National Health and Nutrition Examination Survey 2005–2006

Documentation, Codebook, and Frequencies

Standard Biochemistry Profile

Laboratory

Survey Years:
2005 to 2006

SAS Transport File:
BIOPRO_D.XPT

March 2008

NHANES 2005–2006 Data Documentation

Laboratory Assessment: Standard Biochemistry Profile (BIOPRO_D)

First Published: March 2008 **Last Revised:** N/A

Update: This file was updated to add serum creatinine results and an analytical note regarding correction of serum creatinine.

Component Description

This battery of measurements are used in the diagnosis and treatment of certain liver, heart, and kidney diseases, acid-base imbalance in the respiratory and metabolic systems, other diseases involving lipid metabolism and various endocrine disorders as well as other metabolic or nutritional disorders.

1. Alanine Aminotransferase (ALT)

Alanine aminotransferase measurements are used in the diagnosis and treatment of certain liver diseases (e.g., viral hepatitis and cirrhosis) and heart diseases. Elevated levels of the transaminases can indicate myocardial infarction, hepatic disease, muscular dystrophy, or organ damage. Serum elevations of ALT activity are rarely observed except in parenchymal liver disease, since ALT is a more liver-specific enzyme than aspartate aminotransferase (AST).

2. Albumin

Albumin measurements are used in the diagnosis and treatment of numerous diseases primarily involving the liver or kidneys.

3. Alkaline Phosphatase (ALP)

Increased ALP activity is associated with two groups of diseases: those affecting liver function and those involving osteoblastic activity in the bones. In hepatic disease, an increase in ALP activity is generally accepted as an indication of biliary obstruction. An increase in serum phosphatase activity is associated with primary hyperparathyroidism, secondary hyperparathyroidism owing to chronic renal disease, rickets, and osteitis deformans juvenilia due to vitamin D deficiency and malabsorption or renal tubular dystrophies. Increased levels of ALP are also associated with Von Recklinghausen's disease with bone involvement and malignant infiltrations of bone. Low levels are associated with hyperthyroidism, and with the rare condition of idiopathic hypophosphatasia associated with rickets and the excretion of excess phosphatidyl ethanolamine in the urine.

4. Aspartate Aminotransferase (AST)

AST measurements are used in the diagnosis and treatment of certain

types of liver and heart disease. Elevated levels of the transaminases can signal myocardial infarction, hepatic disease, muscular dystrophy, or organ damage.

5. Bicarbonate (HCO3)

Together with pH determination, bicarbonate measurements are used in the diagnosis and treatment of numerous potentially serious disorders associated with acid-base imbalance in the respiratory and metabolic systems.

6. Blood Urea Nitrogen (BUN)

BUN measurements are used in the diagnosis of certain renal and metabolic diseases. The determination of serum urea nitrogen is the most widely used test for the evaluation of kidney function. The test is frequently requested in conjunction with the serum creatinine test for the differential diagnosis of prerenal, renal, and postrenal uremia. High BUN levels are associated with impaired renal function, increased protein catabolism, nephritis, intestinal obstruction, urinary obstruction, metallic poisoning, cardiac failure, peritonitis, dehydration, malignancy, pneumonia, surgical shock, Addison's disease, and uremia. Low BUN levels are associated with amyloidosis, acute liver disease, pregnancy, and nephrosis. Normal variations are observed according to a person's age and sex, the time of day, and diet, particularly protein intake.

7. Calcium

Elevated total serum calcium levels are associated with idiopathic hypercalcemia, vitamin D intoxication, hyperparathyroidism, sarcoidosis, pneumocystic carinii pneumonia, and blue diaper syndrome. Low calcium levels are associated with hypoparathyroidism, pseudo-hypoparathyroidism, chronic renal failure, rickets, infantile tetany, and steroid therapy.

8. Cholesterol

An elevated cholesterol level is associated with diabetes, nephrosis, hypothyroidism, biliary obstruction, and those rare cases of idiopathic hypercholesterolemia and hyperlipidemia; low levels are associated with hyperthyroidism, hepatitis, and sometimes severe anemia or infection.

9. Creatinine

Creatinine measurement serves as a test for normal glomerular filtration. Elevated levels are associated with acute and chronic renal insufficiency and urinary tract obstruction. Levels below 0.6 mg/dL are of no significance. **See Analytical Note on Serum Creatinine**

correction.

10. Gammaglutamyl Transaminase (GGT)

GT measurement is principally used to diagnose and monitor hepatobiliary disease. It is currently the most sensitive enzymatic indicator of liver disease, with normal values rarely found in the presence of hepatic disease. It is also used as a sensitive screening test for occult alcoholism. Elevated levels are found in patients who chronically take drugs such as phenobarbital and phenytoin.

11. Glucose

Glucose measurements are used in the diagnosis and treatment of pancreatic islet cell carcinoma and of carbohydrate metabolism disorders, including diabetes mellitus, neonatal hypoglycemia, and idiopathic hypoglycemia.

12. Iron

Iron (non-heme) measurements are used in the diagnosis and treatment of diseases such as iron deficiency anemia, chronic renal disease, and hemochromatosis (a disease associated with widespread deposit in the tissues of two iron-containing pigments, hemosiderin and hemofuscin, and characterized by pigmentation of the skin).

13. Lactate Dehydrogenase (LDH)

LDH measurements are used in the diagnosis and treatment of liver diseases such as acute viral hepatitis, cirrhosis, and metastatic carcinoma of the liver; cardiac diseases such as myocardial infarction; and tumors of the lungs or kidneys.

14. Phosphorus

There is a reciprocal relationship between serum calcium and inorganic phosphorus. Any increase in the level of inorganic phosphorus causes a decrease in the calcium level by a mechanism not clearly understood. Hyperphosphatemia is associated with vitamin D hypervitaminosis, hypoparathyroidism, and renal failure. Hypophosphatemia is associated with rickets, hyperparathyroidism, and Fanconi syndrome.

Measurements of inorganic phosphorus are used in the diagnosis and treatment of various disorders, including parathyroid gland, kidney diseases, and vitamin D imbalance.

15. Sodium, Potassium, and Chloride

Hyponatremia (low serum sodium level) is associated with a variety of

conditions, including severe polyuria, metabolic acidosis, Addison's disease, diarrhea, and renal tubular disease. Hypernatremia (increased serum sodium level) is associated with Cushing's syndrome, severe dehydration due to primary water loss, certain types of brain injury, diabetic coma after therapy with insulin, and excess treatment with sodium salts.

Hypokalemia (low serum potassium level) is associated with body potassium deficiency, excessive potassium loss caused by prolonged diarrhea or prolonged periods of vomiting and increased secretion of mineralocorticosteroids. Hyperkalemia (increased serum potassium level) is associated with oliguria, anuria, and urinary obstruction.

Low serum chloride values are associated with salt-losing nephritis; Addisonian crisis, prolonged vomiting, and metabolic acidosis caused by excessive production or diminished excretion of acids. High serum chloride values are associated with dehydration and conditions causing decreased renal blood flow, such as congestive heart failure.

16. Total Bilirubin

Elevated levels are associated with hemolytic jaundice, paroxysmal hemoglobinuria, pernicious anemia, polycythemia, icterus neonatorum, internal hemorrhage, acute hemolytic anemia, malaria, and septicemia.

Low bilirubin levels are associated with aplastic anemia, and certain types of secondary anemia resulting from toxic therapy for carcinoma and chronic nephritis.

17. Total Protein

Total protein measurements are used in the diagnosis and treatment of a variety of diseases involving the liver, kidney, or bone marrow, as well as other metabolic or nutritional disorders.

18. Triglycerides

Triglyceride measurements are used in the diagnosis of diabetes mellitus, nephrosis, liver obstruction, and other diseases involving lipid metabolism and various endocrine disorders and in the treatment of patients with these diseases.

19. Uric Acid

Uric acid measurements are used in the diagnosis and treatment of numerous renal and metabolic disorders, including renal failure, gout, leukemia, psoriasis, starvation, or other wasting conditions and in the treatment of patients receiving cytotoxic drugs.

Eligible Sample

Participants aged 12 year and older are tested.

Description of Laboratory Methodology

The 18 analytes described in this method constitute the routine biochemistry profile. The analyses are performed with a Beckman Synchron LX20. Each analyte is described separately within each pertinent section of this document. NOTE: Glucose, cholesterol, and triglycerides were analyzed as part of this profile, but the results do not replace the formalized reference methods data from NHANES 2005-2006 samples analyzed at other institutions.

1. Alanine Aminotransferase (ALT)

The LX20 uses an enzymatic rate method to measure ALT activity in serum or plasma. In the reaction, ALT catalyzes the reversible transamination of L-alanine and α-ketoglutarate to pyruvate and L-glutamate. The pyruvate is then reduced to lactate in the presence of lactate dehydrogenase (LDH) with the concurrent oxidation of NADH to NAD. The system monitors the rate of change in absorbance at 340 nm over a fixed-time interval. The rate of change in absorbance is directly proportional to the ALT activity in the sample.

2. Albumin

The method used to measure the albumin concentration on the LX20 is a bichromatic digital endpoint method. In the reaction, the albumin combines with Bromcresol Purple (BCP) reagent to form a complex. The system monitors the change in absorbance at 600 nm. The change in absorbance is directly proportional to the concentration of albumin in the sample.

3. Alkaline Phosphatase (ALP)

The LX system uses an enzymatic rate using a 2-Amino-2-Methyl-1-Propanol (AMP) buffer to measure ALP activity in serum or plasma. In the reaction, the ALP catalyzes the hydrolysis of the colorless organic phosphate ester substrate, p-Nitrophenylphosphate, to the yellow colored product p-Nitrophenol and phosphate. This reaction occurs at an alkaline pH of 10.3. The system monitors the rate of change in absorbance at 410 nm over a fixed-time interval. This rate of change in absorbance is directly proportional to the ALP activity in the serum.

4. Aspartate Aminotransferase (AST)

The LX20 uses an enzymatic rate method to measure the AST activity in serum or plasma. In the reaction, the AST catalyzes the reversible

transamination of L-aspartate and α-ketoglutarate to oxaloacetate and L-glutamate. The oxaloacetate is then reduced to malate in the presence of malate dehydrogenase with the concurrent oxidation of NADH to NAD. The system monitors the rate of change in absorbance at 340 nm over a fixed-time interval. The rate of change in absorbance is directly proportional to the AST activity in the sample.

5. Bicarbonate (HCO3)

The LX20 system uses indirect (or diluted) ISE methodology to measure the total CO_2 level in serum, plasma or urine. The system measures the rate of pH change as CO_2 ions diffuse across a membrane. The electrode used for CO_2 determination is actually a pH electrode with the tip covered by a silicone rubber membrane and lowers the pH of a bicarbonate solution between the tip of the membrane and the tip of the pH electrode. The rate of pH change is directly proportional to the carbon dioxide (CO_2) in the sample.

6. Blood Urea Nitrogen (BUN)

The LX20 modular chemistry (BUNm) is used to quantitatively determine the concentration of blood urea nitrogen in serum or plasma by means of the enzymatic conductivity rate method. A precise volume of sample is injected into the urease reagent in a reaction cup containing an electrode that responds to changes in solution conductivity. Electronic circuits determine the rate of increase in conductivity, which is directly proportional to the concentration of urea in the sample.

7. Calcium

The LX20 system uses indirect (or diluted) ISE methodology to measure calcium concentration in serum, plasma, or urine. The system determines calcium concentration by measuring calcium ion activity in solution. When the sample buffer mixture contacts the electrode, calcium ions complex with the ionophore at the electrode surface. Changes in potential develop at the electrode surface as the reaction occurs. These changes in potential are referenced to a sodium reference electrode. The reference signal is used in calculating the analyte concentrations based on the Nernst equation.

8. Cholesterol

The LX20 uses the timed-endpoint method to measure the cholesterol concentration in serum or plasma. In the reaction, the cholesterol esterase hydrolyzes cholesterol esters to free cholesterol and fatty acids. The free cholesterol is oxidized to cholesten-3-one and hydrogen peroxide by cholesterol oxidase. Peroxidase catalyzes the reaction of hydrogen peroxide with 4-aminoantipyrine and phenol to produce a

colored quinoneimine product. The system monitors the change in absorbance at 520 nm at a fixed-time interval. The change in absorbance is directly proportional to the concentration of cholesterol in the sample.

9. Creatinine

The LX20 modular chemistry side uses the Jaffe rate method (kinetic alkaline picrate) to determine the concentration of creatinine in serum, plasma, or urine. A precise volume of sample is introduced into a reaction cup containing an alkaline picrate solution. Absorbance readings are taken at both 520 nm and 560 nm. Creatinine from the sample combines with the reagent to produce a red color complex. The observed rate measurement at 25.6 seconds after sample introduction has been shown to be a direct measure of the concentration of the creatinine in the sample. **See Analytical Note on Serum Creatinine correction.**

10. Gammaglutamyl Transaminase (-GT)

The LX uses an enzymatic rate method to determine the GGT activity in serum or plasma. In the reaction, the GGT catalyzes the transfer of a gamma-glutamyl group from the colorless substrate, gamma-glutamyl-p-nitroaniline, to the acceptor, glycylglycine with production of the colored product, p-nitroaniline. The system monitors the rate of change in absorbance at 410 nm over a fixed-time interval. The rate of change in absorbance is directly proportional to the activity of GGT in the sample.

11. Glucose

On the Modular Chemistry side of the LX20, glucose concentration in biologic fluids is determined by the oxygen rate method employing a Beckman Oxygen electrode. A precise volume of sample is introduced in a reaction cup containing an electrode that responds to oxygen concentration. Electronic circuits determine the rate of oxygen consumption, which is directly proportional to the concentration of glucose in the sample.

12. Iron

The method used to measure the iron concentration is a timed-endpoint method. In the reaction, iron is released from transferrin by acetic acid and is reduced to the ferrous state by hydroxylamine and thioglycolate. The ferrous ion is immediately complexed with the FerroZine Iron Reagent. The system monitors the change in absorbance at 560 nm at a fixed-time interval. This change in absorbance is directly proportional to the concentration of iron in the sample

13. Lactate Dehydrogenase (LDH)

The LX20 with LD reagent (using lactate as substrate) utilizes an enzymatic rate method to measure LD activity in biological fluids. In the reaction, the LD catalyzes the reversible oxidation of L-Lactate to Pyruvate with the concurrent reduction of ß-Nicotinamide Adenine Dinucleotide (NAD) to ß-Nicotinamide Adenine Dinucleotide (reduced form) (NADH). The system monitors the rate of change in absorbance at 340 nm over a fixed-time interval. The rate of change in absorbance is directly proportional to the activity of LD in the sample.

14. Phosphorus

The LX system uses a timed-rate method to determine the concentration of phosphorus in serum, plasma and urine. In the reaction, inorganic phosphorus reacts with ammonium molybdate in an acidic solution to form a colored phosphomolybdate.

15. Sodium, Potassium, and Chloride

The LX system utilizes indirect (or diluted) I.S.E. methodology to determine the concentration of sodium in biological fluids. The LX determines sodium ion concentration by measuring electrolyte activity in solution. When the sample/buffer mixture contacts the electrode, sodium ions undergo an ion exchange in the hydrated outer layer of the glass electrode. As the ion exchange takes place, a change in voltage (potential) is developed at the face of the electrode. The potential follows the Nernst equation and allows the calculation of sodium concentration in a solution.

The LX system uses indirect (or diluted) I.S.E. methodology to measure potassium in biological fluids. The system determines potassium ion concentration by measuring electrolyte activity in solution. The potassium electrode consists of valinomycin membrane. The voltage (potential) change that takes place within the membrane follows the Nernst equation and allows the calculation of potassium concentration in solution.

The LX system uses indirect (or diluted) I.S.E. methodology to determine chloride concentration in biological fluids. Chloride is measured using an Ag/AgCl electrode. At the face of the electrode, solid AgCl dissolves to the extent as to saturate the solution around the tip with silver (Ag+) and Chloride (Cl-) ions until equilibrium is established. The product of the ion concentrations in solution, at equilibrium, with an excess of the slightly soluble AgCl is defined as the solubility product constant (Ksp). When chloride sample is added, the Ksp of the solution at the tip is disrupted as AgCl precipitates out of solution. To reestablish the equilibrium, Ag+ ions are generated from the tip causing a change in the potential. According to the Nernst

equation, this change is proportional to the concentration of chloride in the sample.

16. Total Bilirubin

The LX20 uses a timed-endpoint Diazo method to measure the concentration of total bilirubin in serum or plasma. In the reaction, bilirubin reacts with diazo reagent in the presence of caffeine, benzoate, and acetate as accelerators to form azobilirubin. The system monitors the change in absorbance at 520 nm at a fixed-time interval. This change in absorbance is directly proportional to the concentration of total bilirubin in the sample.

17. Total Protein

The LX20 uses a timed rate biuret method to measure the concentration of total protein in serum or plasma. Proteins in the sample combine with the reagent producing alkaline copper-protein chelate. The rate change in absorbance is monitored by a detector at 545 nm. The observed rate of chelate formation is directly proportional to the total protein concentration in the sample.

18. Triglycerides

The LX uses a timed-endpoint method to determine the concentration of triglycerides in serum or plasma. Triglycerides in the sample are hydrolyzed to glycerol and free fatty acids by the action of lipase. A sequence of three coupled enzymatic steps using glycerol kinase (GK), glycerophosphate oxidase (GPO), and horseradish peroxidase (HPO) causes the oxidative coupling of 3,5-dichloro-2-hydroxybenzenesulfonic acid (DHBS) with 4-aminoantipyrine to form a red quinoneimine dye. The system monitors the change in absorbance at 520 nm for a fixed-time interval. The change in absorbance is directly proportional to the concentration of triglycerides in the sample.

19 Uric acid

The LX20 uses a timed endpoint method to measure the concentration of uric acid in serum, plasma or urine. Uric acid is oxidized by uricase to produce allatoin and hydrogen peroxide. The hydrogen peroxide reacts with 4-aminoantipyrine (4-AAP) and 3, 5-dichloro-2-hydroxybenzene sulfonate (DCHBS) in a reaction catalyzed by peroxidase to produce a colored product. The system monitors the change in absorbance at 520 nm at a fixed time interval. The change in absorbance is directly proportional to the concentration of uric acid in the sample.

There were no changes to the equipment, method or laboratory.

A detailed description of the laboratory methods used can be found at

NHANES website.

Laboratory Quality Control and Monitoring

The NHANES quality control and quality assurance protocols (QA/QC) meet the 1988 Clinical Laboratory Improvement Act mandates. Detailed quality control and quality assurance instructions are discussed in the NHANES Laboratory/Medical Technologists Procedures Manual (LPM). Read the LABDOC file for detailed QA/QC protocols

A detailed description of the quality assurance and quality control procedures can be found on the NHANES website.

Data Processing and Editing

Specimens were processed, stored and shipped to Collaborative Laboratory Services in Ottumwa, Iowa. Detailed specimen collection and processing instructions are discussed in the NHANES Laboratory/Medical Technologists Procedures Manual (LPM). Read the LABDOC file for detailed data processing and editing protocols. The analytical methods are described in the Description of the Laboratory Methodology section.

Many derived variables were created in this data file. The formula for their derivation is as follows:

LBDSALSI:
The albumin in g/dL (LBXSAL) was converted to g/L (LBDSALSI) by multiplying by 10.

LBDSBUSI:
The blood urea nitrogen (BUN) in mg/dL (LBXSBU) was converted to mmol/L (LBDSBUSI) by multiplying by 0.357

LBDSCASI
The calcium in mg/dL (LBXSCA) was converted to mmol/L (LBDSCASI) by multiplying by 0.250

LBDSCHSI
The cholesterol in mg/dL (LBXSCH) was converted to mmol/L (LBDSCHSI) by multiplying by 0.02586.

LBDSCRSIThe creatinine in mg/dL(LBXSCR) was converted to µmol/L (LBDSCRSI) by multiplying by 88.4.

LBDSGLSI
The glucose in mg/dL (LBXSGL) was converted to mmol/L (LBDSGLSI) by multiplying by 0.05551.

LBDSIRSI
The iron in µg/dL (LBXSIR) was converted to µmol/L (LBDSIRSI) by multiplying by 0.1791.

LBDSPHSI
The phosphorus in mg/dL (LBXSPH) was converted to mmol/L (LBDSPHSI) by multiplying by 0.3229.

LBDSTBSI
The total bilirubin in mg/dL (LBXSTB) was converted to µmol/L (LBDSTBSI) by multiplying by 17.1.

LBDSTPSI
The total protein in g/dL (LBXSTP) was converted to g/L (LBDSTPSI) by multiplying by 10.

LBDSTRSI
The triglycerides in mg/dL (LBXSTR) were converted to mmol/L (LBDSTRSI) by multiplying by 0.01129.

LBDSUASI
The uric acid in mg/dL (LBXSUA) was converted to µmol/L (LBDSUASI) by multiplying by 59.48.

LBDSGBSI
The globulin in g/dL (LBXSGB) was converted to g/L (LBDSGBSI) by multiplying by 10.

Detailed instructions on specimen collection and processing can be found at the NHANES website.

Analytic Notes

The analysis of NHANES 2005-2006 laboratory data must be conducted with the key survey design and basic demographic variables. The NHANES 2005-2006 Household Questionnaire Data Files contain demographic data, health indicators, and other related information collected during household interviews. They also contain all survey design variables and sample weights for these age groups. The phlebotomy file includes auxiliary information such as the conditions precluding venipuncture. The household questionnaire and phlebotomy files may be linked to the laboratory data file using the unique survey participant identifier SEQN.

LBXSTR:

This value was obtained from the standard battery of biochemical assessments. Use of the laboratory test result from the reference method (LBXTR), rather than the (LBXSTR) value, is generally recommended. For most triglyceride analyses, the appropriate variable

to use is (LBXTR). The value from the biochemistry profile (LBXSTR) should not be used routinely.

LBXSCH:

This value was obtained from the standard battery of biochemical assessments. Use of the laboratory test result from the reference method (LBXTC), rather than the (LBXSCH) value, is generally recommended. For most analyses of serum cholesterol, the appropriate variable to use will be (LBXTC). The (LBXSCH) value from the biochemistry profile should not be used routinely

LBXSGL

This value was obtained from the standard battery of biochemical assessments. Use of the laboratory test result from the reference method (LBXGLU), rather than the (LBXSGL) value, is generally recommended. These serum glucose values (LBXSGL) reported in this release should not be used to determine undiagnosed diabetes or prediabetes. Instead, plasma glucose values (LBXGLU) should be used based on the reference analytic method of this analyte. Use the special weights included in this glucose data file when analyzing data.

Correction of serum creatinine values in NHANES 2005-2006 <u>is highly recommended</u>:

Serum creatinine was assayed from a random sample of 195 stored specimens from participants aged 60 years or older in NHANES 2005-2006 to determine if the original values obtained by the NHANES laboratory were comparable to values obtained from a method traceable to a “gold standard” (and referred to as “standard creatinine”). The Cleveland Clinic Foundation Research Laboratory (CCRL) analyzed the serum creatinine specimens using a Roche coupled enzymatic assay (creatininase, creatinase, sarcosine oxidase, kits # 1775677 and 1775766) performed on a Roche P Module instrument. College of American Pathologists (CAP) Creatinine Accuracy Calibration Verification/Linearity Survey LN24 (LN24) samples were used as accuracy controls to verify that the calibration of the Roche enzymatic method was traceable to LC-IDMS and correctly implemented in the CCRL. The Roche method exhibits total imprecision ranging from 1.2% C.V. at 1.00 mg/dL (88.4 mol/L) to 1.6% at 3.84 mg/dL (339.5 mol/L). Serum creatinine by the Roche method was compared to the original NHANES 2005-2006 measurements which used a Jaffe rate method performed on a Beckman Synchron LX20. The design and methods for this calibration study were identical to those used for the NHANES III, 1999-2000, 2001-2002, and 2003-2004 surveys (1).

Consistent with previous methods, extreme outliers (difference > 3

standard deviations (SDs) from the mean; equivalent to 0.3% of observations from a normal distribution) were excluded under the premise that these outliers would not contribute useful information to the calibration since they are thought to have arisen through different (non-method related) processes such as inadequate mixing, evaporation, mislabeling, etc. We also excluded one observation with serum creatinine values greater then three standard deviations from the mean on both assays. These clear outliers both had serum creatinine values of greater than 3 mg/dL.

Comparison of means and regression analysis revealed high overall agreement but a significant difference between the two methods (bias). The mean (SD) serum creatinine at CCRL, NHANES, and their difference were 1.010 (0.313), 1.049 (0.320), and -0.040 (0.047) mg/dL, respectively (paired t-test, $p < 0.0001$). The Pearson's correlation was 0.989. The Deming regression of CCRL (Y) on NHANES (X) had an intercept of -0.016 (SE, 0.008) and a slope of 0.978 (SE, 0.007). Thus, a correction of the NHANES 2005-2006 serum creatinine values is highly recommended. The following formula should be used to adjust the NHANES serum creatinine values to ensure comparability with standard creatinine:

Standard creatinine (mg/dL) = -0.016 + 0.978 X (NHANES 05-06 uncalibrated serum creatinine, mg/dL)

References

1. Selvin E, Manzi J, Stevens LA, Van Lente F, Lacher DA, Levey AS et al. Calibration of serum creatinine in the National Health and Nutrition Examination Surveys (NHANES) 1988-1994, 1999-2004. *Am J Kidney Dis* 2007; 50(6):918-926.

Locator Fields

Title: Biochemistry Profile

Contact Number: 1-866-441-NCHS

Years of Content: 2005–2006

First Published: March 2008

Last Revised: N/A

Access Constraints: None

Use Constraints: None

Geographic Coverage: National

Subject: Biochemistry Profile

Record Source: NHANES 2005–2006

Survey Methodology: NHANES 2005–2006 is a stratified multistage probability sample of the civilian non-institutionalized population of the U.S.

Medium: NHANES Web site; SAS transport files

National Health and Nutrition Examination Survey
Codebook for Data Production (2005-2006)

Standard Biochemistry Profile (BIOPRO_D)

March 2008

SEQN	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Respondent sequence number
English Text: Respondent sequence number.	
English Instructions:	

LBXSAL	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Albumin (g/dL)
English Text: Albumin (g/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
2.3 to 5.4	Range of Values	6434	6434	
.	Missing	546	6980	

LBDSALSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Albumin (g/L)
English Text: Albumin (g/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
23 to 54	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSATSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Alanine aminotransferase ALT (U/L)
English Text: Alanine aminotransferase ALT (U/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
5 to 272	Range of Values	6349	6349	
.	Missing	631	6980	

LBXSASSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Aspartate aminotransferase AST (U/L)
English Text: Aspartate aminotransferase AST (U/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
9 to 193	Range of Values	6349	6349	
.	Missing	631	6980	

LBXSAPSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Alkaline phosphotase (U/L)
English Text: Alkaline phosphotase (U/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
20 to 646	Range of Values	6433	6433	
.	Missing	547	6980	

LBXSBU	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Blood urea nitrogen (mg/dL)
English Text: Blood urea nitrogen (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1 to 98	Range of Values	6434	6434	
.	Missing	546	6980	

LBDSBUSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Blood urea nitrogen (mmol/L)
English Text: Blood urea nitrogen (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.36 to 34.99	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSCA	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Total calcium (mg/dL)
English Text: Total calcium (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
6.9 to 12.7	Range of Values	6434	6434	
.	Missing	546	6980	

LBDSCASI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Total calcium (mmol/L)
English Text: Total calcium (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1.725 to 3.175	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSCH	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Cholesterol (mg/dL)
English Text: Cholesterol (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
72 to 649	Range of Values	6433	6433	
.	Missing	547	6980	

LBDSCHSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Cholesterol (mmol/L)
English Text: Cholesterol (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1.862 to 16.783	Range of Values	6433	6433	
.	Missing	547	6980	

LBXSC3SI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Bicarbonate (mmol/L)
English Text: Bicarbonate (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
16 to 38	Range of Values	6349	6349	
.	Missing	631	6980	

LBXSCR	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Creatinine (mg/dL)
English Text: Creatinine (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.4 to 17.8	Range of Values	6434	6434	
.	Missing	546	6980	

LBDSCRSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Creatinine (umol/L)
English Text: Creatinine (umol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
35.36 to 1573.52	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSGTSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Gamma glutamyl transferase (U/L)
English Text: Gamma glutamyl transferase (U/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
5 to 1681	Range of Values	6425	6425	
4	Below Detection Limit Fill Value	7	6432	
.	Missing	548	6980	

LBXSGL	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Glucose, serum (mg/dL)
English Text: Glucose, serum (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
42 to 513	Range of Values	6434	6434	
.	Missing	546	6980	

LBDSGLSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Glucose, serum (mmol/L)
English Text: Glucose, serum (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
2.33 to 28.48	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSIR	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Iron, refigerated (ug/dL)
English Text: Iron, refigerated (ug/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
5 to 382	Range of Values	6432	6432	
.	Missing	548	6980	

LBDSIRSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Iron, refigerated (umol/L)
English Text: Iron, refigerated (umol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.9 to 68.4	Range of Values	6432	6432	
.	Missing	548	6980	

LBXSLDSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Lactate dehydrogenase LDH (U/L)
English Text: Lactate dehydrogenase LDH (U/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
35 to 759	Range of Values	6348	6348	
.	Missing	632	6980	

LBXSPH	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Phosphorus (mg/dL)
English Text: Phosphorus (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1.9 to 8.1	Range of Values	6432	6432	
.	Missing	548	6980	

LBDSPHSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Phosphorus (mmol/L)
English Text: Phosphorus (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.614 to 2.615	Range of Values	6432	6432	
.	Missing	548	6980	

LBXSTB	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Total bilirubin (mg/dL)
English Text: Total bilirubin (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.1 to 13.1	Range of Values	6432	6432	
.	Missing	548	6980	

LBDSTBSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Bilirubin, total (umol/L)
English Text: Bilirubin, total (umol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1.71 to 224.01	Range of Values	6432	6432	
.	Missing	548	6980	

LBXSTP	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Total protein (g/dL)
English Text: Total protein (g/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
4.7 to 10.9	Range of Values	6422	6422	
.	Missing	558	6980	

LBDSTPSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Total protein (g/L)
English Text: Total protein (g/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
47 to 109	Range of Values	6422	6422	
.	Missing	558	6980	

LBXSTR	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Triglycerides (mg/dL)
English Text: Triglycerides (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
14 to 2566	Range of Values	6431	6431	
.	Missing	549	6980	

LBDSTRSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Triglycerides (mmol/L)
English Text: Triglycerides (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.158 to 28.97	Range of Values	6431	6431	
.	Missing	549	6980	

LBXSUA	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Uric acid (mg/dL)
English Text: Uric acid (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.5 to 17.6	Range of Values	6433	6433	
.	Missing	547	6980	

LBDSUASI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Uric acid (umol/L)
English Text: Uric acid (umol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
29.7 to 1046.8	Range of Values	6433	6433	
.	Missing	547	6980	

LBXSNASI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Sodium (mmol/L)
English Text: Sodium (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
99 to 146	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSKSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Potassium (mmol/L)
English Text: Potassium (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
2.4 to 5.8	Range of Values	6433	6433	
.	Missing	547	6980	

LBXSCLSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Chloride (mmol/L)
English Text: Chloride (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
73 to 115	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSOSSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Osmolality (mmol/Kg)
English Text: Osmolality (mmol/Kg)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
201 to 307	Range of Values	6434	6434	
.	Missing	546	6980	

LBXSGB	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Globulin (g/dL)
English Text: Globulin (g/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1.2 to 7.1	Range of Values	6422	6422	
.	Missing	558	6980	

LBDSGBSI	Target
	B(12 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Globulin (g/L)
English Text: Globulin (g/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
12 to 71	Range of Values	6422	6422	
.	Missing	558	6980	