**NHANES 2001-2002 Data Release**
**June 2004**
**MEC Examination**

# Cardiovascular Fitness (CVX_B)

Survey Years Included in this File: 2001-2002

## Component Description:

The cardiovascular (CV) fitness component was implemented in the NHANES in 1999. The goals of this component are to provide: 1) nationally representative data on cardiovascular fitness; 2) prevalence estimates of persons at risk due to poor physical fitness; and 3) data to study the association between cardiovascular fitness and other health conditions and risk factors, such as obesity, cardiovascular disease, diabetes, hypertension, and activity and dietary patterns.

## Eligible Sample and Component-Specific Exclusions:

Survey participants aged 12-49 years old are eligible for the CV fitness component.

Participants are excluded from this component based on medical conditions, medications, physical limitations, limits on heart rate and blood pressure, and irregular heart rates. The screening is done prior to the treadmill test using questions in the household interview, questions administered by the physician in the NHANES Mobile Examination Center (MEC) and aspects of the physician examination such as measurements of heart rate and blood pressure. The list of exclusion criteria used for the CV fitness component is attached as Appendix A.

## Examination Protocol:

The CV fitness exam was performed by trained health technicians. The protocol is a submaximal exercise test. Based on gender, age, body mass index, and self-reported level of physical activity, participants are assigned to one of eight treadmill test protocols. The goal of each protocol is to elicit a heart rate that is approximately 75 percent of the age-predicted maximum (220-age) by the end of the test. Each protocol includes a 2-minute warm-up, two 3-minute exercise stages, and a 2-minute cool down period.

Heart rate was monitored continuously using an automated monitor with four electrodes connected to thorax and abdomen of the participant and was recorded at the end of warm-up, each exercise stage, and each minute of recovery. Blood pressure was measured at the end of each stage. At the end of warm-up and each exercise stage, participants were asked to rate their perceived exertion using the Borg

scale.

The main outcome of this component is the estimated maximal oxygen uptake (VO2max). Based on gender and age specific criteria, the estimated VO2max is also categorized and reported as “low”, “moderate” or “high” level of cardiovascular fitness in the present dataset.

Detailed descriptions of the protocol are provided in the NHANES Cardiovascular Fitness Procedure Manual. [1]

## Quality Control during Data Collection:

Health technicians are regularly monitored by NHANES supervisory staff and expert consultants from the Cooper Institute using a structured performance evaluation and an annual recertification process. Retraining sessions are conducted periodically with the technicians to reinforce the proper protocols and technique. Inspection, calibration, and maintenance of the equipment and supplies are also performed on a regular basis.

As part of on-going quality control practice, all the data are reviewed systematically for logical inconsistencies and technician errors.

Chapter 6 of the NHANES Cardiovascular Fitness Procedure Manual details the quality control procedures.

## Data Processing and Editing:

During the data processing, edits were made to ensure the logical consistency and analytic usefulness of the data. Extreme values were reviewed and cross-checked with other available data. When there was insufficient information to conclude that the values were invalid, they were retained in the data set.

### Variable specific editing:

**CVDEXSTS** (CV fitness exam status)

This derived variable indicates the following for each participants:

1. VO2max estimated.
2. Tested but VO2max estimate missing - data obtained during the treadmill test were insufficient in calculating VO2max.
3. Did not participate in the treadmill test.

**CVDEXCMT** (Comment code for the exam status)

This derived variable denotes the reason the treadmill test was not done or data are missing.

"0" – None: the exam was completed with no missing data point present.

"1" – Met exclusion criteria: exam was not done due to the participant met the exclusion criteria of the component other than pregnancy. Responses in variables CVDEXCL1 - CVDEXCL6 identify specific exclusion criteria the participant met.

"2" – Pregnant more than 12 weeks: pregnant women are excluded from the component because physiologic changes with pregnancy affect heart rate, and therefore the interpretation of the data.

"3" – Refusal: participant refused to undergo or continue the test.

"4" – No time: the exam was not done because there was not enough time.

"5" – Technical problem: problems that occurred during the test with equipment, software applications, or technician error.

"6" – Met priority 1 stopping criteria: participant discomfort or distress observed by the health technician or reported by the participant that warranted an emergency stop of the protocol. See Cardiovascular Fitness Procedure Manual, section 3.13.1 for further details.

"7" – Met priority 2 stopping criteria: safety concerns arose during the test that warranted an early stop of the protocol. Responses in variables CVQ220a-CVQ220m identify specific reason(s) called for the priority 2 stop. See Cardiovascular Fitness Procedure Manual, section 3.13.2 for further details.

"8" – Not able to calculate VO2max: heart rate obtained at the end of stage 2 lower than what obtained at the end of stage 1, or the difference between stages 1 and 2 heart rates is 5 beat/minute or less.

"90" – Other.

**CVDEXCL1 – CVDEXCL6** (Reasons for exclusion)

The exclusion criteria used for the CV fitness component include more than 50 questions or measurements collected during the household interview and the examinations in the MEC. This set of variables summarizes these exclusion criteria into six categories: physical functioning limitations, cardiovascular conditions/ symptoms, lung/breathing conditions/symptoms, asthma symptoms, medication exclusions, and others. Appendix A documents the classification frames for these categories. These six variables are not exclusive to each other to accommodate participants who met multiple criteria in different categories.

**CVXPARC** (Physical activity level)

This variable summarizes the responses from a series of questions and describes the participant's typical physical activity level using the NASA/JSC physical activity scale.[2] See Cardiovascular Fitness Procedure Manual, Appendix E for further details.

**CVDVOMAX** (Predicted VO2max)

This derived variable designates predicted VO2max value calculated with the equation developed by Jackson et al. [3] The prediction model is based on participant's gender, age, body mass index, and self-reported level of physical activity. Predicted VO2max value is used in the determination of the exercise protocol for the treadmill test. See Cardiovascular Fitness Procedure Manual, Appendix F for further details.

**CVAPROT and CVDPROT** (Assigned exercise protocol and the actual protocol used in stages 1 and 2)

Each participant was assigned to one of 8 protocols based on the predicted VO2max. According to the procedure, if the heart rate in warm-up is greater than 60% of the predicted maximal heart rate (PMHR), the assigned exercise protocol is decreased by 1 for the remainder of the treadmill test. When the heart rate in warm-up is less than 50% of the PMHR, the assigned protocol is increased by 1 for the remainder of the test. The variable CVAPROT denotes the exercise protocol that was originally assigned to the case while variable CVDPROT reflects the actual exercise protocol used in stage 1 and stage 2 after the adjustment during warm-up. See CV Fitness Procedures Manual, Sections 3.12 and 4.5 for further details.

**CVDESVO2** (Estimated maximal oxygen uptake)

This derived variable designates the main outcome of the component: VO2max (ml/kg/min). It is estimated by extrapolation using measured heart rate responses to known levels of exercise workloads, assuming the relation between heart rate and oxygen consumption is linear during exercise. [4] See the CV Fitness Procedures Manual, Appendix G for further details.

**CVDFITLV** (Cardiovascular fitness level)

The level of cardiovascular fitness is categorized based on gender-age specific cut-points of estimated VO2max. The reference cut-points used for adults 20-49 years are based on data from the Aerobics Center Longitudinal Study (ACLS). [4, 5] Low level of CV fitness is defined as an estimated VO2max below the 20$^{th}$ percentile of the ACLS data of the same gender and age group; moderate fitness is defined as a value between the 20$^{th}$ and 59$^{th}$ percentile, and high fitness level is defined as at or above the 60$^{th}$ percentile. The reference standards used for adolescents and young adults 12-19 years are based on the criteria used in the FITNESSGRAM program. [6, 7] See CV Fitness Procedures Manual, Appendix I for further details.

## Component-Specific Analytic Notes:

The present dataset contains the NHANES CV fitness data collected during 2001-2002. It is strongly recommended that data users merge this file with the CV fitness data collected in NHANES 1999-2000 to ensure an adequate sample size for analysis. The 1999-2000 NHANES CV fitness data (CVX) are publicly available at http://www.cdc.gov/nchs/about/major/nhanes/NHANES99_00.htm.

To ensure the safety and validity of the test, a series of exclusion criteria were developed for the NHANES CV fitness component to preclude participants with conditions that might endanger them during the testing or affect the estimation of the VO2max from the exam. As a result, approximately 70% of the eligible NHANES participants were tested in this component during 1999-2002. The exclusion rate increases with age. In the present dataset, women have a much higher exclusion rate than men. It is largely due to the pregnancy exclusion which accounts for about 25% of the exclusions among women, and the fact that pregnant women are one of the subpopulations oversampled in the current NHANES. Data users need to be aware of the exclusion rate and be cautious when making inferences for the analyses.

The four-year full sample weight (WTMEC4YR) should be used for the combined analyses of NHANES 1999-2000 and NHANES 2001-2002 data. For further details on analyzing the NHANES data, please refer to the analytic guidelines provided with the 2001-2002 NHANES data release files, available at http://www.cdc.gov/nchs/about/major/nhanes/datalink.htm.

Approximately 12% of the participants in 1999-2002 underwent the treadmill test but did not have their VO2max estimated. Most of these cases resulted from a prematurely terminated test due to meeting the priority 2 stopping criteria. Analysts need to take the incomplete tests into account when interpreting the data.

It is not feasible to utilize a maximal treadmill test to directly measure the cardiovascular fitness level in a population-based study setting such as NHANES. However, due to the nature of the submaximal test, some estimates obtained in this component may appear extreme compared to data obtained from more direct measures. Analysts need to carefully examine the data distribution and consider whether or not it is appropriate to include or exclude extreme values in a given analysis.

During the course of data collection, several protocol modifications were implemented to help improve the completion rate. These modifications do not affect the

comparability of the data and are described below:

1. To allow all participants' heart rates to rise to as high as 80%, instead of 75%, of the PMHR during the first stage of exercise.
2. To allow heart rates of participants aged 12-19 years to rise as high as 90%, instead of 85%, of the PMHR during the second stage of the exercise test.
3. To obtain measured height and weight, instead of self-reported data, for use in setting up the exercise protocol.

## Data Access:

The CV fitness data (CVX_B) are publicly available at www.cdc.gov/nchs/nhanes.htm

## NCHS Research Data Center:

No data from this component are in the Research Data Center.

## Reference:


1. National Center for Health Statistics. *The NHANES Cardiovascular Fitness Procedure Manual.* Hyattsville, MD: National Center for Health Statistics, 2004. Available at: http://www.cdc.gov/nchs/data/nhanes/cv.pdf
2. Ross RM and Jackson AS. *Exercise Concepts, Calculations and Computer Applications.* Carmel, IN: Benchmark Press, 1990; pp95-103, 109.
3. Jackson AS, Blair SN, Mahar MT, et al. *Prediction of Functional Aerobic Capacity without Exercise Testing.* Medicine and Science in Sports and Exercise 1990; 22(6), 863-70.
4. American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*, 6th edition. Philadelphia, PA: Lippincott Williams and Wilkins Company, 1995.
5. Blair SN, Kohl HW 3rd, Paffenbarger RS Jr, et al. *Physical Fitness and All-Cause Mortality. A Prospective Study of Healthy Men and Women.* JAMA1989; 262(17):2395-401.
6. Cureton KJ and Warren GL. *Criterion-Referenced Standards for Youth Health-Related Fitness Tests: A Tutorial.* Research Quarterly for Exercise and Sport 1990; 61(1):7-19.
7. Cureton KJ and Plowman SA. *Aerobic Capacity Assessments.* In Welk GJ, Morrow, JR Jr, and Falls HB (Ed.) *Fitnessgram Reference Guide (pp. 66-86)*. Dallas, TX: Cooper Institute, 1999. Available at: http://dev.cooperinst.org/shopping/PDF%20format/Fitnessgram%20Reference%20Guide.pdf

## Appendix A. Classification of the Exclusion Criteria in the NAHNES Cardiovascular Fitness Component

### CVDEXCL1: Physical functioning limitations

Difficulties in walking for a quarter mile

Difficulties in walking up 10 steps without resting

Difficulties in walking from one room to another on the same level

Difficulties in standing up from an armless straight chair

Having back or neck problems

Having fractures or injuries in bone or joint

Having health problem that requires the use of special equipment, such as a cane or a wheelchair

Having a bone or joint problem that could be made worse by walking

Lose balance due to dizziness on a regular basis

Lose consciousness on a regular basis

Blind or with very poor eyesight

Diabetes affected eyes or had retinopathy

Having developmental problems

Having amputations of legs or feet other than toes

Weight exceeded equipment limitation (>350 lb)

Other specified physical limitations

### CVDEXCL2: Cardiovascular conditions/symptoms

Had been diagnosed with congestive heart failure

Had been diagnosed with coronary heart disease

Had been diagnosed with angina

Had been diagnosed with myocardial infarction

Had been diagnosed with stroke

Self-reported heart problems

Self-reported stroke problems

Having a pacemaker or automatic defibrillator

Doctor had instructed to do only physical activity recommended by a doctor because of a

heart condition

Feeling chest pain during physical activity

Had chest pain when not doing physical activity

Resting heart rate ≥ 100 beats/min

Resting systolic blood pressure ≥ 180 mmHg

Resting diastolic blood pressure ≥ 100 mmHg

Irregular heart beats: 3 or more dropped beats in 30 seconds

**CVDEXCL3: Lung/breathing conditions/symptoms**

Having to stop for breath when walking at own pace on level ground

Having to stop for breath after walking about 100 yards or after a few minutes on level ground

Having been awakened by trouble breathing or shortness of breath

Having breathing trouble during sleep relieved by sitting up

Having to sleep on 2 or more pillows to help breathe

Self-reported lung or breathing problems

Had been diagnosed with emphysema

**CVDEXCL4: Asthma symptoms**

Had 12 or more attacks of wheezing or whistling during the past 12 months

Had wheezing severe enough to limit speech during the past 12 months

**CVDEXCL5: Medication exclusions**

Anti Arrhythmics

Amiodarone (Cordarone)
Bretylium (Bretylol)
Disopyramide (Norpace)
Encainide (Enkaid)
Ethmozine (Moricizine)
Flecanide (Tambocor)
Lidocaine (Xylocaine, Xylocard)
Metoprolol Succinate (Toprol-XL)
Mexiletine (Mexitil)
Moricizine (Ethmozine)
Posicor (Mibefradil)
Procainamide (Pronestyl, Procan SR)
Propafenone (Rhythmol)
Quinidine (Quinora, Quinalan, Cardioquin, Quinidex, Quinaglute)
Tocainide (Tonocard)

Beta Blockers

Acebutolol (Sectral)
Atenolol (Tenormin)
Betagan
Betaxolol (Kerlone)
Bisoprolol (Zebeta)
Carteolol (Cartrol)
Carvedilol (Coreg)
Esmolol (Brevibloc)
Labetalol (Normodyne)
Levobunolol
Metoprolol Tartrate (Lopressor)
Nadolol (Corgard)
Oxprenolol (Trasicor, Slow Trasicor)
Penbutolol (Levatol)
Pindolol (Visken)
Propranolol (Inderal)
Sotolol (Betapace)
Timolol (Blocadren)
Trandate

Beta Blockers/Diuretic Combinations

Corzide
Inderide
Lopressor Hydrochlorothiazide
Tenorectic
Timolide
Ziac

Calcium Channel-Blockers

Amlodipine (Norvasc)
Bepridil (Vascor)
Diltiazem (Cardizem, Dilacor, Tiazac)
Felodipine (Plendil)
Isradipine (Dyna Circ)
Norvasc (Amlodipine)
Nicardipine (Cardene)
Nifedipine (Procardia, Adalat)
Nimodipine (Nimotop)
Nisoldipine (Sular)
Tiazak (Diltiazem HCl)
Verapamil (Covera, Verelan, Calan, Isoptin)

CNS Stimulant

Ma Huang (ephedrine)

Digitalis

Digoxin (Lanoxin)

Eye Drops/ Beta Blockers

- Betagen Eye Drops
- Betoptic Eye Drops
- Levobunolol Eye Drops
- Metipranolol (Optipranolol)
- Timoptic Eye Drops

Nitrates and Nitroglycerin

- Isosorbide Dinitrate (Isordil, Diltrate)
- Isosorbide Mononitrate (Ismo, Monoket)
- Nitroglycerin, Translingual (Nitrostat, Nitrolingual Spray)
- Nitroglycerin, Transmucosal (Nitrogard)
- Nitroglycerin, Topical (Nitrol, Nitro-Bid, Transderm Nitro, Nitro-Dur II, Nitrodisc, Minitran, Deponit, Nitroderm)
- Nitroglycerin, Sustained Release (Nitrong, Nitrocine, Nitroglyn)
- Pentaerythritol Tetranitrate (Cardilate)

Ephedra Based Weight Loss Medication

- Dymetadrine Xtreme
- Extreme Ripped Force
- Metabolife
- Metabolift
- Phentermine
- Pro-Ripped Ephedra
- Ripped Fuel
- Stacker
- Ultra Ripped

**CVDEXCL6: Other specified reasons**

Had been hospitalized for specified reasons in the past 3 months (see the CV Fitness Procedures Manual, Appendix D for details)

Doctor recommended not to participate in sports or other activities due to a health condition

Other safety concerns specified by the participant

Other safety concerns identified by MEC physician or staff