SESUG Paper # 107-2023

Using Macro in SAS ® to Read, Combine Datasets, and Analysis NICU Study

Abbas S. Tavakoli, DrPH, MPH, ME[1], Ashley Howard, BS Student, [2] Kayla Everhart, PhD, RN[1], Jessica Bradshaw PhD, Robin B. Dail, PhD, RN, FAAN[1],

[1]University of South Carolina, College of Nursing
[2]University of South Carolina, College of Statistics
[3] University of South Carolina, College of Arts and Sciences

Abstract

Body temperature is an indication of autonomic control and monitoring body temperature is important for the health of premature babies. One way to monitor body temperature in premature infants is through continuous measurement of central (abdominal) and peripheral (foot) skin temperature. Premature infants, born ≤ 32 weeks gestational age with birthweights < 1500 grams are enrolled in NIH/NINR: 1R01NR017872 to study body temperature and infection. This study enrolled a subset of 17 infants to compare body temperature over infants first month and longitudinal neurodevelopmental assessments for indicators of autism between 6-12 months of age. Infant temperatures are measured using a thermistor attached to their abdomen and a thermistor attached to the sole of one foot, every minute for 28 days. Data is downloaded from research dataloggers in excel format. Lag and several functions in SAS were used to prepare data for analyses. A Macro was used to read, combine, and analyze data for each infant. Several procedures in SAS were used to analyze data such as Means, and Freq to describe each infant by day and week. Use of a Macro reduced many lines of syntax to read, combine, and run analysis. All data analyses were performed using SAS/STAT® statistical software, version 9.4.

Keywords: SAS, body temperature, infant

Background

Temperature control is important for the health of premature babies. One way to monitor body temperature in premature infants is through continuous measurement of central (abdominal) and peripheral (foot) skin temperature.[1] Abnormal patterns of body temperature with increased central-peripheral temperature difference (CPtd) or a CPtd that is negative (foot higher then abdominal temperature) indicate autonomic dysregulation and have been associated with the onset of infection and stressful events in premature infants.[2] Our team is examining CPTd measures in 440 premature infants in relationship to the incidence of infection (NIH/NINR: 1R01NR017872) in 5 NICUs. This study is examining a subset of 17 infants for CPTd measures showing autonomic dysregulation and longitudinal neurodevelopmental assessments at 6-, 9- and 12-months corrected age as an early marker of autism spectral disorder (ASD).

Purpose

This paper describes the use of Macro in SAS to read, combine, and run analysis for NICU study.

Methodology

Seventeen premature infants, born at 32 weeks gestational age or less and having birthweights of less than 1500 grams are enrolled for study after Institutional Review Board approval and parental consent for participation in this study. Physiological data are measured every minute and stored for the first 28 days of life using a research datalogger. Each infant has one skin temperature probe (thermistor) attached to their abdomen and one skin temperature probe to the sole of one foot, with both thermistors inserted into the datalogger. In the data sets we have date, time, abdominal temperature (ABD), foot temperature (FT), the date each temperature measure is recorded in the data logger, and the time of each temperature measure as recorded in the data logger., Minutes since birth (MSB) are calculated from birthdate and time and used to anchor all data longitudinally. Each variable has approximately 40,320 measures for each infant. The final

datasets for each infant included average of all measurement by minutes for all 28 days of data. Several new variables were created. Day and week were created by using minutes (MSB). The difference between the abdominal and foot temperature calculated in analysis (CPTD). The percentage of minutes with the foot temperature greater by any amount than the abdominal temperature (PNTD). The percentage of minutes with the CPTd >0<2C (PNOTD). The percentage of minutes with the abdominal temperature greater than the foot temperature by >2C (PHTD). Macro was used to read, combine, and analyze data for each infant. Several procedures in SAS were used to analyze data such as Means, and Freq to describe each infant by day and week. All data analyses were performed using SAS/STAT® statistical software, version 9.4.[3]

Data Steps

Table 1 shows using macro to read and combine each infant. There are three parameters in the macro for data name, b for reading data from library, and c for each infant id number. Seventeen data sets are created with this macro.

Table1 Macro to read each infant.

Macro to read each infant

```
%macro data (a=one,b=ro1.infant47,c=47);

data &a;
set &b;
infant=&c;
run;

%mend data;

%data (a=a,b=ro1.infant47,c=47);
%data (a=b,b=ro1.infant55,c=55);
%data (a=c,b=ro1.infant62,c=62);
%data (a=d,b=ro1.infant64,c=64);
%data (a=e,b=ro1.infant66,c=66);
%data (a=f,b=ro1.infant69,c=69);
%data (a=g,b=ro1.infant70,c=70);
%data (a=h,b=ro1.infant77,c=77);
%data (a=i,b=ro1.infant78,c=78);
%data (a=j,b=ro1.infant80,c=80);
%data (a=k,b=ro1.infant81,c=81);
%data (a=l,b=ro1.infant84,c=84);
%data (a=m,b=ro1.infant85,c=85);
%data (a=n,b=ro1.infant87,c=87);
%data (a=o,b=ro1.infant88,c=88);
%data (a=p,b=ro1.infant89,c=89);
%data (a=q,b=ro1.infant94,c=94);

run;
```

Table 2 combine all data sets in one data set.

Table 2. Combine all infants.

Combine all Baby
data all; set a b c d e f g h i j k l m n o p q; **run**;

Table 3 shows the SAS program to create new variables. Day and week were created from Minutes since birth (MSB). In addition, The difference between the abdominal and foot temperature calculated in analysis (CPTD). The percentage of minutes with the foot temperature greater by any amount than the abdominal temperature (PNTD). The percentage of minutes with the CPTd >0<2C (PNOTD). The percentage of minutes with the abdominal temperature greater than the foot temperature by >2C (PHTD).

Table 3. SAS Program to final file

SAS Program
data final; set all; if **0**<=msb<**1441** then day=**1**; else if **1440**<msb<**2882** then day=**2**; else if **2881**<msb<**4322** then day=**3**; else if **4322**<msb<**5764** then day=**4**; else if **5763**<msb<**7205** then day=**5**; else if **7204**<msb<**8646** then day=**6**; else if **8645**<msb<**10086** then day=**7**; else if **10085**<msb<**11528** then day=**8**; else if **11527**<msb<**12969** then day=**9**; else if **12968**<msb<**14410** then day=**10**; else if **14409**<msb<**15851** then day=**11**; else if **15850**<msb<**17292** then day=**12**; else if **17291**<msb<**18733** then day=**13**; else if **18732**<msb<**20175** then day=**14**; else if **20174**<msb<**21615** then day=**15**; else if **21614**<msb<**23056** then day=**16**; else if **23055**<msb<**24497** then day=**17**; else if **24496**<msb<**25938** then day=**18**; else if **25937**<msb<**27379** then day=**19**; else if **27378**<msb<**28820** then day=**20**; else if **28819**<msb<**30261** then day=**21**; else if **30260**<msb<**31702** then day=**22**; else if **31701**<msb<**33143** then day=**23**; else if **33142**<msb<**34584** then day=**24**; else if **34583**<msb<**36025** then day=**25**; else if **36024**<msb<**37466** then day=**26**; else if **37465**<msb<**38907** then day=**27**; else if **38906**<msb<**40348** then day=**28**;

```
if 0<day<8 then week=1;
  else if 7<day<15 then week=2;
   else if 14<day<22 then week=3;
    else if 21<day<31 then week=4;

cptd = abd - ftp;

if ftp ne . and abd ne . then do;

if (ftp> abd) or cptd<0  then  pntd=1;
else pntd=0;
end;

if cptd ne . then do;
if cptd>2 then phtd=1;
  else phtd=0;
end;

if cptd ne . then do;
if 0<cptd<2 then pNOTD=1;
   else pnotd=0;
end;
```

Table 4 shows the SAS program using macro to run frequency tables for each infant.

Table 4 Examples of Using Macro to run Freq.

SAS Program

```
ods rtf;
ods listing close;
%macro freqa (i,t);
proc freq data=final;
where infant=&i;

    tables day week pntd phtd pnotd;

title " frequency tables &t ";
    title2 ' nicu Study  ';
run;

%mend freqa;
%freqa (47,infant168_047);
%freqa (55,infant168_055);
%freqa (62,infant168_062);
%freqa (64,infant168_064);
%freqa (66,infant168_066);
%freqa (69,infant168_069);
%freqa (70,infant168_070);
%freqa (77,infant168_077);
%freqa (78,infant168_078);
%freqa (80,infant168_080);
%freqa (81,infant168_081);
%freqa (84,infant168_084);
%freqa (85,infant168_085);
%freqa (87,infant168_087);
%freqa (88,infant168_088);
```

```
%freqa (89,infant168_089);
%freqa (94,infant168_094);
run;
ods rtf close;
ods listing;
quit;
run;
```

Table 5 indicates the SAS program using macro to run frequency tables for each infant by day and week.

Table5 Examples of Using Macro to run Freq by ay and week.

SAS Program

```
 ods rtf;
ods listing close;
%macro freq(i,q,t);
proc freq data=final;
      where infant=&i;
     tables &q*( pntd phtd pnotd);

title " frequency tables  &t";
     title2 ' nicu Study  ';

%mend freq;


%freq(47,day, by day infant168_047 );
%freq(47,week, by week infant168_047);

%freq(55,day, by day infant168_055 );
%freq(55,week, by week infant168_055);

%freq(62,day, by day infant168_062 );
%freq(62,week, by week infant168_062);

%freq(64,day, by day infant168_064 );
%freq(64,week, by week infant168_064);

%freq(69,day, by day infant168_069 );
%freq(69,week, by week infant168_697);

%freq(73,day, by day infant168_073 );
%freq(73,week, by week infant168_073);

run;
ods rtf close;
ods listing;
quit;
run;
```

Table 6. 5 indicates the SAS program using macro to run mean for each infant overall and by day.

Table 6 Example of Macro for means.

SAS Program

```
Ods rtf;
ods listing close;
%macro avg (d,q,t);

proc means data=&d n mean std min max  maxdec=2;
```

```
  class &q;
    var  hrc pntd phtd pnotd;
    title " means / &t" ;
             title2 ' NICU Study  ';
              run;

%mend avg;
%avg(final,infant, by infant);
%avg(final,infant day, by infant and day);

ods rtf close;
ods listing;
quit;
run;
```

Conclusion

Many times, data were not ready in the form needed to be analyzed in statistical software. This data was collected for each Infant NICU study. Using a Macro reduced many lines of syntax to read, combine, and run analysis. Several procedures in SAS were used to analyze data such as Means and Freq. All data analyses were performed using SAS/STAT® statistical software, version 9.4. SAS is the most powerful software to handle any type of data. The research team was able to compare percentages of daily temperatures with abnormal CPTd values, or autonomic dysregulation, to longitudinal assessments of neurological development in 17 within case analysis to address the primary aims of this study.

REFERENCES

1. Lyon A, Freer Y. Goals and options in keeping preterm babies warm. *Archives in Diseases of Childhood.* 2011;96:F71-F74.
2. Knobel-Dail RB, Sloane R, Holditch-Davis D, Tanaka DT. Negative Temperature Differential in Preterm Infants Less Than 29 Weeks Gestational Age: Associations With Infection and Maternal Smoking. *Nurs Res.* 2017;66(6):442-453.
3. SAS Institute Incorporated. (2013). *SAS for Windows 9.4*. Cary, NC: SAS Institute Inc.

TRADEMARK NOTICE

Funding for this submission:

1) National Institute of Health, National Institute of Nursing Research, 1R01NR017872 (9/2018-6/2024) (Dail as PI)

2) University of SC Provost Excellence Initiative Award 6/2021-6/2023 Bradshaw and Dail as PI

Contact Information

Abbas S. Tavakoli, DrPH, MPH, ME
Clinical Professor
College of Nursing
University of South Carolina
1601 Greene Street
Columbia, SC 29208-4001
Fax: (803) 777-5561
E-mail: abbas.tavakoli@sc.edu