 5.2	4.6 - 5	3.1 - 5.9	4.6 - 4.9
Insulin (µU/ml) THUSA	mean	22.6 [ad]	20.1 [bef]	30.6 [ab]	28.9 [de]	28.4 [f]	23.9
	n	212	110	106	191	55	674
	95% CI	19.3 - 25.8	15.6 - 24.7	25.9 - 35.4	25.5 - 32.4	21.8 - 35	21.7 - 26.2
Insulin (µU/ml) Fasting	mean	16.9	17.8	25.6	24	28.5	21.9
	n	37	34	33	70	2	176
	95% CI	9.9 - 23.9	10 - 25.5	17.9 - 33.4	19 - 28.9	-1.6 - 58.7	18.5 - 25.3
Glucose T120 (mmol/L) THUSA	mean	6.1 [ace]	6.8 [ab]	5.4 [bcdf]	6.3 [d]	7.0 [ef]	6.0
	n	502	269	318	536	192	1040
	95% CI	5.8 - 6.4	6.3 - 7.2	4.9 - 5.9	5.9 - 6.6	6.3 - 7.6	5.8 - 6.2
Glucose T120 (mmol/L) Fasting	mean	6.1	6.8	5.1	5.9	6.9	5.9
	n	49	38	56	86	4	233
	95% CI	5.4 - 6.8	6 - 7.5	4.3 - 5.8	5.4 - 6.4	3.9 - 9.8	5.4-6.4

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

Tables 4.3a and b show that except for men in the upper stratum and women in the urban stratum, glucose levels at baseline (T_0) and two hours after the glucose tolerance test (T_{120}) differed very little between the total group and the selected fasted group. As can be expected, the serum insulin levels of the subjects who were really fasted, were consistently lower than those of the non-fasted men and women (Tables 4.3 a and b).

4.2.3 Markers of CHD per level of urbanisation

Information on the markers of CHD for the subjects from the THUSA-study and the fasted sub-sample can be found in Tables 4.4 a and b. Again, no significant differences occurred between the total THUSA-subjects and the fasted sub-sample.

Tables 4.4 a and b show that total serum cholesterol, LDL-C and the LDL-C:HDL-C ratio in both men and women increased with urbanisation. Plasma fibrinogen in women showed the same pattern. In men, the farm workers had high fibrinogen levels. James *et al.* (2000) showed that these high levels in male farm workers were related to under-nutrition, while the higher levels in urban men and women were associated with macronutrient over-nutrition. The same trend was found for the fasted subjects. In both genders the fasted serum TG values were lower than the non fasted THUSA-subjects as expected.

Table 4.4a Markers for CHD of the men per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	**Total** (age & stratum adjusted)
SBP (mmHg) THUSA	mean	123.4 [a d]	124.9 [b f]	131.8 [a b e]	129.2 [d f]	125.1 [e]	126.9
	n	200	117	137	237	86	777
	95% CI	121 - 125.8	121.8 - 128	129 - 134.7	127 - 131.4	120.6 - 129.6	125.4-128.3
SBP (mmHg) Fasting	mean	123.6	122.1	132.9	129.5	122.0	127.8
	n	26	19	59	81	8	193
	95% C	117.9 - 129.4	115.2 - 129	129 - 136.9	126.1 - 132.9	109.7 - 134.3	125.5- 130.1
DBP (mmHg) THUSA	mean	74.6 [c d e]	76.4 [b]	79.8 [bc]	77.7 [d]	80 [e]	76.9
	n	200	117	137	237	86	777
	95% CI	72.9 -76.2	74.2 - 78.5	77.8 - 81.7	76.3 - 79.2	76.9 - 83	75.9 - 77.8
DBP (mmHg) Fasting	mean	75.2	75.4	81.1	77.0	77.2	77.6
	n	26	19	59	81	8	193
	95% CI	71.3 - 79.2	70.6 - 80.2	78.4 - 83.8	74.6 - 79.3	68.7 - 85.7	76.1-79.2
S-TC (mmol/L) THUSA	mean	3.9 [a]	4.0 [b e f]	3.8 [c f]	4.0 [d]	4.7 [a b c d e]	4.0
	n	200	117	137	237	86	777
	95% CI	3.7 - 4	3.9 - 4.2	3.6 - 4	3.9 - 4.1	4.5 - 5	3.9 - 4.1
S-TC (mmol/L) Fasting	mean	3.9	4.1	3.7	3.9	4.4	3.9
	n	26	19	59	81	8	193
	95% CI	3.6 - 4.3	3.6 - 4.5	3.5 - 4	3.7 - 4.1	3.6 - 5.1	3.7 - 4.0
S-HDL-C (mmol/L) THUSA	mean	1.2	1.2	1.2	1.2	1.2	1.2
	n	200	117	137	237	86	777
	95% CI	1.1 - 1.3	1.1 - 1.2	1.1 - 1.3	1.2 - 1.3	1.1 - 1.4	1.2 - 1.2
S-HDL-C (mmol/L) Fasting	mean	1.2	1.2	1.2	1.1	1.2	1.2
	n	26	19	59	81	8	193
	95% CI	1.1 - 1.4	1 - 1.3	1.1 - 1.3	1.1 - 1.2	0.8 - 1.5	1.1 - 1.2
S-LDL-C (mmol/L) THUSA	mean	2.3 [a]	2.4 [b f]	2.2 [f g]	2.4 [d g]	3.0 [a b c d]	2.4
	n	200	117	137	237	86	777
	95% CI	2.2 - 2.4	2.3 - 2.6	2 - 2.3	2.3 - 2.5	2.8 - 3.3	2.3 - 2.5
S-LDL-C (mmol/L) Fasting	mean	2.4	2.5	2.2	2.5	2.8	2.3
	n	26	19	59	81	8	193
	95% CI	2 - 2.7	2.1 - 2.9	1.9 - 2.4	2.2 - 2.7	2.1 - 3.6	2.2 - 2.5
S-TG (mmol/L) THUSA	mean	1.2 [a]	1.2 [b]	1.1 [c]	1.2 [d]	1.5 [a b c d]	1.2
	n	200	117	137	237	86	777
	95% CI	1.1 - 1.3	1.1 - 1.4	1 - 1.3	1.1 - 1.3	1.3 - 1.8	1.2 - 1.3
S-TG (mmol/L) Fasting	mean	0.8	1.1	1.0	1.1	1.4	1.0
	n	26	19	59	81	8	193
	95% CI	0.6 - 1	0.8 - 1.3	0.8 - 1.1	1 - 1.3	0.9 - 1.8	1.0 - 1.1
LDL:HDL THUSA	mean	2.1 [a d]	2.4	2.1 [c]	2.4 [d]	3.1 [a c]	2.3
	n	200	117	137	237	86	777
	95% CI	1.8 - 2.2	2.0 - 2.7	1.8 - 2.3	2.2 - 2.6	2.3 - 3.8	2.2 - 2.5
LDL:HDL Fasting	mean	2.0	2.3	2.0	2.3	3.3	2.2
	n	26	19	58	76	8	193
	95% CI	1.6 - 2.4	1.8 - 2.8	1.7 - 2.2	2.1 - 2.6	2.6 - 4.0	2.0 - 2.3
Blood Hc (%) THUSA	mean	44.9 [b a]	46.1 [a]	44.4	44.5	47.7 [b]	45.1
	n	200	117	137	237	86	777
	95% CI	44.3 - 45.6	45.3 - 47	43.6 - 45.1	44 - 45.1	46.5 - 48.9	44.7 - 45.4
Blood Hc (%) Fasting	mean	46.5	45.2	43.5	45.2	46.8	44.9
	n	26	19	59	81	8	193
	95% CI	44.8 - 48.2	43.1 - 47.2	42.3 - 44.7	44.2 - 46.2	43.2 - 50.4	44.2-45.6
PI-Fib (g/L) THUSA	mean	2.9 [a b c]	3.5 [b d]	3.2 [c]	3.1 [d]	3.3 [a]	3.1
	n	200	117	137	237	86	777
	95% CI	2.7 - 3	3.3 - 3.7	3 - 3.4	2.9 - 3.2	3 - 3.6	3.1 - 3.2
PI-Fib (g\l) Fasting	mean	3.0	3.0	3.2	3.0	3.2	3.1
	n	26	19	59	81	8	193
	95% CI	2.4 - 3.4	2.5 - 3.6	2.9 - 3.5	2.7 - 3.3	2.2 - 4.2	2.9 - 3.2

CI = confidence intervals; Other abbreviations: referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

Table 4.4b Markers for CHD of the women per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
SBP (mmHg) THUSA	mean	124.1 a c d	128.5 a e	130.8 c f	129.4 d g	121.9 e f g	127.4
	n	502	269	318	536	192	1040
	95% CI	121.8 - 126.4	125.4 - 131.7	127.9-133.7	127.1 - 131.6	117.9 - 126	126.2-128.7
SBP (mmHg) Fasting	mean	124.4	124.6	132.3	131.2	134.8	128.1
	n	49	38	56	86	4	233
	95% C	119.3 - 129.6	118.7 - 130.4	127.2- 137.5	127.3 - 135	116.6 - 153	125.7-130.6
DBP (mmHg) THUSA	mean	75.9 a f	77.5 b g	81.4 a b c	80.3 f g d	74.5 c d	78.2
	n	502	269	318	536	192	1040
	95% CI	74.4 - 77.3	75.5 - 79.5	79.5 - 83.2	78.8 - 81.7	71.9 - 77	77.4-78.9
DBP (mmHg) Fasting	mean	75.4	76.6	83.7	81.7	84.6	79.7
	n	49	38	56	86	4	233
	95% CI	72.2 - 78.6	73 - 80.2	80.5 - 86.8	79.3 - 84	73.4 - 95.8	78.2-81.2
S-TC (mmol/L) THUSA	mean	4.0 a e	4.1 b g	4.1 c h	4.4 a b c d	4.8 e g h d	4.3
	n	502	269	318	536	192	1040
	95% CI	3.9 - 4.1	4 - 4.3	4 - 4.3	4.3 - 4.6	4.6 - 5	4.2-4.3
S-TC (mmol/L) Fasting	mean	4.1	4.1	4.1	4.5	4.6	4.2
	n	49	38	56	86	4	233
	95% CI	3.8 - 4.4	3.8 - 4.4	3.8 - 4.3	4.3 - 4.7	3.6 - 5.7	4.1-4.3
S-HDL-C (mmol/L) THUSA	mean	1.2	1.2	1.1 a	1.1 b	1.2 a b	1.2
	n	502	269	318	536	192	1040
	95% CI	1.1 - 1.2	1.1 - 1.2	1.1 - 1.2	1.1 - 1.2	1.2 - 1.3	1.2-1.2
S-HDL-C (mmol/L) Fasting	mean	1.2	1.1	1.2	1.1	1.0	1.1
	n	49	38	56	86	4	233
	95% CI	1.1 - 1.3	1 - 1.2	1.1 - 1.3	1 - 1.2	0.7 - 1.3	1.1-1.2
S-LDL-C (mmol/L) THUSA	mean	2.5 a e	2.6 b g	2.6 c h	2.9 a b c	3.1 e g h	2.7
	n	502	269	318	536	192	1040
	95% CI	2.4 - 2.6	2.4 - 2.7	2.4 - 2.7	2.8 - 3	2.9 - 3.3	2.7-2.8
S-LDL-C (mmol/L) Fasting	mean	2.6	2.6	2.5	3	3.2	2.7
	n	49	38	56	86	4	233
	95% CI	2.3 - 2.9	2.3 - 3	2.2 - 2.8	2.8 - 3.3	2.2 - 4.2	2.6-2.9
S-TG (mmol/L) THUSA	mean	1.1	1.1 a	1.1	1.2 a	1.2	1.2
	n	502	269	318	536	192	1040
	95% CI	1 - 1.2	1 - 1.2	1 - 1.2	1.2 - 1.3	1.1 - 1.4	1.1-1.2
S-TG (mmol/L) Fasting	mean	0.8	1.1	1	1.1	1.4	1.0
	n	49	38	56	86	4	233
	95% CI	0.6 - 1	0.8 - 1.3	0.8 - 1.1	1 - 1.3	0.9 - 1.8	0.9-1.1
LDL:HDL THUSA	mean	2.4 a	2.7	2.3 b	2.9 a b	3.1	2.6
	n	502	269	318	536	192	1040
	95% CI	2.2 - 2.6	2.4 - 2.9	2.1-2.6	2.7 - 3.1	2.1 - 4.1	2.5-2.8
LDL:HDL Fasting	mean	2.4	2.5	2.3	2.9	3.6	2.6
	n	49	38	56	84	4	233
	95% CI	2.0 - 2.8	2.1 - 2.9	2.0 - 2.7	2.7 - 3.3	2.3 - 4.9	2.4-2.8
Blood Hc (%) THUSA	mean	41.2 a	41.5	40.5 b	40.6 c	42.7 a b c	41.1
	n	502	269	318	536	192	1040
	95% CI	40.7 - 41.8	40.8 - 42.3	39.8 - 41.2	40.1 - 41.2	41.7 - 43.7	40.8-41.4
Blood Hc (%) Fasting	mean	42.7	41.6	40.7	40.2	41.2	40.9
	n	49	38	56	86	4	233
	95% CI	41.4 - 44	40.1 - 43.1	39.4 - 41.9	39.2 - 41.2	36.6 - 45.7	40.4-41.5
PI-Fib (g/L) THUSA	mean	3.3 b c d e	3.6 b	3.7 c	3.8 d	3.8 e	3.6
	n	502	269	318	536	192	1040
	95% CI	3.1 - 3.4	3.4 - 3.8	3.6 - 3.9	3.6 - 3.9	3.5 - 4	3.5-3.7
PI-Fib (g\l) Fasting	mean	3.3	3.3	3.8	3.7	3.8	3.6
	n	49	38	56	86	4	233
	95% CI	2.9 - 3.7	2.9 - 3.8	3.4 - 4.2	3.4 - 3.9	2.5 - 5.2	3.4-3.8

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

4.2.4 Markers of obesity per level of urbanisation

Information on the markers of obesity for the subjects from the THUSA-study and the fasted sub-sample can be found in Table 4.5 a&b.

Table 4.5a Markers for obesity of the men per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
BMI (Kg/m^2) THUSA	mean n 95% CI	20.8 [a] 200 20.3 - 21.4	21 [b] 117 20.3 - 21.7	20.4 [cf] 137 19.7 - 21	21.3 [df] 237 20.8 - 21.8	23 [abcd] 86 22.2 - 23.9	20.7 777 20.2-21.2
BMI (Kg/m^2) Fasting	mean n 95% C	19.6 26 18.4 - 20.7	20.2 19 18.9 - 21.4	20.3 59 19.5 - 21	21.1 81 20.5 - 21.7	24 8 22 - 26	20.6 193 20.2-21.0
Triceps (mm) THUSA	mean n 95% CI	7.8 [af] 200 6.9 - 8.7	8.3 [b] 117 6.9 - 9.6	7.5 [cg] 137 6.6 - 8.4	8.8 [acd] 237 8.1 - 9.5	13.3 [bdfg] 86 10.5 - 16	8.2 777 7.6-8.8
Triceps (mm) Fasting	mean n 95% CI	7.6 26 5.8 - 9.4	9.1 19 7 - 11.2	7.4 59 6.2 - 8.6	9.4 81 8.4 - 10.4	14.2 8 10.9 - 17.5	8.7 193 8.0-9.4
Abdomen (mm) THUSA	mean n 95% CI	11.1 [ae] 200 9.5 - 12.8	14.1 [b] 117 11.6 - 16.7	13.3 [cg] 137 11.6 - 15	15.7 [acd] 237 14.4 - 17	24.1 [bdeg] 86 18.8 - 29.4	13.7 777 12.6-14.7
Abdomen (mm) Fasting	mean n 95% CI	9.8 26 6.4 - 13.1	14.8 19 10.9 - 18.6	13.5 59 11.3 - 15.7	16.2 81 14.3 - 18.1	24.3 8 18.2 - 30.4	14.5 193 13.3-15.7
Waist-min (cm) THUSA	mean n 95% CI	74.2 [ae] 200 73 - 75.4	73.2 [b] 117 71.7 - 74.8	72.3 [acg] 137 70.9 - 73.7	75.1 [cd] 237 74 - 76.2	79.8 [begd] 86 78 - 81.7	74.6 777 73.8-75.4
Waist-min (cm) Fasting	mean n 95% CI	69.5 26 67 - 72.1	72 19 69.1 - 75	71.6 59 69.9 - 73.3	74.2 81 72.8 - 75.6	79.4 8 74.8 - 84	72.3 193 71.5-73.2
Hip-max (cm) THUSA	mean n 95% CI	87.7 [a] 200 86.6 - 88.8	88.2 [b] 117 86.7 - 89.6	86.4 [ce] 137 85.1 - 87.7	88.3 [de] 237 87.3 - 89.3	94.9 [abcd] 86 93.2 - 96.6	88.4 777 87.6-89.3
Hip-max (cm) Fasting	mean n 95% CI	84 26 81.7 - 86.4	86.1 19 83.4 - 88.9	85.6 59 84.1 - 87.2	87.6 81 86.3 - 88.9	93.2 8 88.9 - 97.5	86.5 193 85.7-87.4
W/H ratio THUSA	mean n 95% CI	0.84 [a] 200 0.84 - 0.85	0.83 [abc] 117 0.82 - 0.84	0.84 [dc] 137 0.83 - 0.85	0.85 [bd] 237 0.84 - 0.86	0.84 86 0.83 - 0.85	0.84 777 0.84-0.85
W/H ratio Fasting	mean n 95% CI	0.83 26 0.81 - 0.85	0.84 19 0.82 - 0.86	0.84 59 0.82 - 0.85	0.85 81 0.84 - 0.86	0.87 8 0.82 - 0.89	0.84 193 0.83-0.84
Body fat (%) THUSA	mean n 95% CI	20.4 [a] 200 19.3 - 21.4	20.8 117 19.1 - 22.4	20.9 137 19.8 - 22.0	21.7 237 20.9 - 22.6	24.4 [a] 86 21.0	21.1 777 20.3-21.9
Body fat (%) Fasting	mean n 95% CI	17.8 26 16.0 - 20.2	19.6 19 17.9 - 22.7	20.0 59 18.9 - 21.7	20.9 81 20.2 - 22.5	23.4 8 19.8 - 27.5	20.3 193 19.5-21.0

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly ($p <= 0.05$)

Table 4.5b Markers for obesity of the women per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
BMI (Kg/m²) THUSA	mean	25.6 a d e	26.3 b f	26.9 a	28.1 b d	28.1 e f	26.9
	n	502	269	318	536	192	1040
	95% CI	24.9 - 26.4	25.3 - 27.4	25.9 - 27.9	27.4 - 28.9	26.8 - 29.3	26.4-27.3
BMI (Kg/m²) Fasting	mean	26.4	27.4	25.2	27.8	30.6	26.9
	n	49	38	56	86	4	233
	95% C	24.6 - 28.2	25.3 - 29.5	23.4 - 26.9	26.5 - 29.2	24.1 - 37.1	26.0-27.7
Triceps (mm) THUSA	mean	17.1 a b c	21.1 a	18.4 b d	21.2 c d	17.7	19.6
	n	236	125	139	216	102	818
	95% CI	15.5 - 18.7	19.2 - 23	16.6 - 20.2	19.7 - 22.7	6.5 - 28.8	18.9-20.2
Triceps (mm) Fasting	mean	19.1	22.1	17.7	21.3	17.3	19.9
	n	30	28	44	56	1	159
	95% CI	16.3 - 22	19.1 - 25.1	15.3 - 20.1	19.3 - 23.4	1.4 - 33.3	18.6-21.2
Abdomen (mm) THUSA	mean	18.5 a b c	27.7 a d	22.7 b d e	26.7 c e	15.8	24.0
	n	96	66	77	105	2	346
	95% CI	16.1 - 21	24.7 - 30.6	20 - 25.5	24.3 - 29	-1.3 - 32.9	22.9-25.1
Abdomen (mm) Fasting	mean	21.7	27.3	22.4	27.6	19.3	24.8
	n	30	28	44	56	1	159
	95% CI	17.2 - 26.1	22.6 - 31.9	18.6 - 26.1	24.4 - 30.7	-5.5 - 44.1	22.8-26.8
Waist-min (cm) THUSA	mean	76.4 a b	77.3 c f	77.4 d e	80.2 a c d	79.6 b e f	78.2
	n	502	269	318	536	192	1040
	95% CI	74.97 - 77.8	75.3 - 79.2	75.6 - 79.3	78.8 - 81.6	77.2 - 81.96	77.5-78.8
Waist-min (cm) Fasting	mean	77.1	79	76	79	85.2	78.0
	n	49	38	56	86	4	233
	95% CI	73.6 - 80.5	75.2 - 82.9	72.7 - 79.4	76.4 - 81.6	72.8 - 97.6	76.4-79.6
Hip-max (cm) THUSA	mean	99.7 a b	100.2 c d	101.9 e f	104.6 b c e	106.5 a d f	102.3
	n	502	269	318	536	192	1040
	95% CI	98.2 - 101.3	98.0 - 102.4	99.9 - 103.9	103 - 106.2	103.9 - 109.2	101.6-103.1
Hip-max (cm) Fasting	mean	102.3	102.1	98.6	102.8	109.2	101.7
	n	49	38	56	86	4	233
	95% CI	89.7 - 105.9	97.9 - 106.2	95.1 - 102.1	100.1 - 105.5	96.3 - 122.1	100.0-103.4
W/H ratio THUSA	mean	0.77 a	0.77 b	0.76	0.77 d e	0.75 a b c	0.76
	n	502	269	318	536	192	1040
	95% CI	0.76 - 0.77	0.76 - 0.78	0.75 - 0.77	0.76 - 0.77	0.73 - 0.76	0.76-0.77
W/H ratio Fasting	mean	0.75	0.77	0.77	0.77	0.78	0.77
	n	49	38	56	86	4	233
	95% CI	0.73 - 0.77	0.75 - 0.79	0.75 - 0.79	0.75 - 0.78	0.71 - 0.84	0.76-0.77
Body fat (%) THUSA	mean	45.9 a b	48.6 a	46.7 c	50.7 c d	52.2	48.3
	n	502	269	318	536	192	1040
	95% CI	44.3 - 47.5	46.4 - 50.7	44.7 - 48.8	49.2 - 52.3	44 - 60.4	47.6-49.0
Body fat (%) Fasting	mean	48.9	48.3	46.1	50.2	53.8	48.7
	n	49	38	56	86	4	233
	95% CI	46.3 - 51.9	45.7 - 52.3	43.4 - 48.9	48 - 52.3	44 - 64.2	47.4-50.1

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

In both genders all the markers for obesity followed an increasing trend with urbanisation. This trend was also found for the fasted group.

4.2.5 Serum excretion products per level of urbanisation

Information on the serum excretion products for the subjects from the THUSA-study as well as the fasted sub-sample can be found in Table 4.6 a&b.

Table 4.6a Serum excretion products of the men per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
S-Urea (mmol/L) THUSA	mean	3.5 [ae]	3.9 [ab]	3.6 [c]	3.7 [d]	4.7 [ebcd]	3.7
	n	200	117	137	237	86	777
	95% CI	3.4 - 3.7	3.6 - 4.1	3.3 - 3.8	3.5 - 3.8	4.4 - 5	3.6-3.8
S-Urea (mmol/L) Fasting	mean	3.3	4.3	3.6	3.6	4.2	3.6
	n	26	19	59	81	8	193
	95% C	2.9 - 3.8	3.7 - 4.8	3.3 - 3.9	3.3 - 3.8	3.2 - 5.1	3.4-3.8
S-Uric acid (mmol/L) THUSA	mean	0.32 [ab]	0.32 [ef]	0.32 [c]	0.36 [ade]	0.39 [bcdf]	0.34
	n	200	117	137	237	86	777
	95% CI	0.3 - 0.34	0.29 - 0.35	0.3 - 0.35	0.34 - 0.38	0.35 - 0.42	0.33-0.35
S-Uric acid (mmol/L) Fasting	mean	0.3	0.3	0.3	0.4	0.4	0.34
	n	26	19	59	81	8	193
	95% CI	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4	0.3 - 0.4	0.2 - 0.6	0.31-0.36
S-Creat (μmol/L) THUSA	mean	86 [ae]	88.3 [b]	89.1 [c]	90.5 [ad]	97.8 [bcde]	89.1
	n	200	117	137	237	86	777
	95% CI	83.9 - 88.1	85.6 - 91	86.5 - 91.7	88.6 - 92.4	94 - 101.7	88.1-90.1
S-Creat (μmol/L) Fasting	mean	88.6	90.5	90.3	93.7	104	91.9
	n	26	19	59	81	8	193
	95% CI	83.7 - 93.5	84.8 - 96.3	86.7 - 93.8	90.9 - 96.5	94.3 - 113.7	90.1-93.8
S-T-Bili (μmol/L) THUSA	mean	6.8 [a]	6.3 [b]	5.9 [c]	6.6 [d]	11.4 [abcd]	5.4
	n	200	117	137	237	86	777
	95% CI	6 - 7.7	5.2 - 7.4	4.8 - 6.9	5.8 - 7.3	9.8 - 12.9	5.1-5.7
S-T-Bili (μmol/L) Fasting	mean	6.5	4.4	4	4.9	5.5	4.9
	n	26	19	59	81	8	193
	95% CI	5.4 - 7.6	3.1 - 5.7	3.3 - 4.8	4.2 - 5.5	3.3 - 7.6	4.5-5.3

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

In these men the serum urea, uric acid and creatinine levels followed an increasing trend towards the upper urban group. However, the serum urea of the those men living on farms were higher than those in squatter areas and the urban group. The fasted men showed the same pattern.

The serum uric acid of the rural women were higher than those living on farms and in squatter camps. Despite this, the same increasing trend for these serum excretion products towards the upper urban group were found as in the men. However, in the fasted women, serum urea and uric acid did not follow this trend.

Tale 4.6b Serum excretion products of the women per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
S-Urea (mmol/L) THUSA	mean	3.3 [de]	3.4 [b]	3.4 [cf]	3.7 [af]	4.0 [abc]	3.5
	n	502	269	318	536	192	1040
	95% CI	3.2 - 3.4	3.2 - 3.6	3.2 - 3.6	3.5 - 3.8	3.8 - 4.3	3.4-3.6
S-Urea (mmol/L) Fasting	mean	3.1	3.6	3.4	3.4	3.1	3.3
	n	49	38	56	86	4	233
	95% C	2.8 - 3.4	3.3 - 4	3 - 3.7	3.1 - 3.6	2 - 4.2	3.2-3.5
S-Uric acid (mmol/L) THUSA	mean	0.27 [a]	0.25 [bd]	0.26 [cd]	0.29 [de]	0.3 [abc]	0.27
	n	502	269	318	536	192	1040
	95% CI	0.26 - 0.28	0.23 - 0.27	0.25 - 0.28	0.27 - 0.3	0.28 - 0.32	0.26-0.28
S-Uric acid (mmol/L) Fasting	mean	0.24	0.25	0.24	0.27	0.22	0.25
	n	49	38	56	86	4	233
	95% CI	0.21 - 0.25	0.23 - 0.27	0.22 - 0.26	0.26 - 0.29	0.16 - 0.29	0.22-0.27
S-Creat (µmol/L) THUSA	mean	75.8 [ab]	78.1	77.5	80.6 [ac]	79.9 [b]	78.2
	n	502	269	318	536	192	1040
	95% CI	74.2 - 77.3	75.9 - 80.4	75.4 - 79.6	79 - 82.2	77.2 - 82.6	77.3-79.1
S-Creat (µmol/L) Fasting	mean	77.5	81.6	79.8	82.7	88.8	80.3
	n	49	38	56	86	4	233
	95% CI	74.1 - 80.8	77.8 - 85.5	76.4 - 83.3	80.2 - 85.3	76.8 - 100.8	78.6-81.9
S-T-Bili (µmol/L) THUSA	mean	5.6 [ab]	4.1 [bcde]	5.8 [cfg]	5.1 [dfh]	6.8 [adgh]	5.4
	n	502	269	318	536	192	1040
	95% CI	5.2 - 6	3.6 - 4.7	5.3 - 6.3	4.7 - 5.5	6.1 - 7.4	5.1-5.7
S-T-Bili (µmol/L) Fasting	mean	5.4	3.6	4.9	4	6.1	4.6
	n	49	38	56	86	4	233
	95% CI	4.7 - 6.2	2.8 - 4.5	4.2 - 5.7	3.5 - 4.6	3.5 - 8.7	4.2-4.9

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

4.2.6 Serum iron status per level of urbanisation

Information on the serum iron status of the subjects from the THUSA-study and the selected fasting sub-sample can be found in Table 4.7a&b.

The serum iron status of the men increased with urbanisation but no trend was seen in the women. The same patterns were found in the fasted group.

The serum ferritin levels of both genders from the fasted sub-sample were much lower than those of the THUSA-subjects, especially in the rural and urban strata. This might be due to the role of chance. The confidence intervals in the selected sub-sample were large. Therefore, results on the serum ferritin levels of the fasted subjects should be interpreted with care.

Table 4.7a Iron status of the men per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
S-Fe (µmol/L) THUSA	mean n 95% CI	16.8 a c d e 200 15.6 - 18.1	17.9 b 117 16.3 - 19.6	19.8 c 137 18.3 - 21.4	19.9 d 237 18.8 - 21.1	21.1 a b e 86 18.8 - 23.4	18.7 777 17.9 - 19.5
S-Fe (µmol/L) Fasting	mean n 95% CI	16 26 12.9 - 19.2	15.8 19 12.1 - 19.5	17.6 59 15.3 - 19.8	19.9 81 18.1 - 21.7	20.5 8 14.3 - 26.7	18.3 193 17.1 - 19.6
S-TIBC (µmol/L) THUSA	mean n 95% CI	63.9 a 200 62.2 - 65.6	64.1 b 117 61.9 - 66.4	63.8 c 137 61.6 - 65.9	64.8 237 63.2 - 66.3	68.1 a b c 86 64.9 - 71.3	63.2 777 62.0 - 64.5
S-TIBC (µmol/L) Fasting	mean n 95% CI	62.7 26 58.3 - 67	59.5 19 54.4 - 64.7	61.6 59 58.4 - 64.7	65.1 81 62.5 - 67.6	65.5 8 56.9 - 74.1	63.8 193 62.1 - 65.5
S-Fe saturat.% THUSA	mean n 95% CI	27.3 c d 200 25.2 - 29.3	28.8 117 26.1 - 31.5	32.1 c 137 29.5 - 34.7	31.3 d 237 29.4 - 33.2	31.3 86 27.4 - 35.1	30.3 777 29.0 - 32.7
S-Fe saturat.% Fasting	mean n 95% CI	26.4 26 21.3 - 31.5	27.3 19 21.3 - 33.4	29.2 59 25.5 - 32.9	31 81 28 - 34	31.3 8 21.1 - 41.4	29.0 193 27.3 - 31.1
S-Ferritin (µg/L) THUSA	mean n 95% CI	175.4 200 130 - 220.7	221.4 117 162.3-280.6	207.9 137 151.1 -264.7	234.9 237 193.3 -276.5	256.4 86 172.4 - 340.4	190.6 777 167.0-214.3
S-Ferritin (µg/L) Fasting	mean n 95% CI	71.8 26 -40.6-184.1	183.0 19 54.6- 311.4	146.4 59 73.8-219.0	226.5 81 164.6-288.4	76.8 8 -102.1 - 273.9	170.7 193 130.5-210.8

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

Table 4.7b Iron status of the women per level of urbanisation (age adjusted)

Variable	Stats	Rural	Farm dwellers	Squatters	Urban	Upper urban	Total (age & stratum adjusted)
S-Fe (µmol/L) THUSA	mean n 95% CI	14.8 502 13.9 - 15.7	16.3 b 269 15 - 17.6	16 c 318 14.8 - 17.2	14.4 b c 536 13.5 - 15.4	16.2 192 14.6 - 17.7	14.7 1040 14.0 - 15.5
S-Fe (µmol/L) Fasting	mean n 95% C	13.8 49 11.7 - 16	18.1 38 15.6 - 20.5	16.3 56 14.1 - 18.5	13.6 86 11.9 - 15.2	16.7 4 9.1 - 24.4	15.1 233 14.1 - 16.1
S-TIBC (µmol/L) THUSA	mean n 95% CI	68.2 a 502 66.6 - 69.8	69.8 b 269 67.5 - 72.1	67.7 c 318 65.6 - 69.8	70 d 536 68.4 - 71.6	74.6 a b c d 192 71.8 - 77.4	67.5 1040 66.3 - 68.6
S-TIBC (µmol/L) Fasting	mean n 95% CI	63.9 49 59.9 - 67.9	68.2 38 63.6 - 72.8	65.2 56 61 - 69.3	69.4 86 66.3 - 72.5	69.8 4 55.5 - 84.2	67.3 233 65.4 - 69.2
S-Fe saturat.% THUSA	mean n 95% CI	22.5 502 21 - 23.9	24.5 b 269 22.5 - 26.6	24.2 c 318 22.3 - 26.1	21.3 b c 536 19.8 - 22.7	22.9 192 20.4 - 25.4	22.6 1040 21.4 - 23.8
S-Fe saturat.% Fasting	mean n 95% CI	22.7 49 19.2 - 26.2	29.1 38 25 - 33.1	24.9 56 21.3 - 28.5	20.4 86 17.7 - 23.1	24.7 4 12.1 - 37.3	23.4 233 21.7 - 25.1
S-Ferritin (µg/L) THUSA	mean n 95% CI	95.6 502 76.9 -114.4	90.3 269 63.5 - 117.1	87 318 61.9 - 112.	77.1 536 58 - 96.2	88.9 192 56.4 - 121.5	73.1 1040 51.9-94.4
S-Ferritin (µg/L) Fasting	mean n 95% CI	36.9 49 22.3 - 51.5	65.4 38 48.6 - 82.1	58 56 43 - 73.1	56.2 86 45.1 - 67.4	28.8 4 -23.5 - 81.1	50.5 233 43.9-57.0

CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

4.3 The influence of urbanisation on the insulin sensitivity index

As explained earlier in this chapter, insulin sensitivity could not be calculated for all subjects in the THUSA-study due to the non-fasting state and incomplete data on some subjects. Insulin sensitivity was calculated for 133 men and 176 women. The role of urbanisation on insulin sensitivity is illustrated in Table 4.8 by comparing the mean insulin sensitivity index per stratum for men and women respectively. Due to the small numbers of subjects in the upper urban stratum (men=6 and women=3) the urban and upper urban strata were combined and called "urban stratum".

Table 4.8 Insulin sensitivity index per urbanisation level (age adjusted)

Gender	Urbanisation	Mean(age adjusted)	N	Mean(BMI adjusted)
Men	Rural	177.4 **a** (151.3 - 203.6)	24	176.2 **a c** (148.7-203.7)
	Farm dwellers	198.3 **b** (165.0 - 231.5)	13	197.3 **b d** (163.4-231.3)
	Squatters	138 (118.5 - 157.4)	38	137.9 **c d** (118.4-157.6)
	Urban	141.5 **ab** (125.8 - 157.2)	58	141.9 **a b** (125.8-158.0)
Women	Rural	153.6 **a** (133.7 - 173.6)	37	151.8 **a c** (132.5-170.9)
	Farm dwellers	150.6 **b** (129.9 - 171.2)	34	150.3 **b d** (130.4-170.1)
	Squatters	120.5 (99.5 - 141.5)	33	117.3 **c d** (96.7-137.9)
	Urban	113.2 **ab** (98.9 - 127.5)	72	115.3 **a b** (101.3-129.3)

Insulin sensitivity index = 10000 ÷ (fasting glucose X fasting insulin)
CI = confidence intervals; Other abbreviations : referred to "List of abbreviations"
a b c d e = means with the same symbol differ significantly (p<= 0.05)

The lowest mean insulin sensitivity (highest insulin resistance) levels were found in squatter men and urban women. The highest insulin sensitivity levels were found in men living on farms and rural women. From this table it seems that in women insulin

sensitivity decreased (insulin resistance increased) with urbanisation. In the men, no specific pattern was observed. However, in both men and women the subjects in the two most rural groups (rural and farm dwellers) had a significant higher insulin sensitivity index comparing to those in the more urbanised groups (squatters and urban).

4.4 Discussion and conclusions

From the results given in this chapter, it is clear that mostly the same patterns were found in the selected fasted subjects than in those subjects of the larger THUSA study regarding urbanisation. It is therefore possible to conclude that the effect of urbanisation on the fasted subjects can be summarised as follows:

- A conclusion on the influence of urbanisation on the risk markers for NIDDM in both genders is difficult due to the non-fasted state of the larger sample and the small numbers of the fasted sample per level of urbanisation. From Table 4.8 it is, however, possible to conclude that insulin sensitivity decreased (insulin resistance increased) with urbanisation in both gender, because in both men and women the subjects in the two most rural groups (rural and farm dwellers) had a significant higher insulin sensitivity index comparing to those in the more urbanised groups (squatters and urban).
- Deterioration of the lipid profile in both genders occurred with urbanisation.
- BMI and percentage body fat calculated from girths in both genders increased with urbanisation.
- Despite the fact that the BMI of the men was lower than that of the women, they consumed larger amounts of alcohol and their reported food energy intake (excluding alcohol) was also larger. The reported food energy intake of both genders did not differ between the different strata.
- The men living on farms had the lowest alcohol consumption followed by the upper urban group, while the women living on farms had the largest alcohol intake. The lowest intake was reported by the upper urban group.
- No definite trend in the serum excretion products of the women regarding

urbanisation could be demonstrated. In the men an increasing trend with urbanisation was observed.

- The serum iron status of both genders increased with urbanisation. The serum ferritin levels of both genders in the fasted sub-sample were much lower than in the rest of the THUSA-subjects. The large confidence intervals indicate that results of serum ferritin levels of the fasted sub-sample should be interpreted with care.
- From the results in Table 4.1 a&b it seems that age should be used as a confounder in this study.

The results reported here confirm observations in other populations in transition. When Australian Aborigines make the transition from their traditional lifestyle to a westernised lifestyle, they develop many risk factors for the metabolic syndrome (O'Dea, 1991). For most Aborigines, western lifestyle was characterised by reduced physical activity and an energy dense diet that promoted obesity and maximised insulin resistance (O'Dea, 1991). According to Yach (1988), the rapid urbanisation and acculturation, which is taking place in the black populations in many parts of Africa, increase their risk to develop several diseases. Results on urban Africans in Cape Town indicated that the prevalence of NIDDM is associated with urbanisation (Levitt *et al.*, 1993). Mollentze *et al.* (1995) concluded that the risk for developing atherosclerotic diseases increased with urbanisation.

Results from the THUSA project indicated that the impact of urbanisation on the mental health, nutritional status and socioeconomic status of people improved with urbanisation. However, it was the urban men who had the highest mean serum TC and the highest rate of undiagnosed DM (Vorster *et al.*, 2000). This finding could probably be partly explained by the finding by MacIntyre (1998) that during urbanisation, an increasing proportion of the THUSA-subjects consumed diets associated with several chronic diseases. The main dietary change with urbanisation was a gradual decrease in carbohydrate and increase in fat intake (MacIntyre, 1998). The ongoing increase in prevalence of chronic diseases of lifestyle in populations in transition, do not only relate to dietary intakes, but also to a whole range of changes in lifestyle, behaviours and habits (Popkin, 1994; Walker, 1995).