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| **Fasting Serum Insulin** | |
| **Protocol Id** | 141301 |
| **Version #** | 1 |
| **Description of Protocol** | This protocol provides instructions for drawing, processing and storing blood according to the National Health and Nutrition Examination Survey (NHANES) methods. As there are no standard assays for insulin, the protocol also provides basic guidelines to aid comparability among different studies. |
| **Specific Instructions** | Although all three are valuable standalone measures and all should be collected if resources are available, the Diabetes Working Group recommends that investigators prioritize Insulin 1st, C-peptide 2nd and Proinsulin 3rd. This is because results from the Insulin bioassay can be combined with results from Fasting Plasma Glucose bioassay to derive the homeostatic model assessment (HOMA) of insulin resistance and pancreatic beta cell function.  The Diabetes Working Group notes that while it is not the preferred method, the Serum Insulin Assay can be performed on individuals who have not met the fasting requirements.  The Diabetes Working Group notes that there are also protocols to collect samples for Serum Insulin concentrations at 0, 30, 60, 90 and 120 minutes and that this could be done at the same time as the Oral Glucose Tolerance Test. Such protocols would give extra specificity and information but would increase the burden on both the participant and investigator. |
| **Protocol Text** | The following is a summary version of the full National Health and Nutrition Examination Survey 2007-2008 protocol.  **Exclusion Criteria**  Persons will be *excluded*from this component if they:  • Report that they have hemophilia;  • Report that they have received cancer chemotherapy in the last 3 weeks; and • Report that they have not fasted at least 9 hours.  *SP= Sample Person.*  1. Did you eat or drink anything other than plain water after [Insert time at 9 hours prior to sample collection] last night?           [ ] Yes           [ ] No           [ ] Refused           [ ] Don’t Know  If answer is "No" then he or she **has met**the 9-hour fast. If answer is "Yes", "Don’t know", or "Refused", then the actual fasting time is unknown.  Confirmation Question:  2. Have you had any of the following since {insert time from 1 here}?  Coffee or tea with cream and sugar? [Include milk or non-dairy creamers.]           [ ] Yes If Yes, record time and date\_\_\_\_\_\_\_\_\_\_\_\_\_           [ ] No  Alcohol, such as beer, wine, or liquor?           [ ] Yes If Yes, record time and date\_\_\_\_\_\_\_\_\_\_\_\_\_           [ ] No  Gum, breath mints, lozenges, or cough drops, or other cough or cold remedies?           [ ] Yes If Yes, record time and date\_\_\_\_\_\_\_\_\_\_\_\_\_           [ ] No  Antacids, laxatives, or anti-diarrheals?           [ ] Yes If Yes, record time and date\_\_\_\_\_\_\_\_\_\_\_\_\_           [ ] No  Dietary Supplements such as vitamins and minerals? [Include multivitamins and single nutrient supplements.]           [ ] Yes If Yes, record time and date\_\_\_\_\_\_\_\_\_\_\_\_\_           [ ] No  *Note from the Diabetes Working Group: Rather than asking if the subject had anything to eat or drink after 11:30, the Working Group notes that is acceptable to record the current time and time when the subject last had anything other than plain water.*  3. Do you have hemophilia?  **1**  [ ]  Yes  **2**  [ ]  No  **7**  [ ]  Refused  **9**  [ ]  Don’t Know  If the SP answers, "Yes," the SP is excluded from the blood draw. If SP answer "No" or "Don’t Know," blood is drawn from the SP.  4. Have you received cancer chemotherapy in the past four weeks or do you anticipate such therapy in the next four weeks?  **1**  [ ]  Yes  **2**  [ ]  No  **7**  [ ]  Refused  **9**  [ ]  Don’t Know  If the SP answers, "Yes," the SP is excluded from the blood draw. If SP answer "No" or "Don’t Know," blood is drawn from the SP.  *Note from the Diabetes Working Group: The investigator should record the reason a sample person is excluded from the blood draw, whether the subject is fasting, and the number of hours since the last meal.*  **Venipuncture Procedures**  *Editor’s Note:**Please review chapter 4 of the Laboratory Procedures Manual from the National Health and Nutrition Examination Survey for a full description of Phlebotomy procedures.*[2007-2008 NHANES Lab Manual](file:///C:\Users\hpan\Downloads\toolkit_content\supplemental_info\diabetes\additional_info\NHANES_Lab_Manual.pdf)*.*  Venipuncture should generally be performed using the median cubital, cephalic, or basilic veins in the left arm unless this arm is unsuitable. If the veins in the left arm are unsuitable, look for suitable veins on the right arm. If the veins in the antecubital space on both arms are not suitable, then look for veins in the forearm or dorsal side of the hand on the left arm/hand and then the right arm/hand.  *Note from the Diabetes Working Group: Blood should be collected in an appropriate 5- or 10-mL red-top tube or serum separator tube.*  **Recording the Results of the Venipuncture Procedure**  Immediately after completing the venipuncture, record the results of the blood draw, the reasons for a tube not being drawn according to the protocol, and any comments about the venipuncture.  *Note from the Diabetes Working Group: The Diabetes Working Group recommends that the investigator record whether the blood was drawn and whether the full amount was obtained.*  **Blood Processing**  *Editor’s Note: Please review chapter 8 of the Laboratory Procedures Manual from the National Health and Nutrition Examination Survey 2007-2008 for a full description of Blood Processing procedures:*[2007-2008 NHANES Lab Manual](file:///C:\Users\hpan\Downloads\toolkit_content\supplemental_info\diabetes\additional_info\NHANES_Lab_Manual.pdf)*.*  • Allow the blood to clot by setting aside for 30 to 45 minutes at room temperature. Do not clot for more than an hour.  • Centrifuge the tube at room temperature to separate the serum and aliquot into an appropriate storage tube.  • Determine if the serum is hemolyzed, turbid, lipemic, or icteric. If so, enter a comment to describe the plasma.  *Note from the Diabetes Working Group****:****Serum should be stored at -80°C until testing and shipped on dry ice to prevent thawing.*  **Laboratory Assay for Serum Insulin**  The Diabetes Working Groups notes that although there is not a standardized assay, there are a number of different kits which are appropriate to measure the concentration of insulin in serum. Once an assay is chosen for a particular study, the Working Group recommends that no changes in the protocol be made over the course of the study. To aid comparability, the Diabetes Working Group recommends that the investigator record the make and manufacturer of equipment used and the repeatability and coefficients of variation for the assay.  **Reference Ranges:**  Concentrations of fasting insulin normally ranges between 3 and 17 uU/mL |
| **Selection Rationale** | The National Health and Nutrition Examination Survey 2007-2008 protocol was selected as the best, standardized methodology for blood collection, processing and storage. Serum insulin has been measured in the NHANES since 1988. |
| **Source** | Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey Questionnaire. Laboratory Procedures Manual. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2007. |
| **Language** | English, Spanish |
| **Participant** | Participants 6 years of age and older. |
| **Personnel and Training Required** | Phlebotomist Laboratory capable of performing insulin assay |
| **Equipment Needs** | Phlebotomy supplies |
| **Standards** | |  |  |  |  | | --- | --- | --- | --- | | **Standard** | **Name** | **ID** | **Source** | | Common Data Elements (CDE) | Hematology Fasting Serum Insulin Laboratory Procedure Result Value in mU/L | 3070721 | [CDE Browser](https://cdebrowser.nci.nih.gov/CDEBrowser/search?elementDetails=9&FirstTimer=0&PageId=ElementDetailsGroup&publicId=3070721&version=1.0) | | Logical Observation Identifiers Names and Codes (LOINC) | Fasting serum insulin proto | 62805-7 | [LOINC](http://s.details.loinc.org/LOINC/62805-7.html?sections=Web) | |
| **General References** | American Diabetes Association. (2010). Diagnosis and classification of diabetes mellitus. *Diabetes Care*, 33 (Supplement 1), S11 - S61. |
| **Protocol Type** | Bioassay |
| **Derived Variables** | **Homeostasis model assessment (HOMA) of insulin resistance and beta cell function**  insulin resistance = (glucose (mg/dL) X insulin (ųU/mL))/405  percent B-cell function = (20 X insulin (ųU/mL)) / (glucose (mg/dL)/ - 63)  or  insulin resistance = (glucose (mmol/L) X insulin (ųU/mL))/22.5  percent B-cell function = (20 X insulin (mg/dL)) / (glucose (mmol/L)/ - 3.5)  Matthews, DR, Hosker, JP, Rudenski, AS, Naylor, BA, Treacher, DF, & Turner, RC. (1985). Homeostasis model assessment: insulin resistance and b-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia*, 28(7), 412-419. |
| **Requirements** | |  |  | | --- | --- | | **Requirement Category** | **Required** | | Average time of greater than 15 minutes in an unaffected individual  Average time of greater than 15 minutes in an unaffected individual | **Yes** | | Major equipment  This measure requires a specialized measurement device that may not be readily available in every setting where genome wide association studies are being conducted. Examples of specialized equipment are DEXA, Echocardiography, and Spirometry | No | | Specialized requirements for biospecimen collection  This protocol requires that blood, urine, etc. be collected from the study participants. | No | | Specialized training  This measure requires staff training in the protocol methodology and/or in the conduct of the data analysis. | No | |