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User-Friendly Childhood Obesity Screening Charts Using SAS/STAT® Graphics

George Fernandez, University of Nevada-Reno, Reno, Nevada, USA

ABSTRACT

Epidemiological data reveal that 31.9% of U.S. schoolchildren are overweight or obese. The 85th and 95th percentile values of body mass index (BMI) are the accepted screening measures for overweight and obesity respectively for children two years of age and older. While having epidemiological and diagnostic values, the BMI is a measurement not readily available to compute and assess for the layperson. The Center for Disease Control (CDC) 's gender- and age-specific percentile BMI excel data tables for the U.S. population were used as the source to compute the underweight, normal, overweight, and obese weight ranges (in pounds) by converting percentile BMI values to weight limits by (BMI*HT*HT/703) where HT is the child's height in inches. Using Base SAS® and advanced SAS graphical procedures such as SGPLOT and SGPANEL, user-friendly and easy-to-read color-coded tables and charts that depict the weight range corresponding to the underweight, normal, overweight and obese limits are developed. These user-friendly weight limit tables eliminate the need for BMI calculation, and are very easy to read. Check the www.max-weight-limit.com for more information.

INTRODUCTION

 The importance of BMI based screening for childhood obesity in schools and at primary care physician offices received national attention. BMI is a difficult measure to understand and compute and therefore parents are unable to use BMI directly to monitor child's growth and weight gain at present. Thus, we are presenting user-friendly weight limits charts (color coded) for each gender, age and height for children. These simple color coded charts (in English units: lbs, Inches) will provide the necessary tools for parents to monitor the growth patterns of their children and detect the early signs of obesity without computing BMI. Thus, parents can prevent their child from becoming overweight by tracking their child's growth (using the user-friendly charts) and by seeking professional advice and appropriate intervention if necessary.

CURRENTLY AVAILABLE BMI BASED SCREEING CHARTS DEVELOPED BY CDC

The childhood BMI based screening charts developed by CDC[1]are not user-friendly and not easily understandable by everyone because:

  ➢ In the US, body weights are usually measured in pounds and then a BMI conversion is made.

  ➢ These BMI measurements are not readily understood by average individuals.

  ➢ BMI conversion requires special calculators or online tool to make the conversion from weight in pounds each time you record the weight.

  ➢ Parents rely on health officials, school nurse and /or pediatricians to diagnose early signs of overweight.

  ➢ The BMI chart presented in Figure 1 is the only tool recommended by CDC and available to parents and health officials to screen for childhood obesity.

  ➢ However, these CDC recommended charts are not user-friendly, too-crowded, and unable to differentiate differences in BMI values at early years.

  ➢ Obese, overweight and underweight ranges are not clearly marked on these charts. Thus, it is difficult to use at the pediatrician's office

> ➢ These charts are way too complicated for the average person. Even pediatricians, nurses and health officials often need special training in using the BMI percentile growth charts. More importantly the BMI does not allow parents "to get the feel" of what their children's weight should be for normal, overweight or obese status.

> ➢ Therefore I am proposing here age and gender specific user-friendly childhood screening charts that eliminate above mentioned limitations.

Figure 1 Currently available BMI based screening charts developed by CDC

CURRENTLY AVAILABLE BMI BASED SCREEING CHARTS DEVELOPED BY CDC

The CDC's gender and age specific percentile BMI excel data tables for the US population were used as the source to compute the underweight, normal, overweight and obese weight ranges (in pounds) by converting percentile BMI values to weight limits by (BMI*HT*HT/703) where HT is the child's height in inches. Using SAS/BASE and advanced SAS graphical procedures such as SGPLOT and SGPANEL (Code box1 and 2), we developed user-friendly and easy-to-read color-coded tables and charts that depict the weight range corresponding to the underweight, normal, overweight and obese limits.

CODE BOX 1

```
libname bmi 'p:\bmi\';
PROC IMPORT OUT= WORK.bmiage   DATAFILE= "p:\bmi\bmibyage.xls"
            DBMS=xls REPLACE;
RUN;
data kidbmi1; set bmiage;
      ht0=substr(ht,1,2);
      htn=ht0+0;
      MWL=round((p85*htn*htn)/703);
      LWL=round((p5*htn*htn)/703);
      OWL=round((p95*htn*htn)/703);
      label Ht= "Height"
      MWL=" Maximum weight limit" LwL="Lower Weight limit"
      OWL= "Obese Weight limit";
run;
options nodate nonumber ;
ods listing close;
proc template;
      define style mystyle;
      parent=Styles.Default;
      style Graphfonts from GraphFonts
      GraphDataFont' = (Arial,12pt,italic);
      style body from body /  background = white;
      class graphgridlines  / contrastcolor=black;
      class graphbackground / color=cyan;
      class graphwalls /color=white;
      end;
run;
```

```
ods escapechar = "^";

ODS rtf file="p:\bmi\bmikidmale.rtf"  style =mystyle nogtitle;

Title   "^{style [textdecoration=underline foreground=blue] Male: Ages (17
to 20 Yrs)} ^{style [foreground=blue] Healthy and Unhealty weight limits in
pounds} ^{unicode 00A9}";


ods graphics /noborder width=8in height=9.50in;


proc sgpanel data=kidbmi1 nocycleattrs;

      panelby age /  rows=2  columns=2 ;

      series  x=mwl y=ht/ lineattrs=(color=black pattern=1 thickness=1)
      DATALABEL = mwl MARKERATTRS= (color=black symbol=star)    ;

      series  x=lwl y=ht/ lineattrs=(color=black pattern=1 thickness=1)
      DATALABEL = lwl MARKERATTRS= (color=black symbol=star)    ;

      series  x=owl y=ht/ lineattrs=(color=black pattern=1 thickness=1)
      DATALABEL = owl MARKERATTRS= (color=black symbol=star)    ;

      band y=HT upper=MWL lower=LWL /  transparency=.8 FILLATTRS=  (COLOR=
      green) legendlabel="Healthy WT" name="Hly";

      band y=HT upper=OWL lower=MWL /  transparency=.8 FILLATTRS=  (COLOR=
      orange) legendlabel="Over WT" name="Over";

      band y=HT Lower=OWL upper=250/  transparency=.7 FILLATTRS=  (COLOR=
      red) legendlabel="Obese" name="Ob";

      band y=HT Lower=50 upper=LWL/  transparency=.7 FILLATTRS=  (COLOR=
      gray) legendlabel="Under WT" name="Und";

      Where Age = "17 yrs" or AGE= "18 yrs" or Age = "19 yrs"

      or AGE= "20 yrs";

      rowaxis label="Height in Inches" grid;

      keylegend "Und" "Hly" "Over" "Ob" / across=4 noborder position=Top;

      colaxis label=" Lower, Maximum, and Obese weight limits" ;

      footnote1 j=left  h=0.75 color=blue "Developed by Prof George
      Fernandez, University of Nevada-Reno  2009  BMI source:
      http://www.cdc.gov/growthcharts ";

run;
```
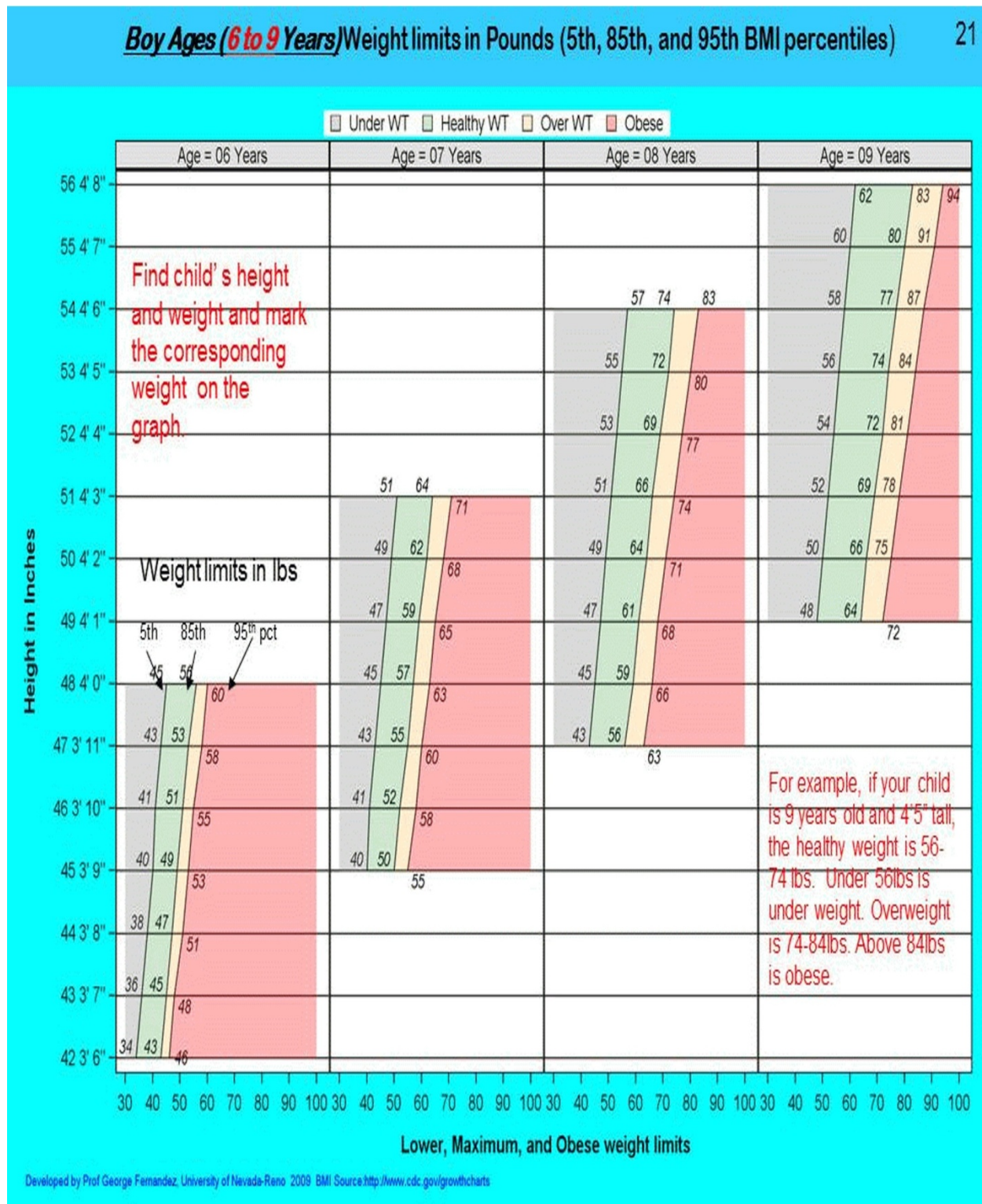
Code Box 2

Figure 2 New User-Friendly Childhood Obesity Screening Charts by Age and Gender

USER-FRIENDLY WEIGHT LIMIT CHARTS FOR CHILDHOOD OBESITY SCREENING

The CDC's gender and age specific percentile BMI excel data tables for the US population were used as the source to compute the underweight, normal, overweight and obese weight ranges(in pounds) by converting percentile BMI values to weight limits by (BMI*HT*HT/703) where HT is the child's height in inches. A sample chart of user-friendly Childhood screening chart is presented in figure1. The SAS codes used to develop these charts are presented in cod boxes 1 & 2.The advantages of using these color coded charts for screening for childhood obesity are:

- BMI conversion is not required every time you measure the body weights in pounds.
- Special calculators or online tool are not required
- Obese, overweight and underweight ranges are clearly marked and color coded on the charts for each gender and 4 year age group.
- Under, healthy, over, and obese weight ranges are clearly marked and the weight limits are displayed on the chart for easy reading.

However, the format of the chart is still not may be easily readable by the average parents who are not familiar with charts. Therefore, a user-friendly table format was developed by converting the chart values to table format.

USER-FRIENDLY WEIGHT LIMIT TABLES FOR CHILDHOOD OBESITY SCREENING

I am presenting the weight limits included in the user-friendly charts as individual tables for each gender by age for simple and easy interpretation (See Figure 3 for a sample chart). More charts are available for both genders by year from age 2 to 20 years. These simple color coded charts (in English units: lbs, Inches) will provide the necessary tools for parents to monitor the growth patterns of their children and detect the early signs overweight [2&3]. These tables eliminate the need for BMI calculation, and are very easy to read. They offer parents with a practical tool that allows them to "personalize" their children's BMI limits. In childhood obesity classification, children at or above the 95th percentile in BMI-for-age are classified as "obese." Children in the 85th to 95th percentile in BMI-for-age are classified as "overweight." Children in the fifth percentile or below in BMI-for-age are classified as "underweight." Pediatricians and parents will be happy to have the computing and work done for them, so that they can just refer to these simplified charts included in the book to monitor the child's growth and screen for overweight / obesity up to first 20 years.

The purpose of this charts and tables are to provide user-friendly (BMI computation is NOT required) and informative tools for parents, pediatricians, and school health officials to monitor a child's growth from birth to adulthood and to detect under or over-weight growth problems by observing early warning signs and taking immediate actions. The growth data measurements reported here are based on 2000 US children survey data. (See the reference for source of CDC survey data information).

Parents are encouraged to take these charts with them when visiting the child's pediatrician and record all relevant growth data. As the boys/girls become teenagers, encourage them to record and monitor their growth directly. If the child's growth changes abruptly (crossing the percentile growth zones rapidly) or is under (below 5th) or over (above 95th) percentile growth talk to the child's doctor and take immediate intervention measures. There is an 80% chance that an obese child becomes an obese adult. Please help in the battle of reducing childhood obesity by preventing your child from becoming over weight.

Boy: Ages (8 to 9 years) Weight limits in Pounds (5th, 85th, and 95th BMI percentiles)   22

Age = 08 - Less than 09 Years

Height: Feet-Inches	Under weight (BMI: Less than 5th Percentile)	Healthy Weight Range (BMI: 5th to 85th Percentiles)	Over Weight Range (BMI:85th to 95th Percentiles)	Obese weight (BMI: Greater than 95th Percentile)
3'11"	_____Less than 43 lbs	43_____56 lbs	57_____63 lbs	Greater than 63 lbs_____
4'0"	_____Less than 45 lbs	45_____59 lbs	60_____66 lbs	Greater than 66 lbs_____
4'1"	_____Less than 47 lbs	47_____61 lbs	62_____68 lbs	Greater than 68 lbs_____
4'2"	_____Less than 49 lbs	49_____64 lbs	65_____71 lbs	Greater than 71 lbs_____
4'3"	_____Less than 51 lbs	51_____66 lbs	67_____74 lbs	Greater than 74 lbs_____
4'4"	_____Less than 53 lbs	53_____69 lbs	70_____77 lbs	Greater than 77 lbs_____
4'5"	_____Less than 55 lbs	55_____72 lbs	73_____80 lbs	Greater than 80 lbs_____
4'6"	_____Less than 57 lbs	57_____74 lbs	75_____83 lbs	Greater than 83 lbs_____

Age = 09 - Less than 10 Years

Height: Feet-Inches	Under weight (BMI: Less than 5th Percentile)	Healthy Weight Range (BMI: 5th to 85th Percentiles)	Over Weight Range (BMI:85th to 95th Percentiles)	Obese weight (BMI: Greater than 95th Percentile)
4'1"	_____Less than 48 lbs	48_____64 lbs	65_____72 lbs	Greater than 72 lbs_____
4'2"	_____Less than 50 lbs	50_____66 lbs	67_____75 lbs	Greater than 75 lbs_____
4'3"	_____Less than 52 lbs	52_____69 lbs	70_____78 lbs	Greater than 78 lbs_____
4'4"	_____Less than 54 lbs	54_____72 lbs	73_____81 lbs	Greater than 81 lbs_____
4'5"	_____Less than 56 lbs	56_____74 lbs	75_____84 lbs	Greater than 84 lbs_____
4'6"	_____Less than 58 lbs	58_____77 lbs	78_____87 lbs	Greater than 87 lbs_____
4'7"	_____Less than 60 lbs	60_____80 lbs	81_____91 lbs	Greater than 91 lbs_____
4'8"	_____Less than 62 lbs	62_____83 lbs	84_____94 lbs	Greater than 94 lbs_____

For example, if your child is 9 years old and 4'7" tall, the healthy weight is 60-80 lbs. Under 60lbs is underweight. Overweight range is 81-91lbs. Above 91 lbs is obese.

Developed by Prof George Fernandez, University of Nevada-Reno 2009 BMI Source:http://www.cdc.gov/growthcharts

Figure 3 New User-Friendly Childhood Obesity Screening Table by Age and Gender

SUMMARY

There is an 80% chance that an obese child becomes an obese adult. Parents can monitor child growth from birth to 20 years and watch for early signs of obesity using these user-friendly charts and tables. These charts are very valuable resources for pediatricians and school nurses. Using these charts, time consuming BMI computations can be eliminated. Please help in the battle against childhood obesity by preventing a child from becoming an overweight adult.

REFERENSES

1. Growth Charts - 2000 CDC Growth Charts - http://www.cdc.gov/growthcharts/clinical_charts.htm

2. GEORGE FERNANDEZ 2010 BOY'S GROWTH CHARTS AND USER-FRIENDLY OVER WEIGHT-OBESITY SCREENING TOOLS PUBLISHER: CREATESPACE USA (MAY 29, 2010) 44 PAGES HTTP://WWW.AMAZON.COM/GROWTH-CHARTS-USER-FRIENDLY-WEIGHT-OBESITY-SCREENING/DP/145283914X/REF=NTT_AT_EP_DPI_4

3. GEORGE FERNANDEZ 2010 GIRL'S GROWTH CHARTS AND USER-FRIENDLY OVER WEIGHT-OBESITY SCREENING TOOLS PUBLISHER: CREATESPACE USA (MAY 29, 2010) 44 HTTP://WWW.AMAZON.COM/GROWTH-CHARTS-USER-FRIENDLY-WEIGHT-OBESITY-SCREENING/DP/1452854076/REF=SR_1_9?IE=UTF8&S=BOOKS&QID=1276323765&SR=1-9

RECOMMENDED READING

UNR Press release - Public release date: 15-September-2009
http://www.unr.edu/nevadanews/templates/details.aspx?articleid=5168&zoneid=8

UNR Press release - Public release date: 3-Dec-2009
http://www.eurekalert.org/pub_releases/2009-12/uonr-npd120309.php

World health organization (WHO) Growth Standards http://www.who.int/childgrowth/en/

Establishing a standard definition for child overweight and obesity worldwide: international survey
http://www.bmj.com/cgi/content/abridged/320/7244/1240

CONTACT INFORMATION:

Your comments and questions are valued and encouraged. Contact the author at:

George Fernandez
University of Nevada, Reno
CRDA/088
Reno NV 89557
775-784-4206
gcjf@unr.edu
http://www.max-weight-limit.com