



SKINFOLD ASSESSOR HANDBOOK

2021-22

The Michigan Weight Monitoring Program is a program of education and regulation for wrestlers, coaches and families regarding healthy weight control prior to and throughout the MHSAA wrestling season.

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THE PROGRAM

The primary purpose for this program is to insure the future and safety of scholastic wrestling programs in the State of Michigan. It has been developed in response to the concern for guidance of young wrestlers as they make decisions about diet, nutrition, and weight control. It has been documented that wrestlers often attempt to lose weight rapidly to gain a perceived advantage over their opponent. The program is designed to assist in avoiding potentially harmful rapid weight reduction practices utilized to achieve specific weight class participation.

COMPONENTS

The program consists of three parts.

1. The Nutrition Education Program
2. The Regulation
3. In-Service of Skinfold Instructors and Assessors

This manual addresses the assessor “In-Service” and the assessment aspect of “The Regulation,” but it is important that you, the assessor, are aware of the nature of the total program. Coaches, parents and administrators will ask questions about the program as you deliver the service of skinfold assessment, so it will be important to become aware of its total implications. The document “WEIGHT MONITORING PROGRAM” provides the information you will need to respond to questions regarding the program. In addition, frequently asked questions, “Program Facts,” are incorporated within the *Weight Monitoring Program* to assist in answering typical questions related to the program. Other information has been provided throughout the manual to assist you with background information. Of specific interest is the material from such organizations as the American College of Sports Medicine and other such influential groups. Articles from professional periodicals that support the assessment process and the program are particularly helpful since they will provide research, scientific and empirical information.

IN-SERVICE EDUCATION AND REGISTRATION

This in-service education program is designed to identify, select, and register individuals capable of serving as “assessors” for the regulation aspect of the program. Those qualifying as “instructors” will also be registered as “assessors”. All would be assessors are required to attend an annual in-service. The class fee must be pre-paid or paid at the site for credit to be given.

PROFESSIONAL RESPONSIBILITIES

It is considered a “conflict of interest” for an active wrestling coach, at any level, to become a registered Skinfold Assessor.

When an individual is registered with the MHSAA as an “assessor” there is an automatic concern for professional responsibility. There is an expectation of the highest professional and ethical conduct relative to performing assessments on the young wrestlers in Michigan. These young wrestlers should be treated with the highest regard for their “right to privacy” and for the confidentiality of all data collected on them for this program. As an MHSAA registered assessor you are expected to conduct yourself in a manner such that there will be no question about your positive contribution to the participants in the sport of wrestling. There will be times when professional judgment will be involved to clarify and validate the assessment process; the greater the depth of

your understanding of body composition assessment, the more able you will be in representing the MHSAA and the program.

BODY COMPOSITION

The human body can be represented as composed of at least two components:

1. Lean Body Mass (LBM) = the muscle and bone mass predicted to be in the body and
2. Body Fat (BF) = essential and non-essential fat storage predicted to be in the body

To some, this is an over simplification. The actual composition of an individual's body is probably not truly known, nor can it actually be determined. All current methods of assessing body composition are indirect methods or predictions of the actual values. While underwater (hydrostatic) weighing has long been considered the "gold standard" (the method to which all other methods of body composition determination have been related) it too has been critically reviewed as having the possibility for error. Population specificity, maturation, and sub-component validity have all been cited as having potential negative impact on hydrostatic body composition assessment. Current technology and its improvement will continue to lead researchers to develop new methods and refine those which currently exist. This will require that those of us assessing body composition through various field techniques must continue to update our knowledge and remain current relative to adjustments in assessment procedures.

PREDICTION OF BODY COMPOSITION

There are a number of field techniques available to attempt to assess body composition. Following is a brief description of some common techniques:

1. **Bioelectric Impedance analysis (BIA)**: A fairly modern technique which utilizes electrode attachment to the extremities and a small (safe) electrical current to determine the conductivity of lean tissue verses fat tissue. It is programmed to calculate lean body mass and percent body fat. The instrument costs about \$3000 to \$6000, is subject to hydration level of subject and is programmed for use on adults.
2. **Skeletal Anthropometric Widths (SAW)**: This method was developed by Tipton et.al. specifically for the wrestling population in Iowa. It utilizes diameter assessment with two types of anthropometric calipers on the chest, hip, and ankle joint areas along with height and weight. A prediction equation includes these various measurements to calculate minimal wrestling weight.
3. **Near Infra-Red technology (NIR)**: This is a method that was developed to determine the legal fat content of packaged meats for human consumption. It utilizes the theory of the passage of light waves through lean muscle tissue verses fat tissue. The cost of the units ranges from \$1000 to \$2000 and purport rapid and non-invasive assessment. Ultrasound technology has also been used in a similar manner to determine fat deposition.
4. **Computed Tomography (CT)**: This is an example of another technology being adapted to the study of body composition. It was developed for the detection of normal verses pathological internal body components. Although few CT scan units are used strictly for determination of body composition, it may be the most valid potential assessment device currently available. As such it may define a new "gold standard" for body composition assessment.

5. **Bod Pod (BP)**: This is an example of new technology being adapted to the study of body composition. It uses many of the same principles as hydrostatic weighing but uses air displacement instead of water displacement. As such it may define a new “gold standard” for body composition assessment.
6. **Hydrostatic Weighing (HSW)**: This is an ancient method (Archimedes’ principle) adapted to the body composition assessment problem in recent times. It involves the submersion of an individual to determine the subject’s under water weight which is used along with the weight on land to calculate the body density. It utilizes the concept that muscle mass and fat mass have specific known densities relative to water. The assessment of residual volume of the lungs is an important feature of this assessment. The availability of a proper space and equipment is a problem with this method, but it can be very accurate if all the conditions of assessment are met.
7. **Skinfold Assessment (SFA)**: This is a current method which has gained popularity with the exercise and fitness community. It is based on the relationship between subcutaneous fat and total body fat and its inverse relationship to body density. The subject is measured at a selected number of sites to determine the thickness of the skin and the subcutaneous fat deposition. The skinfold thickness is used in a regression equation to calculate body density. The regression equations have been derived for specific populations, which is a key to validity of the prediction. The cost of accurate calipers range from \$200 to \$450.

METHOD COMPARISON

The assessment of all wrestlers may begin on **October 25 2021**. Given the methods reviewed above to accomplish this task the appropriate choice is skinfold assessment. There has been more work done to establish population specific methods, procedures, and calculations with the skinfold method than with any other method. The cost of the methods is also a factor to consider in the selection of a program. Standardization of procedures is a major factor in the control of validity and reliability. This can be best accomplished to insure accurate reproducible and fair results in an economically controlled environment through the skinfold assessment procedures.

SKINFOLD ASSESSMENT TERMINOLOGY

The use of skinfold assessment in the process of determination of body composition requires some standardization of terminology used in this field. The following is an attempt to accomplish this standardization:

1. **Total Body Weight (TBW)** = weight of the body on a certified, calibrated scale.
2. **Body Density (BD)** = the mass of the body per unit of volume. (The fat free component is assumed to have a density of 1.100 gm/cm³. the mass of fat is considered to be about .90 gm/cm³.)
3. **Percent Body Fat (%BF)** = the proportion of total body weight that is fat weight and expressed as a percentage. $\%BF = (TBW - LBM) / (TBW) \times 100$
4. **Lean Body Mass (LBM)** = the weight of the lean tissue of the body such as muscle, bone, and blood. The weight of the body without the fat weight. $LBM = TBW - FW$.
5. **Fat Weight (FW)** = the weight of the fat tissue of the body. Includes both essential and stored fat tissue. $FW = TBW \times \%BF$

6. **Minimum Wrestling Weight (MWW)** = the lowest weight at which a wrestler may compete, determined to be 7 % male , 12% female, body fat for the Michigan Wrestling Monitoring Program
7. **Ideal Body Weight** = a body weight selected for a specific individual or group based on both empirical and scientific evidence that provides an optimum level of performance.
8. **Minimum Weight** = a body weight selected for a specific individual or group based on a specific percent body fat. A minimal, but not necessarily ideal or optimum body weight
9. **Regression Equations** = equations which express the relationship (based on correlation) between the criterion measure (gold standard) and the prediction measure. In skinfold assessment these are determined for specific combinations of sites, and specific populations.
10. **Population Specificity** = the attempt to make prediction calculation (equations) on representative subjects from specific groups of individuals, the results of which are intended to be applied to a similar, larger population. In skinfold assessment for body composition the important specific factors are sex, age, national origin, maturation and hydration.
11. **Biological Variability** = variation which will contribute to error due to such factors as hydration and deposition sites.
12. **Technical Variability** = variability which will contribute to error due to such factors as lack of standardization of procedures among assessors.
13. **Reliability** = reproducibility, the consistency and dependability of a measure $>.9$ with experienced assessors. Increases with fewer sites and monitored practice.
14. **Validity** = degree to which an assessor obtains an accurate measure. How well the group being assessed matches the group from which the regression equation was obtained. Dependent upon: age, activity level, population specific, body composition status.

STANDARDIZED SKINFOLD ASSESSMENT FOR MICHIGAN

A key to the success of this program will be our ability to standardize the assessment procedures and the calculations to determine minimal weight. This section is directed specifically to the method and procedures for skinfold assessment for the Michigan Weight Monitoring Program.

INSTRUMENTATION

1. caliper standardization = **Lange** or **Harpenden** skinfold calipers are preferred instruments.
2. tape measure for site location especially during training and practice for site identification.
3. felt pen (preferably washable ink) for site identification.
4. certified/calibrated scale for determination of total body weight (TBW) at same time as skinfold assessment.

SITE SELECTION AND IDENTIFICATION

The sites and regression equation selected for the Program are those described by Lohman specifically for use with young male wrestlers and the Boileau equation for females. The techniques for site identification are adopted from "Anthropometric Standardization Reference Manual," Lohman, Roche, and Martorell, Human Kinetics Books, Box 5076, Champaign, IL 61820, (800-DIAL-HKP).

1. Subject should be standing in the anatomical position with the skin for potential skinfold sites exposed
2. All measurements are obtained on the RIGHT side of the body
3. Identify the sites = TRICEPS, SUBSCAPULAR, ABDOMINAL for males
TRICEPS and SUBSCAPULAR for females

TRICEPS = measured vertically in the midline of the posterior aspect of the upper arm, over the triceps muscle, midway between the lateral acromion process of the scapula and the inferior margin of the olecranon process of the ulna. Elbow is flexed to identify the landmarks but extended and relaxed to elevate the skinfold.

SUBSCAPULAR = measured on a diagonal axis, (left shoulder to right hip) one centimeter below the inferior angle of the scapula. The site is angled infero-laterally about 45 degrees in the natural cleavage line of the skin. It may be necessary to have the subject place their arm behind the back to make the anatomical features more prominent. The arm is returned to the relaxed anatomical position for the measurement procedure.

ABDOMINAL = measured vertically, the site is located 3 centimeters lateral to the midpoint of the umbilicus and 1 cm inferior to the umbilicus. The subject must stand erect with weight on both feet, relax the abdominal wall musculature and breathe normally during the assessment procedure. (Not applicable for females)

HYDRATION ASSESSMENT PROCEDURE

In an attempt to insure valid and reliable assessment of skinfold widths the following general measurement techniques should be employed. These techniques are general in that they are applied to all skinfold site assessments. The subject's skin should be dry. Measurements should not be taken immediately after a workout or when the subject is overheated. This may be an ever present problem because some of the wrestlers may be attempting to take part in rapid weight reduction through exercise just prior to the assessment - **this MUST NOT be allowed**. In addition the process requires that each wrestler pass a urine specific gravity test to determine adequate hydration level for the skinfold assessment procedure.

There is no substitute for practice and experience as an assessor. Quality in-service participation, in-depth knowledge about all aspects of the body composition assessment, careful site identification, and practice will assist in the accuracy and value of this program.

1. Palpate the site to familiarize both you and the subject with the area to be measured.
2. Elevate the double fold of skin and the subcutaneous fat with the thumb and index finger of the left hand 1 cm above or adjacent to the measurement site.
3. Become familiar with the width of the thumb and index finger as well as the perpendicular approach to site assessment prior to the elevation of each specific skinfold site.

4. The fold should be lifted in such a manner as to have two parallel sides.
5. The long axis should be parallel to the natural cleavage lines of the skin.
6. Measure with caliper in right hand with scale in a position to avoid parallax error.
7. Measure midway between the body surface and the bulbous crest of the skinfold.
8. Caliper jaws are placed to measure the thickness of the skinfold perpendicular to its long axis.
9. Caliper pad measurement surface should be in contact with the skinfold for 2 to 4 seconds.
10. Record to the nearest .5 mm and obtain (through rotation of sites) three measures with no more than a .5 mm difference between any two measurements (eg. 9.5, 10, 10.5).
11. Record three measures for each of three sites for males (sub scapular, abdominal and triceps); record only sub scapular and tricep measurements for females on the Skinfold Data Worksheets.

FORMULA FOR CALCULATION OF BODY COMPOSITION VALUES FOR SKINFOLD ASSESSMENT PROCESS OF MALES

STEP 1 LOHMAN EQUATION-CALCULATION OF BODY DENSITY

$$BD = [1.0973 - (\text{sum SF} \times .000815)] + [(\text{sum SF})^2 \times .00000084]$$

sum of SF = Triceps SF + Sub scapular SF + Abdominal SF

STEP 2 BROZEK EQUATION-CALCULATION OF % BODY FAT FROM BODY DENSITY

$$\% \text{ BF} = (457/BD) - (414.2)$$

STEP 3 CALCULATION OF MINIMUM WEIGHT AT 7 % BODY FAT

$$MWW = ([1 - (\% \text{ BF}/100)] \times \text{TBW}) / (.93)$$

ALTERNATE METHOD FOR MWW

$$\text{FAT WEIGHT (FW)} = \text{TBW} \times (\% \text{BF}/100)$$

$$\text{LEAN BODY MASS (LBM)} = \text{TBW} - \text{FW}$$

$$MWW = (\text{LBM}) \div .93$$

BOILEAU EQUATION FOR CALCULATION OF BODY FAT FOR FEMALES

$$\% \text{BF} = [1.35 \times (\text{sum SF})] - [0.012 \times (\text{sum SF})^2] - 3.4$$

sum of SF = Triceps SF + Sub scapular SF

$$MWW (\text{females}) = (\text{LBM}) \div .88$$

MHSAA ASSESSMENT PROCEDURES

TIME PERIOD FOR MEASUREMENT

Skinfold assessment may begin on **Oct. 25, 2021**. Wrestlers MAY be measured any time on or following this date to establish the “ALPHA” weight (weight and associated %BF at the time of initial assessment for the school year). The deadline for a valid Alpha Master is **January 31, 2022**. Processing of Alpha data will not take place after this date. All wrestlers, including those coming out late (after the beginning of the season) must have their minimum weight established prior to competing. Each school is responsible to print their own copy of the Alpha Master from the TrackWrestling Web site at **www.trackwrestling.com**.

A wrestler may NOT compete until the wrestler’s name appears on the Alpha Master.

While it is the school’s responsibility to contact an approved assessor from the list provided by the MHSAA, multiple assessors may be used. The student athlete may be measured by any MHSAA registered Skinfold Assessor. If that athlete chooses to appeal, they must be re-assessed by the **same person** who assessed them originally. Be certain that appeal data is entered into the TrackWrestling Web site.

EQUIPMENT AND PERSONNEL REQUIRED

It is the school’s responsibility to contact an approved assessor from the list provided by the MHSAA. The school must have available at the time of the skinfold assessment:

1. A certified scale (certified after the start of school in the fall and before Alpha weigh-in).
2. Skinfold Data Worksheets (available at www.MHSAA.com).
3. Two school officials (teacher, A.D.) who will:
 - a. assist with obtaining weight of each wrestler,
 - b. assist with the recording of data.
4. Two adults to conduct the urine specific gravity tests. (Med. Tech., R.N., DR., parent volunteer)

<p>NOTE: AT NO TIME IS A SCHOOL’S WRESTLING COACH (head coach, assistant coach, paid coach, volunteer coach) ALLOWED TO CONDUCT, PARTICIPATE, OR ASSIST IN ALPHA WEIGH-IN MEASUREMENTS OR DATA COLLECTION!</p>

HYDRATION REQUIREMENT

Specific gravity assessment of the urine will determine whether a candidate may participate in the skinfold measurement process. If the wrestler has a specific gravity above the predetermined level, he/she may NOT be assessed for body composition for a minimum of 48 hours. This is simply a pass/fail assessment based on a specific gravity level equal to or greater than **1.025g/ml**. The school will provide individuals to conduct the specimen collection and assessment utilizing current dated reagent strips.

Monitoring this process is a part of the assessor’s responsibility. Make certain that each wrestler is tested individually to prevent urine exchange (this is an area where the right to privacy must be respected). The wrestler must partially fill the cup with urine. A reagent strip will be immersed in the urine and pulled out and read horizontally to

determine the specific gravity for the specimen. If the wrestler passes the specific gravity test he/she may continue for the body composition assessment. If the wrestler fails the specific gravity test he/she cannot be assessed for 48 hours and must meet the hydration requirement before the skinfold reassessment may take place.

SKINFOLD ASSESSMENT - REQUIRED

**** (Hydro/DXA are only available for appeal of skinfold) ****

Those meeting the specific hydration requirement will proceed to the area where the skinfold assessment for body composition will be done. This area should be controlled so the assessor can concentrate on the accuracy and communication of scores to the recorder. In addition the setting should allow privacy for the subject and confidentiality of the recorded information.

1. Measure each site (RIGHT SIDE) and record the measurements on the skinfold worksheet.
 - a) Rotate through each site and record values
 - b) Record each of the three measurements to the nearest .5 mm for each site

DATA PROTOCOL

1. Only the assessor shall enter the information from the worksheets to the TrackWrestling Web site for those subjects that the assessor personally assessed. **Each assessor must only enter the athletes that they measured while logged onto the TrackWrestling Web site.**
2. Record three measurements for each of the appropriate sites for each male and female subject.

NOTE: If the difference between the three values is more than .5 mm for a single site, the Web site will not accept the data and the subject will need to be remeasured no sooner than 48 hours after.
3. Calculation and redistribution of results to schools will be done online. Each school (coach or AD) is responsible to print their own copy of the Alpha Master from the TrackWrestling website.
4. **Do not submit failed urine tests to the MHSAA or attempt to enter measurements on the TrackWrestling website for wrestlers that failed the urine hydration test.**

APPEAL PROCESS

Any athlete may appeal their skinfold measurements or calculations one time by reassessment. STEP 1 of the appeal process must be completed within 14 calendar days of the original (Alpha Date) measurement. This step may be bypassed and only STEP 2 performed. The date on which a wrestler may compete at a specific weight may not be appealed. The steps of the appeal process are as follows:

- STEP 1: The athlete shall repeat the "Alpha Weigh-In" as described in the regulation.
- A. The same assessor shall conduct the reassessment.
 - B. When re-submitting the data electronically, they system will recognize that it is additional data for the same wrestler and automatically mark it as an appeal.

- C. The reassessment shall occur within 14 calendar days of the original Alpha date unless a **written** extension is granted by the MHSAA **before** the expiration of the 14 day period.
- D. Reassessment includes hydration assessment, weight measurement plus three measurements of the skinfold sites.
- E. A wrestler may compete at their approved lowest minimum weight during an appeal for a lower weight.
- F. Failure to adhere to these conditions or timelines will be cause for denial.

STEP 2: If dissatisfaction with the results remains, the wrestler may choose to be hydrostatically/DXA weighed to determine body fat percentage. Results obtained at this step are automatically accepted; the athlete, family, school or coach may not appeal further.

- A. **The school shall file a Hydrostatic Weighing Proposal (STEP 1) to be approved by the MHSAA for hydrostatic weighing and must be conducted by January 15.** The one exception is for a wrestler who receives an Alpha measurement for the first time after January 15. This student has until the Alpha deadline for a hydrostatic appeal.
- B. Hydrostatic weighing facilities must be approved by the MHSAA, and the Hydrostatic weighing Report Form (STEP 2) shall be filed with the MHSAA.
- C. STEP 1 (of the appeal) may be passed and only STEP 2 performed.
- D. Results are **FINAL** and may not be appealed or modified.

It is planned to support “assessors” in a follow-up procedure to check the reliability of assessors from each clinic. The “instructors” are encouraged to attend skinfold assessment sessions of those whom attended their “assessor” in-service. The function of a visit is to check the methods and procedures of the assessors they have trained. This provides two services: 1) it will assist in identifying quality assessors and 2) it will help instructors to determine the impact of their in-service clinics.

NOTE: Any male below 7% and female below 12% BF **MUST** have a **Physician’s Clearance Form** submitted to the MHSAA and updated in TrackWrestling by the MHSAA **BEFORE** they may compete. Wrestlers without a Physician’s Clearance Form submitted, received and updated in TrackWrestling are **INELIGIBLE**.

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Quick Reference

Skinfold (SKF) Technique

1. All measurements are done on the RIGHT side of the body
2. Carefully mark the sites
3. Grasp the SKF firmly with the thumb and index finger 1 cm above the measurement site
4. Carefully lift the SKF on the long axis of the measurement
5. Keep the fold elevated as you measure
6. Place the caliper pads 1 cm below the fingers and half-way the depth of the fat fold
7. Release the caliper pads gently
8. Read measurement 2-4 seconds after releasing jaws on fold
9. Open the jaws prior to removing off the body

Improving Accuracy

1. Read to nearest 0.5 mm (Lange)
2. Rotate sites
3. Measure a minimum of 3 times
4. Perform measures on clean, dry skin
5. Avoid measurement post exercise due to fluid shift
6. Practice, practice, practice

Sites Described

1. Triceps - Halfway between lateral acromion process and olecranon process (vertical fold)
2. Sub scapular - One cm below inferior angle of scapula (diagonal fold)
3. Abdominal – Three cm lateral and one cm below center of umbilicus (vertical fold)

SPECIFIC GRAVITY ASSESSMENT PROCEDURE. Reagent Strips Method

Bayer Multistix – Product must have 8 sg or 10 sg identification

Bayer Multistix is a registered name for one of the most common visually read urinalysis reagent strips available which provide urine chemistry information. One of the test strip areas is designed to assess specific gravity. Other test strip areas provide for assessment of glucose, bilirubin, ketone, blood, pH, protein, urobilinogen, nitrite, and leukocytes in the urine.

Specific Gravity: The specific gravity of the urine is an indication of the relative proportions of dissolved solid components to the total volume of the specimen. It is an indication of the relative degree of concentration or dilution of the sample. Specific gravity is elevated whenever there has been excessive loss of water through sweating, vomiting, diarrhea, or elevated body temperature. Elevated glucose and protein do not tend to affect the reagent strip test and so give a more valid specific gravity measure. Expected values for specific gravity range from 1.003 to 1.030 but are typically between

1.010 and 1.025. Specific gravity is typically higher in the first morning sample and will be different in random samples through the day.

NOTE: Trim the stix so the “Specific Gravity” is the bottom block (furthest from finger tips).

PROCEDURE FOR MULTISTIX METHOD

- Evaluator shall use rubber gloves for these procedures
 - Subject handles ALL urine sampling
 - Subject handles all urine disposal
 - Procedure designed for Multistix 10SG Reagent Strips
1. Subject Collects sample in mid stream in privacy of urinal
 - a. Provide marked cup immediately before sampling occurs
 - b. Limit access to one subject at a time
 - c. Practice/Enforce secure procedures by immediately testing specific gravity after urine draw.
 2. ONE Multistix Reagent Strip is pulled from concurrently opened container
 3. Subject completely immerses Multistix in fresh urine sample
 4. Make certain all reagent patches are moistened
 5. The strip should be removed immediately running edge of strip along container to remove excess urine (caution not to “whip” or “snap” urine residue from free end of strip)
 6. Allow strip to air **45 seconds** in horizontal position
 7. Hold strip next to color chart on bottle or supplied card
 8. **Compare Specific Gravity (olive reagent section - 3rd from blank space/8SG; 4th from blank space/10SG) section of Multistix to color on card at 45 sec.**
 9. If equal to or greater than 1.025, the subject may NOT stand for body composition assessment
 10. Subject discards Multistix reagent strip in acceptable waste receptacle

COMPARISON CHART

Immerse strip in urine, remove immediately - read test after 45 seconds.

	PASS					FAIL								
<i>SPECIFIC GRAVITY</i>	1.000	<input type="checkbox"/>	1.005	<input type="checkbox"/>	1.010	<input type="checkbox"/>	1.015	<input type="checkbox"/>	1.020	<input type="checkbox"/>	1.025	<input type="checkbox"/>	1.030	<input type="checkbox"/>

