

IMAGES in PAEDIATRIC CARDIOLOGY

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Key words

Obesity
Child
Malta

Software
Cohort Study

Abstract

Introduction

Obesity is a chronic disease that often commences in childhood. Several publications have shown that a quarter to a third of Maltese children are overweight or obese. Malta will be the first country to measure height and weight (and hence Body Mass Index) for all school children in order to quantify the extent of the problem.

Methods

This study would include 46,000 children in 150 schools. This would be the first time that any country measured its entire childhood cohort, as opposed to sampling. Hence, it was decided to attempt to facilitate data collection and analysis with the use of bespoke spreadsheets.

Results

This paper will demonstrate how standard Microsoft Excel was used to accomplish this, greatly speeding up the data analysis process.

Conclusion

Software should be prepared in advance in anticipation of large amounts of data that need to be analysed and summarised. Particular care must be taken in order to prepare the requisite graphs and tables in advance so as to process the data once and present it in a suitable format for consumption and evaluation.

Introduction

Obesity is a chronic disease, a worldwide scourge that constitutes a literal epidemic. The effects of this condition are legion, with significant morbidity from cardiovascular, neural and oncological sequelae.¹

Obesity often begins in childhood.² Malta is by no means unique and two publications dealing with Maltese children have shown that a quarter to a third of children are overweight or obese.^{3,4} The first author of this study won over the Maltese authorities into undertaking a national study in Malta which would incorporate the measurement of the height and weight of all primary and secondary school children in Malta (and hence their body mass index). The school bags would also be measured for the purposes of a separate study. All schools participated - State, Church and Independent.

This study would include the entire cohort and not just a sample, potentially 46,000 children in 150 schools. This would be the first time that any country measured its entire childhood cohort, as opposed to sampling. Hence, it was decided to attempt to facilitate data collection and analysis with the use of bespoke spreadsheets. This paper will demonstrate how standard Microsoft Excel was used to accomplish this.

Hardware

Twenty identical scale-stadiometers were bought (GIMA 27288 PEGASO DIGITAL SCALE) and used to measure children in State Schools and in Church Schools. Independent Schools purchased their own (identical model) scales. Measurements were carried out by Physical Education teachers and were inputted into a bespoke spreadsheet. They were aided by physiotherapists coordinated by the Maltese Association of Physiotherapists while other administrative staff helped to transport the scales to different schools based on a timetable created by the Education Division. Each school retained a set of scales for a maximum of one week.

Software

Three bespoke spreadsheets were prepared and they will be outlined below.

Data entry sheet

Data entry is subject to a number of data validation settings and locked cells, deliberately restricting input capacity in an effort to minimise error. Certain cells are locked for editing as these contained either formulas (e.g. Body Mass Index (BMI) calculation from height and weight) or data that is fixed, such as name of school. Certain fields such as the latter is automatically filled when a new student name was entered. The month and day of measurement are also filled automatically, such that when this date is entered in the first row, it is routinely be filled in subsequent rows.

Examples of validation include gender, which is only accepted as female or male, day of month only accepted a whole numerical value up to 31, month up to 12, and birth year is restricted to 1998-2015. Locality is a dropdown list of villages and towns.

Once the class measurements are complete, a button activated macro saves the file, unprotects all fields, copies and repastes all data as values so as to delete formulae, deletes unwanted columns (e.g. surname, name), and saves the file in this new format under a different name. The macro is listed hereunder:

```
' Private Sub Macro8()  
' Macro8 Macro  
    ActiveWorkbook.Save  
  
    Dim wSheet    As Worksheet  
    Dim Pwd      As String  
  
    Pwd = "RDD12345"  
    On Error Resume Next  
    For Each wSheet In Worksheets  
        wSheet.Unprotect Password:=Pwd  
    Next wSheet  
    If Err <> 0 Then  
        MsgBox "You have entered an incorect password. All worksheets could not " & _  
            "be unprotected.", vbCritical, "Incorect Password"  
    End If  
    On Error GoTo 0  
    On Error Resume Next  
    'in case the sheet is protected  
    ActiveSheet.Cells.EntireColumn.Hidden = False  
    ActiveSheet.Next.Activate
```

```
Application.DisplayAlerts = False
Application.DisplayAlerts = True
ActiveSheet.Unprotect Password:=Pwd
Range("A1:S51").Select
Selection.EntireColumn.Hidden = False
Selection.Copy
Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone, SkipBlanks _
:=False, Transpose:=False
Columns("M:M").Select
Selection.Insert Shift:=xlToRight, CopyOrigin:=xlFormatFromLeftOrAbove
With Selection.Validation
.Delete
.Add Type:=xlValidateInputOnly, AlertStyle:=xlValidAlertStop, Operator _
:=xlBetween
.IgnoreBlank = True
.InCellDropdown = True
.ShowInput = True
.ShowError = True
End With
Range("M3").Select
ActiveCell.FormulaR1C1 = "=IF(RC[-2]<>""""",ABS(RC[1]-RC[-2]),""""")"
Range("M3").Select
Selection.AutoFill Destination:=Range("M3:M51"), Type:=xlFillDefault
Range("M3:M51").Select
Range("M1").Select
ActiveCell.FormulaR1C1 = "Bag Weight"
Range("M2").Select
ActiveCell.FormulaR1C1 = "(in Kg)"
With ActiveCell.Characters(Start:=1, Length:=7).Font
.Name = "Calibri"
.FontStyle = "Regular"
.Size = 11
.Strikethrough = False
.Superscript = False
.Subscript = False
.OutlineFont = False
.Shadow = False
.Underline = xlUnderlineStyleNone
.ThemeColor = xlThemeColorLight1
.TintAndShade = 0
.ThemeFont = xlThemeFontMinor
End With
Columns("M:M").Select
Selection.Copy
Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone, SkipBlanks _
:=False, Transpose:=False
Columns("N:N").Select
Application.CutCopyMode = False
Selection.Delete Shift:=xlToLeft
Columns("N:P").Select
Selection.Delete Shift:=xlToLeft
Columns("G:I").Select
```

```
Selection.Delete Shift:=xlToLeft
ActiveWindow.ScrollColumn = 2
ActiveWindow.ScrollColumn = 3
Columns("D:E").Select
Selection.Delete Shift:=xlToLeft
Cells.Select
Range("C1").Activate
Selection.Locked = True
Selection.FormulaHidden = False
ActiveSheet.Protect DrawingObjects:=True, Contents:=True, Scenarios:=True
ThisWorkbook.SaveAs Filename:=ThisWorkbook.Path & "\" & "Anonymised_Data_" &
Sheets(1).Range("c3").Text & " " & Sheets(1).Range("b3") & ".xslm", FileFormat:=52
Application.Quit
End Sub
```

Variables now available for analysis are Student Number, School, Class, Gender, Locality, Student Weight (in Kg), Student Height (in cm), Bag Weight (in kg), BMI, Decimal age on date of test and Comments.

Analysis sheet

A spreadsheet was created with tabs named “Raw”, “Data”, “Working” and “School Summary”. Button-driven macros were created to facilitate data analysis from “Working”. The first step was to clear the first two sheets using the following macros:

```
' ClearRaw Macro
  Sheets("raw").Select
  Cells.Select
  Selection.Delete Shift:=xlUp
  Range("A1").Select
End Sub

' ClearData Macro
  Sheets("data").Select
  Cells.Select
  Selection.Delete Shift:=xlUp
  Range("A1").Select
End Sub
```

Classes for each school by gender and form are then copied into “Raw”. The following macro is used to enable autofiltering:

```
' FilteronRaw Macro
  Sheets("raw").Select
  Range("A1").Select
  Selection.AutoFilter
End Sub
```

This permits the selection of groups for analysis, such as gender (since males and females have different BMI cut-offs for overweight, obesity and underweight), as per figure 1.

Figure 1: Autofilter enabled for “Raw” spreadsheet

| | A | B | C | D | E | F | G | H | I | J | K |
|---|--------------|------------------------|------------|--------|----------|------------------------|------------------------|--------------------|------|---------------------|----------|
| 1 | Student Numb | School | Class | Gender | Locality | Student Weight (in Kg) | Student Height (in cm) | Bag Weight (in kg) | BMI | Age on Date of test | Comments |
| 2 | 1 | St Monica School Gzira | F1Diamonds | f | Iklin | 26.3 | 131.0 | 9.0 | 15.3 | | 11.1 |
| 3 | 2 | St Monica School Gzira | F1Diamonds | f | Paola | 33.0 | 142.0 | 5.6 | 16.4 | | 11.2 |
| 4 | 3 | St Monica School Gzira | F1Diamonds | f | Pembroke | 46.4 | 164.0 | 6.4 | 17.3 | | 11.3 |
| 5 | 4 | St Monica School Gzira | F1Diamonds | f | Fgura | 60.1 | 150.0 | 8.8 | 26.7 | | 11.7 |

The following macro is then used to paste filtered and unformatted data from “Raw” to “Data”

```
' PasteData Macro
  Sheets("data").Select
  Cells.Select
  Selection.Delete Shift:=xlUp
  Sheets("raw").Select
  Cells.Select
  Selection.Copy
  Sheets("data").Select
  Range("A1").Select
  Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone, SkipBlanks _
    :=False, Transpose:=False
  Range("A1").Select
End Sub
```

The next sheet, “Working” obtains, summarises and analyses information from “Data” on the fly.

The column containing BMI is always column L but the option to input a different column in cell B5 (and hence analyse a different variable) was incorporated. The first step is to build an expression that contains the range for BMI to be studied (top row and bottom row). The top row is the second (after the header row). The next step is the identification of the last row containing data since different schools have different numbers of forms with different numbers of students. This was done using the following formula which identifies the last row with a BMI entry in column I in sheet “Data” as specified in “Working” sheet B5.

```
=ADDRESS(MATCH(9.999999999999999E+307,INDIRECT("data!"&B5&" ":"&B5)),COLUMN(INDIRECT(B5&"2")))
```

For example, in a particular school with three classes in third form and a total of 71 girls, the result was \$I\$72 (reflecting the extra header row).

The range of BMI to be examined is instantaneously built up by the equation ="\$"&B5&"\$2:"&B6, resulting in the value \$I\$2:\$I\$72 in B8. The concatenation for the term to be used to obtain the range of cells with BMI from sheet “Data” is thus ="data!"&B8 resulting in the range: data!\$I\$2:\$I\$72 in B9.

Excel has a useful function INDIRECT(ref_text) function which returns the reference specified by a text string. The range in B9 was thus equated as hereunder using this function in order to obtain a basic statistical summary, as shown in table 1 which demonstrates the equations and the value obtained in this example.

Table 1: Basic summary statistics for BMI – equations and values thereby obtained.

| | | |
|------------------|---------------------------|-------|
| n | =COUNTA(INDIRECT(B9)) | 71 |
| Median | =MEDIAN(INDIRECT(B9)) | 21.88 |
| Mean | =AVERAGE(INDIRECT(B9)) | 22.29 |
| Std error | =B15/SQRT(B11) | 0.532 |
| Std dev | =STDEV(INDIRECT(B9)) | 4.48 |
| Variance | =VAR(INDIRECT(B9)) | 20.10 |
| Min | =MIN(INDIRECT(B9)) | 15.26 |
| Max | =MAX(INDIRECT(B9)) | 39.34 |
| CI | =CONFIDENCE(0.05,B15,B11) | 1.04 |
| | | |
| Q4 | =QUARTILE(INDIRECT(B9),4) | 39.34 |
| Q3 | =QUARTILE(INDIRECT(B9),3) | 24.09 |
| Q2 | =QUARTILE(INDIRECT(B9),2) | 21.88 |
| Q1 | =QUARTILE(INDIRECT(B9),1) | 19.45 |
| Q0 | =QUARTILE(INDIRECT(B9),0) | 15.26 |

These values instantly update two precreated graphs: a boxplot and whisker graph (figure 2) and a plot of mean and confidence intervals (figure 3).

Figure 2: Boxplot and whisker chart for BMI

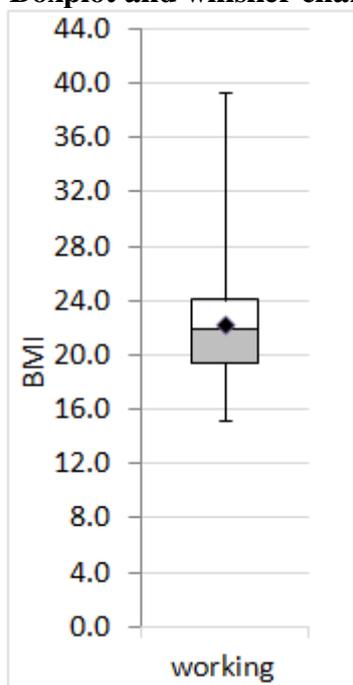
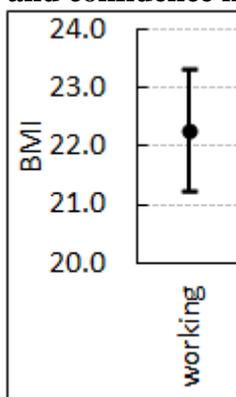


Figure 3: Mean and confidence intervals for BMI



The sheet also contains a table of cut-off BMIs by the World Health Organisation (WHO) by age, in 0.5 year increments, from 5 to 16.5 years. Mean age is also obtained using the steps as outlined above and rounded to the nearest 0.5 value using the =MROUND() function. In this example, a mean age of 13.4 is rounded to 13.5. The value of 13.5 is dynamically used by the sheet to obtain the following key values from the WHO table using the vlookup() function, as per table 2.

Table 2: Relevant centiles and equivalent BMI cutoffs.

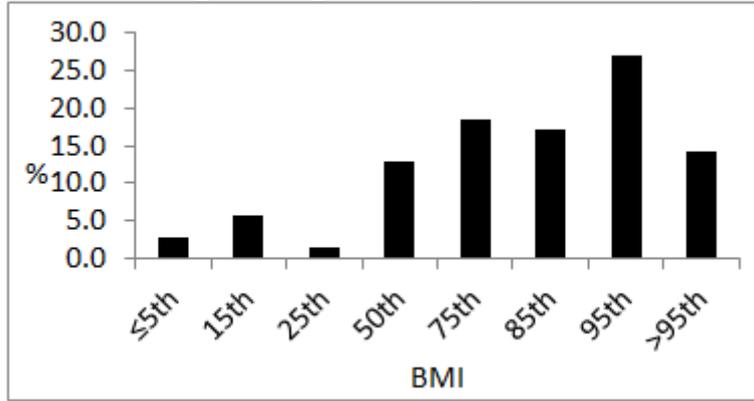
| 5th | 15th | 25th | 50th | 75th | 85th | 95th |
|------|------|------|------|------|------|------|
| 15.8 | 16.9 | 17.6 | 19.2 | 21.2 | 22.4 | 25 |

The Frequency() function is then used in order to dynamically obtain frequencies and calculate percentages as per table 3. This is dynamically used to create a histogram as per figure 4.

Table 3: Frequency and percentages for key cut-off WHO BMI values

| Bin | Frequency | % |
|------|-----------|------|
| 15.8 | 2 | 2.9 |
| 16.9 | 4 | 5.7 |
| 17.6 | 1 | 1.4 |
| 19.2 | 9 | 12.9 |
| 21.2 | 13 | 18.6 |
| 22.4 | 12 | 17.1 |
| 25.0 | 19 | 27.1 |
| | 10 | 14.3 |

Figure 4: Percentages histogram for key cutoff WHO BMI values



Important summary statistics for the form analysed are then copied and pasted to from “Working” to “School Summary” as unformatted text.

```
' CopyWHOOnly Macro
  Range("D54:D60").Select
  Selection.Copy
  Sheets("School Summary").Select
  Range("B1").Select
  Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone, SkipBlanks _
    :=False, Transpose:=False
  Application.CutCopyMode = False
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = False
  End With
  Range("B2,B4,B5,B6,B7").Select
  Range("B7").Activate
  Selection.NumberFormat = "0.0"
  Range("B1:B7").Select
End Sub
```

The output obtained is shown in table 4. Key BMI value cutoffs are used in order to count the number of children who are overweight (between WHO 85-95 percentiles), obese (greater than WHO 95th percentile), the sum of the two (overweight & obese) and underweight (less than the 5th percentile).

Table 4: Summary data by form

| Class | FORM |
|-----------------------------------|------|
| Mean age | 13.4 |
| n | 71 |
| Overweight & obese (\geq P85%) | 40.8 |
| Obese (\geq P95%) | 14.1 |
| Overweight (P85-95%) | 26.8 |
| Underweight (%) | 2.8 |

The summary data in table 5 is also dynamically created in order to prepare for possible statistical comparison, in this case, for a two-tailed Student t-test (table 5).

Table 5: Summary data by form

| Mean | SE | N | Std dev | Variance |
|-------|-------|----|---------|----------|
| 22.29 | 0.532 | 71 | 4.48 | 20.10 |

Student T-test calculator

A separate spreadsheet for these calculations was created that allows the comparison of two samples, from data copied and pasted as per table 4 (table 6).

Table 6: Student T-test calculator

| | A | B | C | D | E | F |
|---|----------|-------|-------|------|---------|----------|
| 1 | Variable | Mean | SE | N | Std dev | Variance |
| 2 | Group X | 16.96 | 0.062 | 1792 | 2.61 | 6.81 |
| 3 | Group Y | 16.71 | 0.059 | 1669 | 2.42 | 5.87 |

Results in this example are:

| t | P |
|------|----------|
| 2.83 | 0.004678 |

Where $t = \frac{B2 - B\$3}{\sqrt{(F2/D2) + (F\$3/D\$3)}}$ and $p = \text{TDIST}(\text{ABS}(H2), D2 - 1, 2)$.

When individual schools are finally analysed, a report summarising the entire school (and also by gender if coeducational) is sent to the school head, using tables showing each form as per table 4.

National analysis

As data by school becomes available, it is input into a master spreadsheet in which additional variables are also added, such as type of school (State, Church or Independent). When all data is available, the same process outlined above will be undertaken for the following cohorts:

1. By gender for the different types of schools (State, Church or Independent).
2. By gender for the sum of the above.

All of the abovementioned tables and graphs can and will be used to depict and summarise BMI. Furthermore, this will allow comparison (as per table 5) between school types and by locality. These specific variables are mentioned because they have been shown to vary significantly in an

earlier study which analysed school-entry age BMI (mean age 5.5 years) at mandatory pre-school entry medical examination.

Conclusion

The Scouting adage “be prepared” should be adopted and software should be prepared in advance in anticipation of large amounts of data that need to be analysed and summarised. Analysing the data more than once would be an onerous and arduous task. Particular care must be taken in order to prepare the requisite graphs and tables in advance so as to process the data once and present it in a suitable format for consumption and evaluation. It is also hoped that the data will prompt local authorities to continue to escalate their attempts to mitigate and hopefully even reverse the rising local trend in childhood obesity, the deadly precursor of adult obesity and all that the condition entails.

References

1. Llewellyn, A., Simmonds, M., Owen, C. G. and Woolacott, N. (2015), Childhood obesity as a predictor of morbidity in adulthood: a systematic review and meta-analysis. *Obesity Reviews*. doi: 10.1111/obr.12316
2. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. *Pediatrics* 2005;115:22-7.
3. Grech V, Farrugia Sant'Angelo V. Body mass index estimation in a school-entry aged cohort in Malta. *Int. J. Paediatr Obesity* 2009;4;123-128
4. Farrugia Sant' Angelo V, Grech V. Comparison of body mass index of a national cohort of Maltese children over a 3-year interval. *Maltese Med J* 2011;23:34-39.

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