First National Health and Nutrition Examination Survey
(NHANES I), 1971-75

NHANES I ELECTROCARDIOGRAPHY DATA FILE DOCUMENTATION

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ELECTROCARDIOGRAM EXAMINATION NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEYS (NHANES) I, II, & III

These data files are dedicated to the memory of Daniel D. Savage, M.D., Ph.D.

Daniel D. Savage (1944-1990) was born in Memphis, Tennessee. He attended the University of Wisconsin in Madison, and between 1965 and 1972 he received four degrees from that institution, including a Bachelor of Science degree in Chemistry, a Master of Science degree in Physiology, a Ph.D. in Physiology and an M.D. degree. During a life that was too short, Dr. Savage made major contributions to the field of cardiovascular medicine as an epidemiologist, researcher, and author. Perhaps his most important scientific contributions were the establishment and conduct of the Minority Framingham Study, and the establishment of left ventricular hypertrophy as an independent risk factor for sudden cardiac death. Dr. Savage has been described by his colleagues as a man of ideas, an innovator, scholar, and scientist who fervently served his community. His challenge to students was to "set your standards high, sacrifice to achieve your goals, and don't stop until you've done your best."

The data presented in this file consist of information about standard 12-lead resting electrocardiogram(ECG) recorded on men and women in the mobile examination center (MEC)during NHANES I. NHANES is a series of cross-sectional, national noninstitutionalized representative surveys conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. Table 1 represents the following information: years the surveys were conducted; the eligibility age of the examinee receiving the ECG exam; and equipment used.

Table 1. General information

Survey	Survey years	Age	Equipment used
I	1971-1975	25-74	Beckman Digicorder*
II	1976-1981	25-74	Marquette**
III	1988-1994	40 and over	Marquette** MAC 12

*Beckman Instruments, Inc. Fullerton California
**Marquette Medical Systems, Inc. Milwaukee, Wisconsin,

NHANES I ECG data quality and data processing procedures were substantially different from those used for NHANES II and NHANES III. NHANES I ECGs, recorded with Beckman Digicorders, were available as single channel data, 2.5 seconds per lead and sampled at 500 samples per second. In 1970-1975 when the survey was conducted, ECG acquisition technology was still in an early phase of development, and ECG data quality was in general poor. This made automated ECG processing difficult. The initial attempts to process NHANES I ECGs with an automated ECG program (ECAN-E, U.S. Public Health Service) from these single channel data did not produce stable ECG wave measurements, and a semiautomated procedure was later developed in an attempt to remedy the problem. This process involved the display of each ECG lead on a large screen of a Tektronix terminal, and an operator used cursors to identify the onsets and offsets of P, QRS and T waves of the complex selected for analysis. These ECG segments were then processed by the Dalhousie Novacode ECG program (Rautaharju et al, 1990).

The single channel ECG data of relatively poor quality imposes certain limitations on the validity of NHANES I ECG reports, particularly concerning ECG codes which rely on P wave detection and measurements. Arrhythmias were not coded. However, ECGs with no P waves identified by the program were checked visually for the presence of a trial fibrillation.

The QRS amplitude measurements in NHANES I were obtained with a reasonable degree of confidence although at times the gain control and calibration could not be ascertained with adequate reliability. ST-T measurements were more

difficult because of drift problems, and although the program had algorithms with higher order terms for non-linear drift correction, these were difficult to apply because of the short record length (2.5 records).

NHANES II 12-lead ECG data were recorded in 4 lead groups sequenced 3 leads at a time for 5 seconds (I, II, III, aVR, aVL, aVF, V1, V2, V3 and V4, V5, V6), and NHANES III ECGs with 8 independent components of the 12 standard leads simultaneously. For both surveys, the ECG data were sampled at 250 samples per second per channel. The availability of multiple simultaneous ECG leads for analysis greatly improved the precision and accuracy of ECG amplitude and interval measurements compared to the single channel procedure applied on NHANES I ECG data.

The key features of the Novacode ECG program are described elsewhere (Rautaharju et al, 1990). The program was designed to handle both the resting and exercise ECGs and it relies on the use of selective averaging to derive a representative P-QRS-T complex for analysis of wave durations and amplitudes.

The data are presented as three separate files, one for each survey. However, we named all the variables the same. The variable ECPSNUM is the variable showing the survey number. Eight fill values "Blank but applicable," were used to represent certain conditions or responses in which a respondent was eligible to receive the ECG but did not because of refusal, lack of time, lack of staff, loss of data, language barrier, unreliability, or the computer program not able to code the data.

Because we administered this test in the examination center, MEC examination weights (WTPFEX) must be used for data analysis. Besides the MEC weights, each file contains the following additional variables: respondent identification number (SEQN); race-ethnicity (DMARETHN); sex (HSSEX); age at interview (HSAGEIR); pseudo-PSU (SDPPSU); and pseudo-stratum (SDPSTRA). Tables 2a, 2b, and 3 list additional information available from NHANES I and II. These data sets are available on tape and can be ordered from the National Technical Information Service (NTIS), Computer Products Office, 5285 Port Royal Road, Springfield, Virginia 22161 (703) 487-4807.

Table 2a. NHANES I PUBLIC USE DATA SETS

TAPE NAME/NUMBER	ORDER NUMBER
Anthropometry, goniometry, skeletal age, bone density, and cortical thickness, ages 1-74 years (4111)	PB-295908
Arthritis, ages 25-74 years (4121)	PB-296018
Audiometric test (air, bone, speech reception), ages 25-74 years (4241)	PB-297337
Biochemistry, serology, hematology, peripheral blood	PB-297344

slide, and urinary findings, ages 25-74 years (4800)	
Dental, ages 1-74 years (4235)	PB-296023
Dermatology, ages 1-74 years (4151)	PB80-130255
Dietary frequency and adequacy, ages 1-74 years (4701)	PB-295906
General well-being and the CES-D depression scale developed by the National Institute of Mental Health, ages 25-74 years (4171)	PB-296020

Table 2b. NHANES I PUBLIC USE DATA SETS

TAPE NAME/NUMBER	ORDER NUMBER
Health care needs, general medical history, sample person supplement, and respiratory and cardiovascular supplements, ages 25-74 years (4091)	PB-296029
Medical examination, ages 1-74 years (4233)	PB-296035
Medical history questionnaire, ages 12-74 years (4081)	PB-296073
Model gram and nutrient composition (4702-4703)	PB-296027
Near and distant vision, ages 25-74 years (4163)	PB-295910
Ophthalmology, ages 1-74 years (4161)	PB-296033
Pulmonary diffusion, TB, chest x ray planimetry, heart	PB87-126009

size, and lung and heart pathology, ages 25-74 years (4251)	
Spirometry-best trials only, ages 25-74 years (4250)	PB80-145931
24-hour recall consumption intake, ages 1-74 years (4704)	PB-297339

Table 3. NHANES II PUBLIC USE DATA SETS

TAPE NAME/NUMBER	ORDER NUMBER
Anthropometric data, ages 6 months 74 years (5301)	PB82-191917
Behavior questionnaire, ages 25-74 years (5317)	PB90-501578
Chest x ray examination ages 25-74 years (5252)	PB89-136667
Health History supplement, ages 12-74 years (5305)	PB83-256537
Hematology and biochemistry, ages 6 months-74 years (5411) Version 2	PB90-500943
Medical History, ages 12 -74 years (5020)	PB83-154815
Model gram and nutrient composition (5702-5703)	PB82-142613
Physician's examination, ages 6 months-74 years (5302)	PB86-242930
Total nutrient intake, food frequency, and other related dietary data, ages 6 months-74 years (5701)	PB82-168261

Allergy Skin Testing, Ages 6-74, (5309)	PB86-121613
24-hour recall specific food item, ages 6 months-74 years (5704)	PB82-142639

Two aspects of NHANES surveys should be taken into account when conducting any analyses: the sample weights and the complex survey design. Therefore it is very important that the analyst refers to Landis et al. (1982) and NHANES III Analytic and Reporting Guidelines (U.S. DHHS, 1996b) before attempting to analyze the data.

A detailed description of the ECG procedure can be found in the plan and operation of the respective survey, NHANES I (U.S. DHEW, 1973), NHANES II (U.S. DHHS, 1980), and NHANES III (U.S. DHHS, 1996).

A bibliography of NHANES journal articles citing data from 1980 through 1996 and additional NHANES data can be obtained from the Data Dissemination Branch, NCHS at:

Data Dissemination Branch
National Center for Health Statistics
Room 1018
6525 Belcrest Road
Hyattsville, Maryland 20782

Phone: (301)436-8500

URL:http://www.cdc.gov/nchswww

NHANES I Electrocardiography Data File Index

Description	Variable Name	Positions
DEMOGRAPHIC DATA		
Sample person identification number	SEQN	1-5
NHANES I Survey (1971-75)	ECPSNUM	6
Sex	HSSEX	7
Race	DMARACER	8
Age at interview (Screener) in years	HSAGEIR	9-10
Pseudo-PSU	SDPPSU	11-13
Pseudo-stratum	SDPSTRA	14-15
Revised Pseudo-PSU	SDPPSUR	16
MEC-examined sample final weight	WTPFEX	17-22
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Chest half-width (mm) (not reported)	ECPWIDTH	26
Chest half-depth (mm) (not reported)	ECPDEPTH	27
Major ECG abnormalities	ECPG1	28
Minor ECG abnormalities	ECPG2	29
Probable myocardial infarction (MI)	ECPG3	30
Possible MI	ECPG4	31
Probable left ventricular hypertrophy	ECPG5	32
Possible LVH by MC	ECPG6	33
MINNESOTA CODES		
MC 1 Leadgroup L(I, aVL, V6)	ECPL1	34-35
MC 1 Leadgroup F(II, III, aVF)	ECPF1	36-37
MC 1 Leadgroup V(V1-V5)	ECPV1	38-39
MC 4 Leadgroup L	ECPL4	40-41
MC 4 Leadgroup F	ECPF4	42-43
MC 4 Leadgroup V	ECPV4	44-45
MC 5 Leadgroup L	ECPL5	46
MC 5 Leadgroup F	ECPF5	47
MC 5 Leadgroup V	ECPV5	48
MC 9.2 Leadgroup L	ECPL9	49
MC 9.2 Leadgroup F	ECPF9	50

NHANES I Electrocardiography Data File Index

Description	Variable Name	Positions
MC 9.2 Leadgroup V	ECPV9	51
MC 2 (QRS axis code)	ECPMC2	52-53
MC 3 (High-amplitude R waves)	ECPMC3	54-55
MC 6 (A-V conduction)	ECPMC6	56-57
MC 7 (Ventricular conduction)	ECPMC7	58
MC 9.1 (Low-amplitude QRS)	ECPMC91	59
MC 9.3 (High-amplitude P)	ECPMC93	60
MC 9.4 (QRS transition zone)	ECPMC94	61
MC 9.5 (High-amplitude T)	ECPMC95	62
CARDIAC/INFARCTION INJURY SCORE		
Cardiac infarction score (12-lead by 10)	ECPCIIS	63-65
Probable infarction/injury	ECPCIIS2	66
Possible infarction/injury	ECPCIIS3	67
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ECG estimate of LV mass	ECPLVM	69-71
ECG estimate of LV mass index	ECPLVMI	72-74
Probable LVH	ECPLVM3	75
HEART RATE, BASIC ECG INTERVALS, AND MEAN AXIS DATA		
Heart rate (beats per minute)	ECPRATE	76-78
PR interval (msec)	ECPPR	79-81

QRS interval (msec)	ECPQRS	82-84
QT interval (msec)	ECPQT	85-87
P axis, frontal plane (degrees)	ECPAXIS1	88-91
QRS axis, frontal plane (degrees)	ECPAXIS2	92-95
T axis, frontal plane (degrees)	ECPAXIS3	96-99
Rhythm code	ECPBEAT	100-101

ECG WAVE MEASUREMENTS

P amplitude, positive phase, lead II(uV)	ECPP1	102-104

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Description	Variable Name	Positions
P duration, lead II (msec)	ECPP2	105-107
P amplitude, positive phase, lead V1(uV)	ECPP3	108-110
P amplitude, negative phase, lead V1(uV)	ECPP4	111-114
Q or QS amplitude, lead I (uV)	ECPQA1	115-118
Q or QS amplitude, lead II (uV)	ECPQA2	119-122
Q or QS amplitude, lead III (uV)	ECPQA3	123-126
Q or QS amplitude, lead aVL (uV)	ECPQA4	127-130
Q or QS amplitude, lead AVF (uV)	ECPQA5	131-134
Q or QS amplitude, lead V1 (uV)	ECPQA6	135-138
Q or QS amplitude, lead V2 (uV)	ECPQA7	139-142
Q or QS amplitude, lead V3 (uV)	ECPQA8	143-146
Q or QS amplitude, lead V4 (uV)	ECPQA9	147-150
Q or QS amplitude, lead V5 (uV)	ECPQA10	151-154
Q or QS amplitude, lead V6 (uV)	ECPQA11	155-158
Q or QS duration, lead I (msec)	ECPQD1	159-161
Q or QS duration, lead II (msec)	ECPQD2	162-164
Q or QS duration, lead III (msec)	ECPQD3	165-167
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Q or QS duration, lead V3 (msec)	ECPQD8	180-182
Q or QS duration, lead V4 (msec)	ECPQD9	183-185
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R amplitude, lead aVL (uV)	ECPRA5	208-211
R amplitude, lead aVF (uV)	ECPRA6	212-215
R amplitude, lead V1 (uV)	ECPRA7	216-219
R amplitude, lead V2 (uV)	ECPRA8	220-223
R amplitude, lead V3 (uV)	ECPRA9	224-227
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R amplitude, lead V5 (uV)	ECPRA11	232-235
R amplitude, lead V6 (uV)	ECPRA12	236-239
R duration, lead I (msec)	ECPRD1	240-242
R duration, lead II (msec)	ECPRD2	243-245
R duration, lead III (msec)	ECPRD3	246-248

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Description	Variable Name	Positions
R duration, lead aVR (msec)	ECPRD4	249-251
R duration, lead aVL (msec)	ECPRD5	252-254
R duration, lead aVF (msec)	ECPRD6	255-257
R duration, lead V1 (msec)	ECPRD7	258-260
R duration, lead V2 (msec)	ECPRD8	261-263
R duration, lead V3 (msec)	ECPRD9	264-266
R duration, lead V4 (msec)	ECPRD10	267-269
R duration, lead V5 (msec)	ECPRD11	270-272
R duration, lead V6 (msec)	ECPRD12	273-275
S amplitude, lead I (uV)	ECPSA1	276-279
S amplitude, lead II (uV)	ECPSA2	280-283
S amplitude, lead III (uV)	ECPSA3	284-287
S amplitude, lead aVR (uV)	ECPSA4	288-291
S amplitude, lead aVL (uV)	ECPSA5	292-295
S amplitude, lead aVF (uV)	ECPSA6	296-299
S amplitude, lead V1 (uV)	ECPSA7	300-303
S amplitude, lead V2 (uV)	ECPSA8	304-307
S amplitude, lead V3 (uV)	ECPSA9	308-311
S amplitude, lead V4 (uV)	ECPSA10	312-315
S amplitude, lead V5 (uV)	ECPSA11	316-319
S amplitude, lead V6 (uV)	ECPSA12	320-323
S duration, lead I (msec)	ECPSD1	324-326
S duration, lead II (msec)	ECPSD2	327-329
S duration, lead III (msec)	ECPSD3	330-332
S duration, lead aVR (msec)	ECPSD4	333-335
S duration, lead aVL (msec)	ECPSD5	336-338
S duration, lead aVF (msec)	ECPSD6	339-341
S duration, lead V1 (msec)	ECPSD7	342-344
S duration, lead V2 (msec)	ECPSD8	345-347
S duration, lead V3 (msec)	ECPSD9	348-350
S duration, lead V4 (msec)	ECPSD10	351-353
S duration, lead V5 (msec)	ECPSD11	354-356
S duration, lead V6 (msec)	ECPSD12	357-359
R' amplitude, lead I (uV)	ECPRPA1	360-363
R' amplitude, lead II (uV)	ECPRPA2	364-367
R' amplitude, lead III (uV)	ECPRPA3	368-371
R' amplitude, lead aVR (uV)	ECPRPA4	372-375
R' amplitude, lead aVL (uV)	ECPRPA5	376-379
R' amplitude, lead aVF (uV)	ECPRPA6	380-383
R' amplitude, lead V1 (uV)	ECPRPA7	384-387

NHANES I Electrocardiography Data File Index

Description	Variable Name	Positions
R' amplitude, lead V2 (uV)	ECPRPA8	388-391
R' amplitude, lead V3 (uV)	ECPRPA9	392-395

R' amplitude, lead V4 (uV)	ECPRPA10	396-399
R' amplitude, lead V5 (uV)	ECPRPA11	400-403
R' amplitude, lead V6 (uV)	ECPRPA12	404-407
J amplitude, lead I (uV)	ECPJ1	408-411
J amplitude, lead II (uV)	ECPJ2	412-415
J amplitude, lead III (uV)	ECPJ3	416-419
J amplitude, lead aVR (uV)	ECPJ4	420-423
J amplitude, lead aVL (uV)	ECPJ5	424-427
J amplitude, lead aVF (uV)	ECPJ6	428-431
J amplitude, lead V1 (uV)	ECPJ7	432-435
J amplitude, lead V2 (uV)	ECPJ8	436-439
J amplitude, lead V3 (uV)	ECPJ9	440-443
J amplitude, lead V4 (uV)	ECPJ10	444-447
J amplitude, lead V5 (uV)	ECPJ11	448-451
J amplitude, lead V6 (uV)	ECPJ12	452-455
Negative T amplitude, lead I (uV)	ECPNTA1	456-460
Negative T amplitude, lead II (uV)	ECPNTA2	461-464
Negative T amplitude, lead III (uV)	ECPNTA3	465-468
Negative T amplitude, lead aVR (uV)	ECPNTA4	469-472
Negative T amplitude, lead aVL (uV)	ECPNTA5	473-476
Negative T amplitude, lead aVF (uV)	ECPNTA6	477-480
Negative T amplitude, lead V1 (uV)	ECPNTA7	481-484
Negative T amplitude, lead V2 (uV)	ECPNTA8	485-489
Negative T amplitude, lead V3 (uV)	ECPNTA9	490-494
Negative T amplitude, lead V4 (uV)	ECPNTA10	495-499
Negative T amplitude, lead V5 (uV)	ECPNTA11	500-504
Negative T amplitude, lead V6 (uV)	ECPNTA12	505-509
Positive T amplitude, lead I (uV)	ECPPTA1	510-513
Positive T amplitude, lead II (uV)	ECPPTA2	514-517
Positive T amplitude, lead III (uV)	ECPPTA3	518-521
Positive T amplitude, lead aVR (uV)	ECPPTA4	522-525
Positive T amplitude, lead aVL (uV)	ECPPTA5	526-529
Positive T amplitude, lead aVF (uV)	ECPPTA6	530-533
Positive T amplitude, lead V1 (uV)	ECPPTA7	534-537
Positive T amplitude, lead V2 (uV)	ECPPTA8	538-541
Positive T amplitude, lead V3 (uV)	ECPPTA9	542-545
Positive T amplitude, lead V4 (uV)	ECPPTA10	546-549
Positive T amplitude, lead V5 (uV)	ECPPTA11	550-553

NHANES I Electrocardiography Data File Index

Description	Variable Name	Positions
Positive T amplitude, lead V6 (uV)	ECPPTA12	554-557

NHANES I Electrocardiography Data File

FILENAME=NH1ECG VERSION 1.0 N=6,316

DEMOGRAPHIC DATA

Positions SAS name	Counts	Item description and code	Notes

1-5		Sample person identification number	
SEQN	6316	00228-25061	
6		NHANES I Survey (1971-75)	
ECPSNUM	6316	1	NHANES I
7		Sex	
HSSEX	2870	1	Male
	3446	2	Female
8		Race	
DMARACER	5522	1	White
	725	2	Black
	69	3	Other
9-10		Age at interview (Screener) in years	
HSAGEIR	6316	25-74	
11-13		Pseudo-PSU	
SDPPSU	6316	001-235	
14-15		Pseudo-stratum	
SDPSTRA	6316	01-35	
16		Revised Pseudo-PSU	
SDPPSUR	6316	1-3	
17-22		MEC-examined sample final weight	
WTPFEX	6316	001004-121040	

NHANES I Electrocardiography Data File

INTRODUCTORY INFORMATION

Positions SAS name	Counts	Item description and code	Notes
23		Technician number	
ECPTECH1		(not reported in NHANES I)	
	6316	Blank	
24-25		Number of leads	
ECPLEADS	1	05	
	3	06	
	6	07	
	15	08	
	32	09	
	114	10	
	1229	11	
	4911	12	
	5	88	Blank but applicable
26		Chest half-width (mm)	
ECPWIDTH		(not reported in NHANES I)	

	6316	Blank		
27		Chest half-depth (mm)		
ECPDEPTH		(not reported in NHANES I)		
	6316	Blank		
28		Major ECG abnormalities		See note
ECPG1	5455	0	Absent	
	861	1	Present	
29		Minor ECG abnormalities		See note
ECPG2	5012	0	Absent	
	1304	1	Present	
30		Probable myocardial infarction (MI)		See note
ECPG3	6295	0	Absent	
	21	1	Present	

NHANES I Electrocardiography Data File

INTRODUCTORY INFORMATION

Positions SAS name	Counts	Item description and code		Notes
31		Possible MI		See note
ECPG4	6160	0	Absent	
	156	1	Present	
32		Probable left ventricular hypertrophy (LVH) by Minnesota Code (MC)		See note
ECPG5	6237	0	Absent	
	79	1	Present	
33		Possible LVH by MC		See note
ECPG6	5788	0	Absent	
	528	1	Present	

NHANES I Electrocardiography Data File

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
34-35		MC 1 Leadgroup L(I, aVL, V6)		
ECPL1	5593	00	1.0.0	
	5	11	1.1.1	
	1	12	1.1.2	
	3	13	1.1.3	
	7	21	1.2.1	

	2	22	1.2.2
	20	31	1.3.1
	10	33	1.3.3
	675	88	Blank but applicable
36-37		MC 1 Leadgroup F(II, III, aVF)	
ECPF1	5515	00	1.0.0
	2	11	1.1.1
	17	14	1.1.4
	15	21	1.2.1
	4	22	1.2.2
	6	23	1.2.3
	18	24	1.2.4
	1	25	1.2.5
	56	26	1.2.6
	13	31	1.3.1
	54	34	1.3.4
	3	35	1.3.5
	36	36	1.3.6
	576	88	Blank but applicable

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
38-39		MC 1 Leadgroup V(V1-V5)		
ECPV1	5894	00	1.0.0	
	12	11	1.1.1	
	17	12	1.1.2	
	19	16	1.1.6	
	10	17	1.1.7	
	3	21	1.2.1	
	20	27	1.2.7	
	33	28	1.2.8	
	5	31	1.3.1	
	44	32	1.3.2	
	259	88	Blank but applicable	
40-41		MC 4 Leadgroup L		
ECPL4	5464	00	4.0.0	
	2	11	4.1.1	
	28	12	4.1.2	
	104	20	4.2.0	
	31	30	4.3.0	
	28	40	4.4.0	
	659	88	Blank but applicable	
42-43		MC 4 Leadgroup F		
ECPF4	5671	00	4.0.0	
	6	12	4.1.2	
	49	20	4.2.0	
	10	30	4.3.0	
	5	40	4.4.0	

	575	88	Blank but applicable

NHANES I Electrocardiography Data File

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
44-45		MC 4 Leadgroup V		
ECPV4	5877	00	4.0.0	
	5	11	4.1.1	
	23	12	4.1.2	
	76	20	4.2.0	
	37	30	4.3.0	
	50	40	4.4.0	
	248	88	Blank but applicable	
46		MC 5 Leadgroup L		
ECPL5	5216	0	5.0	
	5	1	5.1	
	133	2	5.2	
	243	3	5.3	
	82	4	5.4	
	637	8	Blank but applicable	
47		MC 5 Leadgroup F		
ECPF5	5587	0	5.0	
	52	2	5.2	
	94	3	5.3	
	21	4	5.4	
	562	8	Blank but applicable	
48		MC 5 Leadgroup V		
ECPV5	5713	0	5.0	
	12	1	5.1	
	177	2	5.2	
	112	3	5.3	
	67	4	5.4	
	235	8	Blank but applicable	

NHANES I Electrocardiography Data File

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
49		MC 9.2 Leadgroup L		
ECPL9	5607	0	9.2.0	
	36	2	9.2.2	

	673	8	Blank but applicable	
50			MC 9.2 Leadgroup F	
ECPF9	5722	0	9.2.0	
	9	2	9.2.2	
	585	8	Blank but applicable	
51			MC 9.2 Leadgroup V	
ECPV9	5907	0	9.2.0	
	147	2	9.2.2	
	262	8	Blank but applicable	
52-53			MC 2 (QRS axis code)	See note
ECPMC2	4033	00	2.0.0	
	473	11	2.1.1	
	182	12	2.1.2	
	424	21	2.2.1	
	33	22	2.2.2	
	14	30	2.3.0	
	5	40	2.4.0	
	1152	88	Blank but applicable	
54-55			MC 3 (High-amplitude R waves)	
ECPMC3	4413	00	3.0.0	
	244	12	3.1.2	
	38	13	3.1.3	
	112	14	3.1.4	
	6	20	3.2.0	
	40	31	3.3.1	
	173	32	3.3.2	
	1290	88	Blank but applicable	

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
56-57			MC 6 (A-V conduction)	
ECPMC6	4905	00	6.0	
	88	30	6.3	
	9	40	6.4	
	49	50	6.5	
	1265	88	Blank but applicable	
58			MC 7 (Ventricular conduction)	
ECPMC7	4803	0	7.0	
	19	1	7.1	
	88	2	7.2	
	217	3	7.3	
	123	4	7.4	
	298	5	7.5	
	17	6	7.6	
	751	8	Blank but applicable	

59		MC 9.1 (Low-amplitude QRS)	
ECPMC91	5823	0	9.1.0
	56	1	9.1.1
	437	8	Blank but applicable
60		MC 9.3 (High-amplitude P)	
ECPMC93	6070	0	9.3.0
	27	3	9.3.3
	219	8	Blank but applicable
61		MC 9.4 (QRS transition zone)	
ECPMC94	2184	0	9.4.0
	2860	1	9.4.1
	1272	2	9.4.2

MINNESOTA CODES

Positions SAS name	Counts	Item description and code		Notes
62		MC 9.5 (High-amplitude T)		
ECPMC95	4822	0	9.5.0	
	122	5	9.5.5	
	1372	8	Blank but applicable	

NHANES I Electrocardiography Data File

CARDIAC/INFARCTION INJURY SCORE

Positions SAS name	Counts	Item description and code		Notes
63-65		Cardiac infarction/injury score for 12-lead ECG multiplied by 10		See note
ECPCIIS	4911	000-462		
	1405	888	Blank but applicable	
66		Probable infarction/injury		See note
ECPCIIS2	4789	0	Absent	
	183	1	Present	
	1344	8	Blank but applicable	
67		Possible infarction/injury		See note
ECPCIIS3	4791	0	Absent	
	181	1	Present	
	1344	8	Blank but applicable	
68		Consider infarction/injury		See note
ECPCIIS4	4660	0	Absent	

	312	1	Present
	1344	8	Blank but applicable

NHANES I Electrocardiography Data File

LEFT VENTRICULAR MASS

Positions SAS name	Counts	Item description and code		Notes
69-71		ECG estimate of LV mass		See note
ECPLVM	5739	062-358		
	577	888	Blank but applicable	
72-74		ECG estimate of LV mass index		See note
ECPLVMI	5806	041-295		
	510	888	Blank but applicable	
75		Probable LVH		See note
ECPLVM3	5309	0	Absent	
	497	1	Present	
	510	8	Blank but applicable	

NHANES I Electrocardiography Data File

HEART RATE, BASIC ECG INTERVALS, AND MEAN AXIS DATA

Positions SAS name	Counts	Item description and code		Notes
76-78		Heart rate (beats per minute)		
ECPRATE	6312	040-136		
	4	888	Blank but applicable	
79-81		PR interval (msec)		
ECPPR	6311	003-389		
	5	888	Blank but applicable	
82-84		QRS interval (msec)		
ECPQRS	6312	071-203		
	4	888	Blank but applicable	
85-87		QT interval (msec)		
ECPQT	6132	309-527		
	184	888	Blank but applicable	
88-91		P axis, frontal plane (degrees)		
ECPAXIS1	6261	-117-0159		
	55	8888	Blank but applicable	
92-95		QRS axis, frontal plane (degrees)		

ECPAXIS2	6280	-179-0177	
	36	8888 Blank but applicable	
96-99		T axis, frontal plane (degrees)	
ECPAXIS3	6272	-179-0178	
	44	8888 Blank but applicable	
100-101		Rhythm code	See note
ECPBEAT	6210	01 Sinus rhythm	
	28	02 Atrial fibrillation/flutter	
	78	88 Blank but applicable	

NHANES I Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
102-104		P amplitude, positive phase,	
ECPP1		lead II (microvolt (uV))	
	6249	000-394	
	67	888 Blank but applicable	
105-107		P duration, lead II (msec)	
ECPP2	6249	000-169	
	67	888 Blank but applicable	
108-110		P amplitude, positive phase,	
ECPP3		lead V1 (uV)	
	6243	000-406	
	73	888 Blank but applicable	
111-114		P amplitude, negative phase,	
ECPP4		lead V1 (uV)	
	6243	-498-0000	
	73	8888 Blank but applicable	
115-118		Q or QS amplitude, lead I (uV)	
ECPQA1	6236	0000-1285	
	80	8888 Blank but applicable	
119-122		Q or QS amplitude, lead II (uV)	
ECPQA2	6249	0000-1921	
	67	8888 Blank but applicable	
123-126		Q or QS amplitude, lead III (uV)	
ECPQA3	5991	0000-2262	
	325	8888 Blank but applicable	
127-130		Q or QS amplitude, lead aVL (uV)	
ECPQA4	5773	0000-1077	
	543	8888 Blank but applicable	

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
131-134		Q or QS amplitude, lead AVF (uV)	
ECPQA5	6077	0000-1740	
	239	8888 Blank but applicable	
135-138		Q or QS amplitude, lead V1 (uV)	
ECPQA6	6243	0000-2957	
	73	8888 Blank but applicable	
139-142		Q or QS amplitude, lead V2 (uV)	
ECPQA7	6244	0000-3403	
	72	8888 Blank but applicable	
143-146		Q or QS amplitude, lead V3 (uV)	
ECPQA8	6246	0000-3726	
	70	8888 Blank but applicable	
147-150		Q or QS amplitude, lead V4 (uV)	
ECPQA9	6268	0000-2065	
	48	8888 Blank but applicable	
151-154		Q or QS amplitude, lead V5 (uV)	
ECPQA10	6255	0000-1518	
	61	8888 Blank but applicable	
155-158		Q or QS amplitude, lead V6 (uV)	
ECPQA11	6216	0000-2000	
	100	8888 Blank but applicable	
159-161		Q or QS duration, lead I (msec)	
ECPQD1	6236	000-128	
	80	888 Blank but applicable	
162-164		Q or QS duration, lead II (msec)	
ECPQD2	6249	000-118	
	67	888 Blank but applicable	

NHANES I Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
165-167		Q or QS duration, lead III (msec)	
ECPQD3	5991	000-126	
	325	888 Blank but applicable	

168-170		Q or QS duration, lead aVL (msec)
ECPQD4	5773	000-134
	543	888 Blank but applicable
171-173		Q or QS duration, lead aVF (msec)
ECPQD5	6077	000-124
	239	888 Blank but applicable
174-176		Q or QS duration, lead V1 (msec)
ECPQD6	6243	000-152
	73	888 Blank but applicable
177-179		Q or QS duration, lead V2 (msec)
ECPQD7	6244	000-148
	72	888 Blank but applicable
180-182		Q or QS duration, lead V3 (msec)
ECPQD8	6246	000-102
	70	888 Blank but applicable
183-185		Q or QS duration, lead V4 (msec)
ECPQD9	6268	000-106
	48	888 Blank but applicable
186-188		Q or QS duration, lead V5 (msec)
ECPQD10	6255	000-098
	61	888 Blank but applicable
189-191		Q or QS duration, lead V6 (msec)
ECPQD11	6216	000-064
	100	888 Blank but applicable

NHANES I Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
192-195		R amplitude, lead I (uV)	
ECPRA1	6236	0000-2850	
	80	8888 Blank but applicable	
196-199		R amplitude, lead II (uV)	
ECPRA2	6249	0000-2773	
	67	8888 Blank but applicable	
200-203		R amplitude, lead III (uV)	
ECPRA3	5991	0000-2835	
	325	8888 Blank but applicable	
204-207		R amplitude, lead aVR (uV)	
ECPRA4	6270	0000-1410	
	46	8888 Blank but applicable	

208-211		R amplitude, lead aVL (uV)
ECPRA5	5773	0000-2624
	543	8888 Blank but applicable
212-215		R amplitude, lead aVF (uV)
ECPRA6	6077	0000-2784
	239	8888 Blank but applicable
216-219		R amplitude, lead V1 (uV)
ECPRA7	6243	0000-1396
	73	8888 Blank but applicable
220-223		R amplitude, lead V2 (uV)
ECPRA8	6244	0000-3631
	72	8888 Blank but applicable
224-227		R amplitude, lead V3 (uV)
ECPRA9	6246	0000-3909
	70	8888 Blank but applicable

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
228-231		R amplitude, lead V4 (uV)	
ECPRA10	6268	0000-3977	
	48	8888 Blank but applicable	
232-235		R amplitude, lead V5 (uV)	
ECPRA11	6255	0000-3934	
	61	8888 Blank but applicable	
236-239		R amplitude, lead V6 (uV)	
ECPRA12	6216	0000-3985	
	100	8888 Blank but applicable	
240-242		R duration, lead I (msec)	
ECPRD1	6236	000-180	
	80	888 Blank but applicable	
243-245		R duration, lead II (msec)	
ECPRD2	6249	000-148	
	67	888 Blank but applicable	
246-248		R duration, lead III (msec)	
ECPRD3	5991	000-128	
	325	888 Blank but applicable	
249-251		R duration, lead aVR (msec)	
ECPRD4	6270	000-130	
	46	888 Blank but applicable	
252-254		R duration, lead aVL (msec)	

ECPRD5	5773	000-166
	543	888 Blank but applicable
255-257		R duration, lead aVF (msec)
ECPRD6	6077	000-140
	239	888 Blank but applicable

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
258-260		R duration, lead V1 (msec)	
ECPRD7	6243	000-160	
	73	888 Blank but applicable	
261-263		R duration, lead V2 (msec)	
ECPRD8	6244	000-150	
	72	888 Blank but applicable	
264-266		R duration, lead V3 (msec)	
ECPRD9	6246	000-170	
	70	888 Blank but applicable	
267-269		R duration, lead V4 (msec)	
ECPRD10	6268	000-168	
	48	888 Blank but applicable	
270-272		R duration, lead V5 (msec)	
ECPRD11	6255	000-170	
	61	888 Blank but applicable	
273-275		R duration, lead V6 (msec)	
ECPRD12	6216	000-158	
	100	888 Blank but applicable	
276-279		S amplitude, lead I (uV)	
ECPSA1	6236	0000-1517	
	80	8888 Blank but applicable	
280-283		S amplitude, lead II (uV)	
ECPSA2	6249	0000-1540	
	67	8888 Blank but applicable	
284-287		S amplitude, lead III (uV)	
ECPSA3	5991	0000-3171	
	325	8888 Blank but applicable	

NHANES I Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
288-291		S amplitude, lead aVR (uV)	
ECPSA4	6270	0000-2386	
	46	8888 Blank but applicable	
292-295		S amplitude, lead aVL (uV)	
ECPSA5	5773	0000-1878	
	543	8888 Blank but applicable	
296-299		S amplitude, lead aVF (uV)	
ECPSA6	6077	0000-2134	
	239	8888 Blank but applicable	
300-303		S amplitude, lead V1 (uV)	
ECPSA7	6243	0000-3346	
	73	8888 Blank but applicable	
304-307		S amplitude, lead V2 (uV)	
ECPSA8	6244	0000-3992	
	72	8888 Blank but applicable	
308-311		S amplitude, lead V3 (uV)	
ECPSA9	6246	0000-3976	
	70	8888 Blank but applicable	
312-315		S amplitude, lead V4 (uV)	
ECPSA10	6268	0000-3182	
	48	8888 Blank but applicable	
316-319		S amplitude, lead V5 (uV)	
ECPSA11	6255	0000-3157	
	61	8888 Blank but applicable	
320-323		S amplitude, lead V6 (uV)	
ECPSA12	6216	0000-2689	
	100	8888 Blank but applicable	

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
324-326		S duration, lead I (msec)	
ECPSD1	6236	000-120	
	80	888 Blank but applicable	
327-329		S duration, lead II (msec)	
ECPSD2	6249	000-126	
	67	888 Blank but applicable	

330-332		S duration, lead III (msec)	
ECPSD3	5991	000-130	
	325	888	Blank but applicable
333-335		S duration, lead aVR (msec)	
ECPSD4	6270	000-102	
	46	888	Blank but applicable
336-338		S duration, lead aVL (msec)	
ECPSD5	5773	000-130	
	543	888	Blank but applicable
339-341		S duration, lead aVF (msec)	
ECPSD6	6077	000-116	
	239	888	Blank but applicable
342-344		S duration, lead V1 (msec)	
ECPSD7	6243	000-142	
	73	888	Blank but applicable
345-347		S duration, lead V2 (msec)	
ECPSD8	6244	000-144	
	72	888	Blank but applicable
348-350		S duration, lead V3 (msec)	
ECPSD9	6246	000-140	
	70	888	Blank but applicable

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
351-353		S duration, lead V4 (msec)	
ECPSD10	6268	000-144	
	48	888 Blank but applicable	
354-356		S duration, lead V5 (msec)	
ECPSD11	6255	000-140	
	61	888 Blank but applicable	
357-359		S duration, lead V6 (msec)	
ECPSD12	6216	000-122	
	100	888 Blank but applicable	
360-363		R' amplitude, lead I (uV)	
ECPRPA1	6236	0000-1046	
	80	8888 Blank but applicable	
364-367		R' amplitude, lead II (uV)	
ECPRPA2	6249	0000-2003	
	67	8888 Blank but applicable	

368-371		R' amplitude, lead III (uV)
ECPRPA3	5991	0000-1425
	325	8888 Blank but applicable
372-375		R' amplitude, lead aVR (uV)
ECPRPA4	6270	0000-0516
	46	8888 Blank but applicable
376-379		R' amplitude, lead aVL (uV)
ECPRPA5	5773	0000-2140
	543	8888 Blank but applicable
380-383		R' amplitude, lead aVF (uV)
ECPRPA6	6077	0000-1807
	239	8888 Blank but applicable

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
384-387		R' amplitude, lead V1 (uV)	
ECPRPA7	6243	0000-1437	
	73	8888 Blank but applicable	
388-391		R' amplitude, lead V2 (uV)	
ECPRPA8	6244	0000-3491	
	72	8888 Blank but applicable	
392-395		R' amplitude, lead V3 (uV)	
ECPRPA9	6246	0000-2911	
	70	8888 Blank but applicable	
396-399		R' amplitude, lead V4 (uV)	
ECPRPA10	6268	0000-2908	
	48	8888 Blank but applicable	
400-403		R' amplitude, lead V5 (uV)	
ECPRPA11	6255	0000-3245	
	61	8888 Blank but applicable	
404-407		R' amplitude, lead V6 (uV)	
ECPRPA12	6216	0000-1560	
	100	8888 Blank but applicable	
408-411		J amplitude, lead I (uV)	
ECPJ1	6236	-233-0139	
	80	8888 Blank but applicable	
412-415		J amplitude, lead II (uV)	
ECPJ2	6249	-231-0261	
	67	8888 Blank but applicable	
416-419		J amplitude, lead III (uV)	

ECPJ3	5991	-234-0247	
	325	8888	Blank but applicable

NHANES I Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
420-423		J amplitude, lead aVR (uV)	
ECPJ4	6270	-184-0212	
	46	8888 Blank but applicable	
424-427		J amplitude, lead aVL (uV)	
ECPJ5	5773	-193-0398	
	543	8888 Blank but applicable	
428-431		J amplitude, lead aVF (uV)	
ECPJ6	6077	-256-0179	
	239	8888 Blank but applicable	
432-435		J amplitude, lead V1 (uV)	
ECPJ7	6243	-390-0589	
	73	8888 Blank but applicable	
436-439		J amplitude, lead V2 (uV)	
ECPJ8	6244	-427-0455	
	72	8888 Blank but applicable	
440-443		J amplitude, lead V3 (uV)	
ECPJ9	6245	-606-0362	
	71	8888 Blank but applicable	
444-447		J amplitude, lead V4 (uV)	
ECPJ10	6267	-621-0345	
	49	8888 Blank but applicable	
448-451		J amplitude, lead V5 (uV)	
ECPJ11	6255	-919-0363	
	61	8888 Blank but applicable	
452-455		J amplitude, lead V6 (uV)	
ECPJ12	6216	-383-0288	
	100	8888 Blank but applicable	

NHANES I Electrocardiography Data File

ECG WAVE MEASUREMENTS

Positions SAS name | Counts | Item description and code | Notes

Positions SAS name	Counts	Item description and code	Notes
456-460		Negative T amplitude, lead I (uV)	
ECPNTA1	6236	-0549-00000	
	80	88888 Blank but applicable	
461-464		Negative T amplitude, lead II (uV)	
ECPNTA2	6249	-407-0000	
	67	8888 Blank but applicable	
465-468		Negative T amplitude, lead III (uV)	
ECPNTA3	5991	-523-0000	
	325	8888 Blank but applicable	
469-472		Negative T amplitude, lead aVR (uV)	
ECPNTA4	6270	-671-0000	
	46	8888 Blank but applicable	
473-476		Negative T amplitude, lead aVL (uV)	
ECPNTA5	5773	-588-0000	
	543	8888 Blank but applicable	
477-480		Negative T amplitude, lead aVF (uV)	
ECPNTA6	6077	-368-0000	
	239	8888 Blank but applicable	
481-484		Negative T amplitude, lead V1 (uV)	
ECPNTA7	6243	-765-0000	
	73	8888 Blank but applicable	
485-489		Negative T amplitude, lead V2 (uV)	
ECPNTA8	6244	-0650-00000	
	72	88888 Blank but applicable	
490-494		Negative T amplitude, lead V3 (uV)	
ECPNTA9	6246	-0609-00000	
	70	88888 Blank but applicable	

Positions SAS name	Counts	Item description and code	Notes
495-499		Negative T amplitude, lead V4 (uV)	
ECPNTA10	6268	-1328-00000	
	48	88888 Blank but applicable	
500-504		Negative T amplitude, lead V5 (uV)	
ECPNTA11	6255	-1414-00000	
	61	88888 Blank but applicable	
505-509		Negative T amplitude, lead V6 (uV)	
ECPNTA12	6216	-1154-00000	
	100	88888 Blank but applicable	

510-513		Positive T amplitude, lead I (uV)
ECPPTA1	6236	0000-0652
	80	8888 Blank but applicable
514-517		Positive T amplitude, lead II (uV)
ECPPTA2	6249	0000-0824
	67	8888 Blank but applicable
518-521		Positive T amplitude, lead III (uV)
ECPPTA3	5991	0000-0624
	325	8888 Blank but applicable
522-525		Positive T amplitude, lead aVR (uV)
ECPPTA4	6270	0000-0507
	46	8888 Blank but applicable
526-529		Positive T amplitude, lead aVL (uV)
ECPPTA5	5773	0000-0619
	543	8888 Blank but applicable
530-533		Positive T amplitude, lead aVF (uV)
ECPPTA6	6077	0000-0722
	239	8888 Blank but applicable

ECG WAVE MEASUREMENTS

Positions SAS name	Counts	Item description and code	Notes
534-537		Positive T amplitude, lead V1 (uV)	
ECPPTA7	6243	0000-1156	
	73	8888 Blank but applicable	
538-541		Positive T amplitude, lead V2 (uV)	
ECPPTA8	6244	0000-1897	
	72	8888 Blank but applicable	
542-545		Positive T amplitude, lead V3 (uV)	
ECPPTA9	6246	0000-1760	
	70	8888 Blank but applicable	
546-549		Positive T amplitude, lead V4 (uV)	
ECPPTA10	6268	0000-1748	
	48	8888 Blank but applicable	
550-553		Positive T amplitude, lead V5 (uV)	
ECPPTA11	6255	0000-1831	
	61	8888 Blank but applicable	
554-557		Positive T amplitude, lead V6 (uV)	
ECPPTA12	6216	0000-1691	
	100	8888 Blank but applicable	

Notes

ECPWIDTH: Chest half-width(mm)

Two anthropometric measurements related to the chest dimensions and chest electrode locations were obtained in NHANES III using an electrode locator (Heartsquare) used to position the V4 electrode at a 45 degree angle between the midsternal line and the left midaxillary line (location of V6) (Rautaharju et al, 1976). The half-width of the chest is the distance (cm) from the midsternal line to the left lateral chest wall at the level of V6. The half-depth of the chest is the distance from the frontal plane at lower sternum to the frontal plane which transsects the thorax at the level of the midaxillary levels. Both of these measurements were obtained to the nearest 0.5 cm and reported as three digit numbers without a decimal (mm) for NHANES III only.

ECPDEPTH: Chest half-depth (mm)

See note for ECPWIDTH.

ECPG1: Major ECG abnormalities

	Minnesota Code	Comments
Major Q, QS waves	1.1 or 1.2 except 1.2.8	Highest code in any leadgroup
ST depression	4.1 or 4.2	
Negative T waves	5.1 or 5.2	
Complete AV block	6.1	Coded visually, not coded in NHANES I
WPW pattern	6.4	
Artificial pacemaker	6.8	Coded visually, not coded in NHANES I
Ventricular conduction defect	7.1 or 7.2 or 7.4	
Atrial fibrillation /flutter	8.3	Coded visually
ST elevation	9.2	

ECPG2: Minor ECG abnormalities

	Minnesota Code	Comments
Minor Q waves	1.2.8 or 1.3	
High R waves	3.1 or 3.3	Any 3.1 or 3.3 code
Minor ST codes	4.3 or 4.4	
Minor T wave codes	5.3 or 5.4	
Prolonged PR interval	6.3	
RR' in V1 or V2	7.3 or 7.5	
Left anterior fascicular block	7.7	

ECPG3: Probable myocardial infarction by the Minnesota Code

Major Q/QS waves (Code 1.1.1 through 1.1.7), or Moderate Q/QS waves with ST depression or T wave inversion (Code 1.2.1 through 1.2.7 and code 4.1, 4.2, 5.1 or 5.2)

ECPG4: Possible myocardial infarction by the Minnesota Code

Moderate Q/QS waves without ST depression or T wave inversion (Code 1.2.1 through 1.2.7 without Code 4.1, 4.2, 5.1 and 5.2),or minor Q/QS waves with ST depression or T wave inversion (Code 1.2.8 or 1.3.1 through 1.3.6 and Code 4.1, 4.2, 5.1 or 5.2)

ECPG5: Probable LVH by the Minnesota Code

Code 3.1 with code 5.1 or 5.2 or 5.3

ECPG6: Possible LVH by the Minnesota Code

Code 3.1 without code 5.1 and 5.2 and 5.3, OR Any code 3.3

ECPMC2 MC 2 (QRS axis code)

The algorithm used for QRS axis determination provides a more accurate estimation of the mean frontal plane axis than the approximation used in Minnesota Code 2 according to the conventional visual measurement.

The algorithm used for the QRS axis determination is also used for P and T axis calculation.

Values of QRS integrals (net QRS 'areas', A) determined from the six limb leads are used for the mean frontal plane QRS axis calculation.

Three separate axis angle (ANG) values are calculated from three pairs of limb leads. The lead vectors of these three pairs of leads are assumed to be orthogonal according to the Einthoven's equilateral triangle approximation, and the relative strength of the lead vectors of leads aVR, aVL and aVF are assumed to be 3/2 times the lead vector strengths of leads I, II and III. Consequently, the augmented unipolar limb leads are scaled by factor 1.16 in these pairwise calculations of the three angles ANG(1), ANG(2) and ANG(3).

$$ANG(1) = ARCTG\ (1.16 \times A(aVF),\ A(I)),$$
$$ANG(2) = ARCTG\ (A(II),\ 1.16 \times A(aVF)),$$
$$ANG(3) = ARCTG\ (1.16 \times A(aVR),\ A(III)) + 120$$

In case the three values are reasonably consistent, the final mean frontal plane axis is taken as the mean value of these three separate angle determinations. Several inconsistency checks are performed, and if abnormally large discrepancies are found, the angle is termed 'undetermined'.

QRS axis values are used to identify abnormal axis deviations, with the following categories for the QRS axis code (code 2):

2.0.0	from 0 to 90 degrees	Normal QRS axis
2.1.1	from -29 to -1 degrees (LAD)	Borderline left axis deviation
2.1.2	from -89 to -30 degrees	LAD
2.2.1	from 91 to 119 degrees (RAD)	Borderline right axis deviation
2.2.2	from 120 to 150 degrees	RAD
3.3	from 149 to 90 degrees	Extreme axis deviation
2.4		Indeterminate QRS axis

ECPCIIS, ECPCIIS2, ECPCIIS3, ECPCIIS4: Cardiac Infarction/Injury Score for 12 lead ECG multiplied by 10

This ECG coding scheme was developed as a measure of the likelihood of myocardial infarction on a continuous scale. The following thresholds for the score define the likelihood of infarction in a decreasing order:

Probable infarction CIIS >= 20
Possible infarction 15 <= CIIS < 20
Consider infarction 10 <= CIIS < 15

These thresholds correspond to the estimated specificity levels of 98%, 95% and 90% (Rautaharju et al., 1981.).

ECPCIIS2: Infarction/Injury probable

See note for ECPCIIS.

ECPCIIS3: Infarction/Injury possible

See note for ECPCIIS.

ECPCIIS4: Consider Infarction/Injury probable

See note for ECPCIIS.

ECPLVM, ECPLVMI, ECPLVM3: Estimate LV Mass and LV Mass Index

Coefficients for the regression equation used for ECG estimation of left ventricular mass (LVM) and left ventricular mass index (LVMI) (Rautaharju et al, 1990).

White and Black Men

Variables	LVM	LVMI
R amplitude in V5 (æV)	0.0217	0.0100
Q or S amplitude in V1 (æV)*	0.0338	0.0203
Q or S amplitude in III (æV)*	0.0600	0.0287
Negative T amplitude in V6 (æV)	0.3158	0.1819
Positive T amplitude in aVR (æV)	-0.2958	-0.1482
QRS duration (msec.)	1.8204	1.0485
Intercept	-58.5098	-36.4290

White Women

Variables	LVM	LVMI
R amplitude on aVL (æV)	0.0320	--
R amplitude in V5 (æV)	0.0233	0.0178
Q or S amplitude in V5 (æV)*	0.0693	0.0528
Q or S amplitude in I (æV)*	-0.1545	-0.1128
Positive T amplitude in V1 (æV)	0.1122	0.1075
Negative T amplitude in aVF (æV)	--	0.1701
Positive T amplitude in V6 (æV)	-0.1236	-0.0939
Intercept	134.7722	88.4357

Black Women

Variables	LVM	LVMI
R amplitude in aVL (æV)	--	0.0216

R amplitude in I (æV)	0.0498	--
(R amplitude in V6 + S amplitude in V2) (æV)	0.0235	0.0184
R amplitude in V1	-0.0507	--
R amplitude in V2 (æV)	--	-0.0143
Q or S amplitude in V6 (æV)*	-0.0980	-0.0693
Negative T amplitude in aVL (æV)	--	0.199
Negative T amplitude in I (æV)	0.5225	--
QRS duration (msec.)	1.8478	0.7460
Intercept	-90.7136	-22.3064

* whichever is larger

The following limits for LVMI are taken to indicate the presence of probable left ventricular hypertrophy to correspond upper normal limits for echocardiographic LVMI by the conventions of the American Society for Echocardiography (Levy et al. 1987). These LVH criteria have been evaluated recently in an independent study population (Rautaharju et al, 1996).

Males> 150 g/m2
Females> 120 g/m2

ECPLVMI: ECG estimate LV Mass Index

See note for ECPLVM.

ECPLVM3: Probable LVH

See note for ECPLVM.

ECPAXIS2: QRS axis, frontal plane (degrees)

See note for ECPMC2

ECPBEAT: Rhythm Code

Arrhythmias were not coded in NHANES I except that ECGs with no P waves detected or with P wave detection uncertain were coded visually for the presence of atrial fibrillation. Arrhythmic codes were determined visually by a senior electrocardiographer (PMR) for NHANES II and III. Note that the history of atrial fibrillation was an exclusion criterion for ECG recording in NHANES III. Pacemaker enhancement circuits were not used in ECG recorders of any of these surveys which makes coding uncertain.

References

Blackburn H, Keys A, Simonson E, Rautaharju PM and Punsar S. The electrocardiogram in population studies: A classification system. Circulation 1960;21:1160-1175.

Levy D, Savage DD, Garrison RJ, Anderson KM, Kannel WB, Castelli WP. Echocardiographic criteria for left ventricular hypertrophy: The Framingham Heart Study. Am J Cardiol 1987;59:956-60.

National Center for Health Statistics. Ingram DD, Makuc DM. Statistical issues in analyzing the NHANES I epidemiologic followup study. Vital and Health Statistics, Series 2, Number 92. DHHS Pub. No. (PHS) 94-1395. Public Health Service. Washington. U.S. Government Printing Office. May., 1994.

National Center for Health Statistics. Landis JR, Lepkowski JM, Eklund SA, Stehouwer SA. A statistical Methodology for Analyzing Data from a Complex Survey: The First National Health and Nutrition Examination Survey. Vital and Health Statistics. Series 2, No. 92. DHHS Pub. No. (PHS) 82-1366. Public Health Service. Washington. U.S. Government Printing Office. Sept., 1982.

National Center for Health Statistics. Miller HW: Plan and Operation of the Health and Nutrition Examination Survey, United States 1971-73. Vital and Health Statistics. Series 1, Nos 10a and 10b. DHEW Pub. No. (Stat.) 73-1310. Health Services and Mental Health Administration, Washington. DC. U.S. Government Printing Office. Feb 1973.

National Center for Health Statistics. Engel A, Murphy RS, Maurer K, Collins E. Plan and Operation of the HANES I Augmentation Survey of Adults 25-74 Years, United States, 1974-75. Vital and Health Statistics. Series 1, No 14. DHEW Pub. No. (PHS) 78-1314. Public Health Service. Washington. U.S., Government Printing Office, June 1978.

Plan and Operation of the Second National Health and Nutrition Examination Survey. 1976-1980. Vital and Health Statistics. Series 1, No. 15. DHEW Pub. No. (PHS) 81-1317. Public Health Services, Washington. DC. U.S. Government Printing Office.

Prineas RJ, Crow RS and Blackburn H. The Minnesota Code Manual of Electrocardiographic findings. Standards and Procedures for Measurement and Classification. John Wright. PSG Inc. Boston, Bristol, London, 1982

Rautaharju PM, Wolf HK, Eifler WL, Blackburn H. A simple procedure for positioning precordial ECG and VCG electrodes using an electrode locator. Journal of Electrocardiology 1976;9:35-40.

Rautaharju PM, Warren J, Jain U, Wolf HK and Nielsen CL. Cardiac infarction injury score: An electrocardiographic coding scheme for ischemic heart disease. Circulation 1981;64:249-256.

Rautaharju PM, LaCroix AZ, Savage DD, Haynes S, Madans JH, Wolf HK, Hadden W, Keller J, Cornoni-Huntly J. Electrocardiographic estimate of left ventricular mass vs. radiographic cardiac size and the risk of cardiovascular disease mortality in the epidemiologic follow-up study of the First National Health and Nutrition Examination Survey. Am J Cardiol 1988;62:59-68.

Rautaharju PM, MacInnis PJ, Warren JW, Wolf HK, Rykers PM, Calhoun HP. Methodology of ECG Interpretation in the Dalhousie Program: NOVACODE ECG classification procedures for clinical trials and population health surveys. Methods of Information in Medicine 1990;29:362-74.

Rautaharju PM, Manolio TA, Siscovick D, Zhou SH, Gardin LM, Furberg CD, Borhahi NO, Newman A. Classification accuracy of electrocardiographic criteria for left ventricurlar hypertrophy in normal weight and overweight older adults: The Cardiovascular Health Study. Annals Noninvasive Electrocardiology 1996;1:121-32.

Rowland M, Parsons V, Makuc D. Simplified design structures for NHANES I variance estimation. Proceeding American Statistical Association, 1988:773-76.

U.S. Department of Health and Human Services (DHHS). National Center for Health Statistics. Third National Health and Nutrition Examination Survey, 1988-94, Plan and Operations Procedures Manuals (CD-ROM). Hyattsville, Md.: Centers for Disease Control and Prevention, 1996. Available from National

Technical Information Service (NTIS), Springfield, Va. Acrobat .PDF format; includes access software: Adobe Systems Inc. Acrobat Reader 2.0).