

**DePaul Symptom Questionnaire (DSQ-1):
R Script for Case Definition Scoring Rules**

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The DePaul Symptom Questionnaire (DSQ-1) can be downloaded from the REDCap shared library.
You can view the instrument here:

<https://redcap.is.depaul.edu/surveys/?s=H443P9TPFX>

Information regarding the DePaul Symptom Questionnaire:

Jason, L.A., & Sunquist, M. (2018). The development of the DePaul Symptom Questionnaire: Original, expanded, brief and pediatric versions. *Frontiers in Pediatrics*, 6:330.

<https://doi.org/10.3389/fped.2018.00330>

Information regarding SPSS syntax and other DSQ instruments:

https://www.leonardjason.com/cfsme_measures-2/

Case Definition Criteria:

Fukuda (Fukuda et al., 1994)

- Substantial Reduction in Functioning (must meet 2 of the following 3 SF-36 score cutoffs):
 - Role Physical ≤ 50
 - Social Functioning ≤ 62.5
 - Vitality ≤ 35
- 6+ months of fatigue (Question 69)
 - Fatigue not lifelong (Exclude if: Question 67 = “Yes” and Question 69 = “Had problem since childhood/adolescence” and Question 77 = “Over 3 or more years”)
 - Fatigue not the result of exertion: (Exclude if: Sum of Question 89a and 89d ≥ 60)
- At least 1 symptom (frequency and severity ratings ≥ 1) from at least 4 symptom domains:
 - Memory / Concentration (Questions 36-39; 43-44)
 - Unrefreshing Sleep (Question 19)
 - Joint Pain (Question 26)
 - Tender / Sore Lymph Nodes (Question 63)
 - Muscle Aches (Question 25)
 - Post-Exertional Malaise (Questions 14-18)
 - Headaches (Question 31; must also be of a new place/type, Question 68)
 - Sore Throat (Question 62)

Canadian Consensus Criteria (CCC Case Definition, Carruthers et al., 2003)

- Substantial Reduction in Functioning (must meet 2 of the following 3 SF-36 score cutoffs):
 - Role Physical ≤ 50
 - Social Functioning ≤ 62.5
 - Vitality ≤ 35
- Fatigue:
 - 6+ months of fatigue (Question 69)
 - Fatigue frequency and severity ≥ 2 (Question 13)
 - Fatigue *not* lifelong (Exclude if: Question 67 = “Yes” *and* Question 69 = “Had problem since childhood/adolescence” *and* Question 77 = “Over 3 or more years”)
 - Fatigue *not* the result of exertion: (Exclude if: Sum of Question 89a and 89d ≥ 60)
- Post-Exertional Malaise (At least 1 symptom (frequency and severity ratings ≥ 2) from questions 14-18)
- Sleep Problems (At least 1 symptom (frequency and severity ratings ≥ 2) from questions 19-24)
- Pain (At least 1 symptom (frequency and severity ratings ≥ 2) from questions 25-31)
- Neurological / Cognitive Problems (At least 2 symptoms (frequency and severity ratings ≥ 2) from questions 32-44)
- At least 1 symptom (frequency and severity ratings ≥ 2) from 2 of the 3 following areas:
 - Autonomic (Questions 45-51)
 - Neuroendocrine (Questions 52-61)
 - Immune (Questions 62-66)

Myalgic Encephalomyelitis International Consensus Criteria (ME-ICC; Carruthers et al., 2011)

- 50% reduction in activity level (“Yes” to Question 97)
- Post Exertional Malaise (At least one symptom (frequency and severity ratings ≥ 2) from question 14-18)
- At least 1 symptom (frequency and severity ratings ≥ 2) from 3 of the following 4 symptom domains:
 - Neurocognitive: Questions 36-44
 - Pain: Questions 25-28; 31
 - Sleep Disturbance: Questions 19-24
 - Neurosensory, Perceptual, and Motor Disturbance: Questions 32-35; 48
- At least 1 symptom (frequency and severity ratings ≥ 2 ; except for Question 98, which requires a response of “Yes”) from 3 of the following 5 symptom domains:
 - Flu-like: Questions 62-65
 - Gastrointestinal: Questions 29-30; 46-47
 - Genitourinary: Question 45
 - Sensitivities: Questions 61, 66
 - Susceptibility to Viral Infections: Question 98
- At least 1 symptom (frequency and severity ratings ≥ 2 ; except for Question 99, which requires a response of “Yes”) from 1 of the following 4 symptom domains:
 - Cardiovascular: Questions 50-51
 - Respiratory: Question 49
 - Loss of thermostatic ability: Questions 54-60
 - Temperature intolerance: Question 99

IOM Clinical Case Definition (IOM, 2015):

- Substantial Reduction in functioning (must meet 2 of the following 3 SF-36 score cutoffs):
 - Role Physical ≤ 50
 - Social Functioning ≤ 62.5
 - Vitality ≤ 35
- 6+ months of fatigue (Question 69)
 - Fatigue *not* lifelong (Exclude if: Question 67 = “Yes” and Question 69 = “Had problem since childhood/adolescence” and Question 77 = “Over 3 or more years”)
 - Fatigue *not* the result of exertion: (Exclude if: Sum of Question 89a and 89d ≥ 60)
- Post-Exertional Malaise (At least 1 symptom (frequency and severity ratings ≥ 2) from questions 14-18)
- Unrefreshing Sleep (At least 1 symptom (frequency and severity ratings ≥ 2) from questions 19-22; 24)
- At least 1 symptom (frequency and severity ratings ≥ 2) from 1 of the following 2 symptom domains:
 - Cognitive Impairment (Questions 36-40; 43-44)
 - Orthostatic Intolerance (Questions 48-51)

DSQ-1

R Case Definition Syntax:

**Scoring Note: To determine which variables are associated with which items, note that variable names utilize the items numbers present in the questionnaire*.*

**To score the SF-36, use scoring rules found here:*

**https://www.rand.org/health/surveys_tools/mos/36-item-short-form/scoring.html*

**Variable names are equivalent to SF-36 Subscale Names*

****Usage Note: copy and paste the syntax below into R.***

```
install.packages("tidyverse")
```

```
library("tidyverse")
```

```
### Fukuda (Fukuda et al., 1994)
```

```
###Fukuda Criteria Scoring Function
```

```
DSQ_1_Fukuda <- function(DSQ, SF){
```

```
  Fukuda <- DSQ[,1, drop = F] #Create empty dataframe of correct row length
```

```
  #Substantial Reduction in SF-36 criteria
```

```
  Fukuda$Fukuda_RP[(SF$RolePhysical <= 50)] <- 1
```

```
  Fukuda$Fukuda_RP[(SF$RolePhysical > 50)] <- 0
```

```
  Fukuda$Fukuda_SF[(SF$SocialFunctioning <= 62.5)] <- 1
```

```
  Fukuda$Fukuda_SF[(SF$SocialFunctioning > 62.5)] <- 0
```

```
  Fukuda$Fukuda_V[(SF$Vitality <= 35)] <- 1
```

```
  Fukuda$Fukuda_V[(SF$Vitality > 35)] <- 0
```

```
  Fukuda$Fukuda_SR[rowSums(Fukuda[,c("Fukuda_RP", "Fukuda_SF", "Fukuda_V")]) >= 2] <- 1
```

```
Fukuda$Fukuda_SR[rowSums(Fukuda[,c("Fukuda_RP", "Fukuda_SF", "Fukuda_V")]) < 2] <- 0
```

```
#Fatigue, Not Lifelong, Not Result of Exertion
```

```
Fukuda$Fukuda_Six[(DSQ$dsq_69 == 2) | (DSQ$dsq_69 == 3) | (DSQ$dsq_69 == 4) | (DSQ$dsq_69 == 5)] <- 1
```

```
Fukuda$Fukuda_Six[(DSQ$dsq_69 == 1) | (DSQ$dsq_69 == 6)] <- 0
```

```
Fukuda$Fukuda_Life[(DSQ$dsq_67 == 1) & (DSQ$dsq_69 == 5) & (DSQ$dsq_77 == 7)] <- 1
```

```
Fukuda$Fukuda_Life[DSQ$dsq_67 != 1 | DSQ$dsq_69 != 5 | DSQ$dsq_77 != 7] <- 0
```

```
Fukuda$Fukuda_Exert[rowSums(DSQ[,c("dsq_89a", "dsq_89d")]) >= 60] <- 1
```

```
Fukuda$Fukuda_Exert[rowSums(DSQ[,c("dsq_89a", "dsq_89d")]) < 60] <- 0
```

```
Fukuda$Fukuda_Fatigue[(Fukuda$Fukuda_Six == 1) & (Fukuda$Fukuda_Life == 0) & (Fukuda$Fukuda_Exert == 0)] <- 1
```

```
Fukuda$Fukuda_Fatigue[(Fukuda$Fukuda_Six != 1) | (Fukuda$Fukuda_Life != 0) | (Fukuda$Fukuda_Exert != 0)] <- 0
```

```
#Post-Exertional Malaise
```

```
Fukuda$Fukuda_14[(DSQ$dsq_14f >= 1) & (DSQ$dsq_14s >= 1)] <- 1
```

```
Fukuda$Fukuda_14[(DSQ$dsq_14f == 0) | (DSQ$dsq_14s == 0)] <- 0
```

```
Fukuda$Fukuda_15[(DSQ$dsq_15f >= 1) & (DSQ$dsq_15s >= 1)] <- 1
```

```
Fukuda$Fukuda_15[(DSQ$dsq_15f < 1) | (DSQ$dsq_15s < 1)] <- 0
```

```
Fukuda$Fukuda_16[(DSQ$dsq_16f >= 1) & (DSQ$dsq_16s >= 1)] <- 1
```

```
Fukuda$Fukuda_16[(DSQ$dsq_16f < 1) | (DSQ$dsq_16s < 1)] <- 0
```

```
Fukuda$Fukuda_17[(DSQ$dsq_17f >= 1) & (DSQ$dsq_17s >= 1)] <- 1
```

```
Fukuda$Fukuda_17[(DSQ$dsq_17f < 1) | (DSQ$dsq_17s < 1)] <- 0
```

```
Fukuda$Fukuda_18[(DSQ$dsq_18f >= 1) & (DSQ$dsq_18s >= 1)] <- 1
```

```
Fukuda$Fukuda_18[(DSQ$dsq_18f < 1) | (DSQ$dsq_18s < 1)] <- 0
```

```
Fukuda$Fukuda_PEM[rowSums(Fukuda[,c("Fukuda_14", "Fukuda_15", "Fukuda_16", "Fukuda_17",  
"Fukuda_18")], na.rm = TRUE) >= 1] <- 1
```

```
Fukuda$Fukuda_PEM[rowSums(Fukuda[,c("Fukuda_14", "Fukuda_15", "Fukuda_16", "Fukuda_17",  
"Fukuda_18")], na.rm = TRUE) < 1] <- 0
```

```
#Unrefreshing Sleep
```

```
Fukuda$Fukuda_Sleep[(DSQ$dsq_19f >= 1) & (DSQ$dsq_19s >= 1)] <- 1
```

```
Fukuda$Fukuda_Sleep[(DSQ$dsq_19f < 1) | (DSQ$dsq_19s < 1)] <- 0
```

```
#Muscle Aches
```

```
Fukuda$Fukuda_Muscle[(DSQ$dsq_25f >= 1) & (DSQ$dsq_25s >= 1)] <- 1
```

```
Fukuda$Fukuda_Muscle[(DSQ$dsq_25f < 1) | (DSQ$dsq_25s < 1)] <- 0
```

```
#Joint Pain
```

```
Fukuda$Fukuda_Joint[(DSQ$dsq_26f >= 1) & (DSQ$dsq_26s >= 1)] <- 1
```

```
Fukuda$Fukuda_Joint[(DSQ$dsq_26f < 1) | (DSQ$dsq_26s < 1)] <- 0
```

```
#Headaches
```

```
Fukuda$Fukuda_Headache[(DSQ$dsq_31f >= 1) & (DSQ$dsq_31s >= 1) & (DSQ$dsq_68 == 1)] <- 1
```



```
Fukuda$Fukuda_Headache[(DSQ$dsq_31f < 1) | (DSQ$dsq_31s < 1) | (DSQ$dsq_68 != 1)] <- 0
```

#Memory and Concentration

```
Fukuda$Fukuda_36[(DSQ$dsq_36f >= 1) & (DSQ$dsq_36s >= 1)] <- 1
```

```
Fukuda$Fukuda_36[(DSQ$dsq_36f < 1) | (DSQ$dsq_36s < 1)] <- 0
```

```
Fukuda$Fukuda_37[(DSQ$dsq_37f >= 1) & (DSQ$dsq_37s >= 1)] <- 1
```

```
Fukuda$Fukuda_37[(DSQ$dsq_37f < 1) | (DSQ$dsq_37s < 1)] <- 0
```

```
Fukuda$Fukuda_38[(DSQ$dsq_38f >= 1) & (DSQ$dsq_38s >= 1)] <- 1
```

```
Fukuda$Fukuda_38[(DSQ$dsq_38f < 1) | (DSQ$dsq_38s < 1)] <- 0
```

```
Fukuda$Fukuda_39[(DSQ$dsq_39f >= 1) & (DSQ$dsq_39s >= 1)] <- 1
```

```
Fukuda$Fukuda_39[(DSQ$dsq_39f < 1) | (DSQ$dsq_39s < 1)] <- 0
```

```
Fukuda$Fukuda_43[(DSQ$dsq_43f >= 1) & (DSQ$dsq_43s >= 1)] <- 1
```

```
Fukuda$Fukuda_43[(DSQ$dsq_43f < 1) | (DSQ$dsq_43s < 1)] <- 0
```

```
Fukuda$Fukuda_44[(DSQ$dsq_44f >= 1) & (DSQ$dsq_44s >= 1)] <- 1
```

```
Fukuda$Fukuda_44[(DSQ$dsq_44f < 1) | (DSQ$dsq_44s < 1)] <- 0
```

```
Fukuda$Fukuda_Memory[rowSums(Fukuda[,c("Fukuda_36", "Fukuda_37", "Fukuda_38", "Fukuda_39",  
"Fukuda_43", "Fukuda_44")]) >= 1] <- 1
```

```
Fukuda$Fukuda_Memory[rowSums(Fukuda[,c("Fukuda_36", "Fukuda_37", "Fukuda_38", "Fukuda_39",  
"Fukuda_43", "Fukuda_44")]) < 1] <- 0
```

#Sore Throat

```
Fukuda$Fukuda_Throat[(DSQ$dsq_62f >= 1) & (DSQ$dsq_62s >= 1)] <- 1
```

```
Fukuda$Fukuda_Throat[(DSQ$dsq_62f < 1) | (DSQ$dsq_62s < 1)] <- 0
```

```
#Lymph Nodes
```

```
Fukuda$Fukuda_Lymph[(DSQ$dsq_63f >= 1) & (DSQ$dsq_63s >= 1)] <- 1
```

```
Fukuda$Fukuda_Lymph[(DSQ$dsq_63f < 1) | (DSQ$dsq_63s < 1)] <- 0
```

```
###Fukuda Case Definition
```

```
Fukuda$Fukuda_Case_Definition[(Fukuda$Fukuda_SR == 1) & (Fukuda$Fukuda_Fatigue == 1) &
(rowSums(Fukuda[,c("Fukuda_PEM", "Fukuda_Sleep", "Fukuda_Muscle", "Fukuda_Joint", "Fukuda_Headache", "Fukuda_Memory", "Fukuda_Throat", "Fukuda_Lymph")], na.rm = TRUE) >= 4)] <- 1
```

```
Fukuda$Fukuda_Case_Definition[(Fukuda$Fukuda_SR != 1) | (Fukuda$Fukuda_Fatigue != 1) |
(rowSums(Fukuda[,c("Fukuda_PEM", "Fukuda_Sleep", "Fukuda_Muscle", "Fukuda_Joint", "Fukuda_Headache", "Fukuda_Memory", "Fukuda_Throat", "Fukuda_Lymph")], na.rm = TRUE) < 4)] <- 0
```

```
Fukuda$Fukuda_Case_Definition <- factor(Fukuda$Fukuda_Case_Definition, levels = c(0, 1), labels =
c("Does Not Meet Fukuda Criteria", "Meets Fukuda Criteria"))
```

```
return(Fukuda)
```

```
}
```

```
###Canadian Clinical ME/CFS Criteria (CCC; Carruthers et al., 2003)
```

```
###Canadian Consensus Criteria Scoring Function
```

```
DSQ_1_CCC <- function(DSQ, SF){
```

```
  CCC <- DSQ[,1, drop = F]
```

```
  #Substantial Reduction in Functioning criteria, SF-36
```

```
  CCC$CCC_RP[(SF$RolePhysical <= 50)] <- 1
```

```
  CCC$CCC_RP[(SF$RolePhysical > 50)] <- 0
```

```
  CCC$CCC_SF[SF$SocialFunctioning <= 62.5] <- 1
```

```
  CCC$CCC_SF[SF$SocialFunctioning > 62.5] <- 0
```

```
  CCC$CCC_V[SF$Vitality <= 35] <- 1
```

```
  CCC$CCC_V[SF$Vitality > 35] <- 0
```

```
  CCC$CCC_SR[rowSums(CCC[,c("CCC_RP", "CCC_SF", "CCC_V")]) >= 2] <- 1
```

```
  CCC$CCC_SR[rowSums(CCC[,c("CCC_RP", "CCC_SF", "CCC_V")]) < 2] <- 0
```

```
  #DSQ-1 Symptom Scoring
```

```
  #Fatigue, Not Lifelong, Not Result of Exertion
```

```
  CCC$CCC_Six[(DSQ$dsq_69 == 2) | (DSQ$dsq_69 == 3) | (DSQ$dsq_69 == 4) | (DSQ$dsq_69 == 5)] <- 1
```

```
  CCC$CCC_Six[(DSQ$dsq_69 == 1) | (DSQ$dsq_69 == 6)] <- 0
```

```
  CCC$CCC_13[(DSQ$dsq_13f >= 2) & (DSQ$dsq_13s >= 2)] <- 1
```

```
  CCC$CCC_13[(DSQ$dsq_13f < 2) | (DSQ$dsq_13s < 2)] <- 0
```

```
CCC$CCC_Life[(DSQ$dsq_67 == 1) & (DSQ$dsq_69 == 5) & (DSQ$dsq_77 == 7)] <- 1
```

```
CCC$CCC_Life[DSQ$dsq_67 != 1 | DSQ$dsq_69 != 5 | DSQ$dsq_77 != 7] <- 0
```

```
CCC$CCC_Exert[rowSums(DSQ[,c("dsq_89a", "dsq_89d")]) >= 60] <- 1
```

```
CCC$CCC_Exert[rowSums(DSQ[,c("dsq_89a", "dsq_89d")]) < 60] <- 0
```

```
CCC$CCC_Fatigue[(CCC$CCC_Six == 1) & (CCC$CCC_13 == 1) & (CCC$CCC_Life == 0) & (CCC$CCC_Exert == 0)] <- 1
```

```
CCC$CCC_Fatigue[(CCC$CCC_Six != 1) | (CCC$CCC_13 != 1) | (CCC$CCC_Life != 0) | (CCC$CCC_Exert != 0)] <- 0
```

```
#Post-Exertional Malaise
```

```
CCC$CCC_14[(DSQ$dsq_14f >= 2) & (DSQ$dsq_14s >= 2)] <- 1
```

```
CCC$CCC_14[(DSQ$dsq_14f < 2) | (DSQ$dsq_14s < 2)] <- 0
```

```
CCC$CCC_15[(DSQ$dsq_15f >= 2) & (DSQ$dsq_15s >= 2)] <- 1
```

```
CCC$CCC_15[(DSQ$dsq_15f < 2) | (DSQ$dsq_15s < 2)] <- 0
```

```
CCC$CCC_16[(DSQ$dsq_16f >= 2) & (DSQ$dsq_16s >= 2)] <- 1
```

```
CCC$CCC_16[(DSQ$dsq_16f < 2) | (DSQ$dsq_16s < 2)] <- 0
```

```
CCC$CCC_17[(DSQ$dsq_17f >= 2) & (DSQ$dsq_17s >= 2)] <- 1
```

```
CCC$CCC_17[(DSQ$dsq_17f < 2) | (DSQ$dsq_17s < 2)] <- 0
```

```
CCC$CCC_18[(DSQ$dsq_18f >= 2) & (DSQ$dsq_18s >= 2)] <- 1
```

```
CCC$CCC_18[(DSQ$dsq_18f < 2) | (DSQ$dsq_18s < 2)] <- 0
```

```
CCC$CCC_PEM[rowSums(CCC[,c("CCC_14", "CCC_15", "CCC_16", "CCC_17", "CCC_18")], na.rm = TRUE) >= 1] <- 1
```

```
CCC$CCC_PEM[rowSums(CCC[,c("CCC_14", "CCC_15", "CCC_16", "CCC_17", "CCC_18")], na.rm = TRUE)
< 1] <- 0
```

```
#Sleep
```

```
CCC$CCC_19[(DSQ$dsq_19f >= 2) & (DSQ$dsq_19s >= 2)] <- 1
```

```
CCC$CCC_19[(DSQ$dsq_19f < 2) | (DSQ$dsq_19s < 2)] <- 0
```

```
CCC$CCC_20[(DSQ$dsq_20f >= 2) & (DSQ$dsq_20s >= 2)] <- 1
```

```
CCC$CCC_20[(DSQ$dsq_20f < 2) | (DSQ$dsq_20s < 2)] <- 0
```

```
CCC$CCC_21[(DSQ$dsq_21f >= 2) & (DSQ$dsq_21s >= 2)] <- 1
```

```
CCC$CCC_21[(DSQ$dsq_21f < 2) | (DSQ$dsq_21s < 2)] <- 0
```

```
CCC$CCC_22[(DSQ$dsq_22f >= 2) & (DSQ$dsq_22s >= 2)] <- 1
```

```
CCC$CCC_22[(DSQ$dsq_22f < 2) | (DSQ$dsq_22s < 2)] <- 0
```

```
CCC$CCC_23[(DSQ$dsq_23f >= 2) & (DSQ$dsq_23s >= 2)] <- 1
```

```
CCC$CCC_23[(DSQ$dsq_23f < 2) | (DSQ$dsq_23s < 2)] <- 0
```

```
CCC$CCC_24[(DSQ$dsq_24f >= 2) & (DSQ$dsq_24s >= 2)] <- 1
```

```
CCC$CCC_24[(DSQ$dsq_24f < 2) | (DSQ$dsq_24s < 2)] <- 0
```

```
CCC$CCC_Sleep[rowSums(CCC[,c("CCC_19", "CCC_20", "CCC_21", "CCC_22", "CCC_23", "CCC_24")],
na.rm = TRUE) >= 1] <- 1
```

```
CCC$CCC_Sleep[rowSums(CCC[,c("CCC_19", "CCC_20", "CCC_21", "CCC_22", "CCC_23", "CCC_24")],
na.rm = TRUE) < 1] <- 0
```

```
#Pain
```

```
CCC$CCC_25[(DSQ$dsq_25f >= 2) & (DSQ$dsq_25s >= 2)] <- 1
```

```
CCC$CCC_25[(DSQ$dsq_25f < 2) | (DSQ$dsq_25s < 2)] <- 0
```

```
CCC$CCC_26[(DSQ$dsq_26f >= 2) & (DSQ$dsq_26s >= 2)] <- 1
```

```
CCC$CCC_26[(DSQ$dsq_26f < 2) | (DSQ$dsq_26s < 2)] <- 0
```

```
CCC$CCC_27[(DSQ$dsq_27f >= 2) & (DSQ$dsq_27s >= 2)] <- 1
```

```
CCC$CCC_27[(DSQ$dsq_27f < 2) | (DSQ$dsq_27s < 2)] <- 0
```

```
CCC$CCC_28[(DSQ$dsq_28f >= 2) & (DSQ$dsq_28s >= 2)] <- 1
```

```
CCC$CCC_28[(DSQ$dsq_28f < 2) | (DSQ$dsq_28s < 2)] <- 0
```

```
CCC$CCC_29[(DSQ$dsq_29f >= 2) & (DSQ$dsq_29s >= 2)] <- 1
```

```
CCC$CCC_29[(DSQ$dsq_29f < 2) | (DSQ$dsq_29s < 2)] <- 0
```

```
CCC$CCC_30[(DSQ$dsq_30f >= 2) & (DSQ$dsq_30s >= 2)] <- 1
```

```
CCC$CCC_30[(DSQ$dsq_30f < 2) | (DSQ$dsq_30s < 2)] <- 0
```

```
CCC$CCC_31[(DSQ$dsq_31f >= 2) & (DSQ$dsq_31s >= 2)] <- 1
```

```
CCC$CCC_31[(DSQ$dsq_31f < 2) | (DSQ$dsq_31s < 2)] <- 0
```

```
CCC$CCC_Pain[rowSums(CCC[,c("CCC_25", "CCC_26", "CCC_27", "CCC_28", "CCC_29", "CCC_30",  
"CCC_31")], na.rm = TRUE) >= 1] <- 1
```

```
CCC$CCC_Pain[rowSums(CCC[,c("CCC_25", "CCC_26", "CCC_27", "CCC_28", "CCC_29", "CCC_30",  
"CCC_31")], na.rm = TRUE) < 1] <- 0
```

```
#Neurocognitive
```

```
CCC$CCC_32[(DSQ$dsq_32f >= 2) & (DSQ$dsq_32s >= 2)] <- 1
```

CCC\$CCC_32[(DSQ\$dsq_32f >= 2) | (DSQ\$dsq_32s < 2)] <- 0

CCC\$CCC_33[(DSQ\$dsq_33f >= 2) & (DSQ\$dsq_33s >= 2)] <- 1

CCC\$CCC_33[(DSQ\$dsq_33f < 2) | (DSQ\$dsq_33s < 2)] <- 0

CCC\$CCC_34[(DSQ\$dsq_34f >= 2) & (DSQ\$dsq_34s >= 2)] <- 1

CCC\$CCC_34[(DSQ\$dsq_34f < 2) | (DSQ\$dsq_34s < 2)] <- 0

CCC\$CCC_35[(DSQ\$dsq_35f >= 2) & (DSQ\$dsq_35s >= 2)] <- 1

CCC\$CCC_35[(DSQ\$dsq_35f < 2) | (DSQ\$dsq_35s < 2)] <- 0

CCC\$CCC_36[(DSQ\$dsq_36f >= 2) & (DSQ\$dsq_36s >= 2)] <- 1

CCC\$CCC_36[(DSQ\$dsq_36f < 2) | (DSQ\$dsq_36s < 2)] <- 0

CCC\$CCC_37[(DSQ\$dsq_37f >= 2) & (DSQ\$dsq_37s >= 2)] <- 1

CCC\$CCC_37[(DSQ\$dsq_37f < 2) | (DSQ\$dsq_37s < 2)] <- 0

CCC\$CCC_38[(DSQ\$dsq_38f >= 2) & (DSQ\$dsq_38s >= 2)] <- 1

CCC\$CCC_38[(DSQ\$dsq_38f < 2) | (DSQ\$dsq_38s < 2)] <- 0

CCC\$CCC_39[(DSQ\$dsq_39f >= 2) & (DSQ\$dsq_39s >= 2)] <- 1

CCC\$CCC_39[(DSQ\$dsq_39f < 2) | (DSQ\$dsq_39s < 2)] <- 0

CCC\$CCC_40[(DSQ\$dsq_40f >= 2) & (DSQ\$dsq_40s >= 2)] <- 1

CCC\$CCC_40[(DSQ\$dsq_40f < 2) | (DSQ\$dsq_40s < 2)] <- 0

CCC\$CCC_41[(DSQ\$dsq_41f >= 2) & (DSQ\$dsq_41s >= 2)] <- 1

CCC\$CCC_41[(DSQ\$dsq_41f < 2) | (DSQ\$dsq_41s < 2)] <- 0

```
CCC$CCC_42[(DSQ$dsq_42f >= 2) & (DSQ$dsq_42s >= 2)] <- 1
```

```
CCC$CCC_42[(DSQ$dsq_42f < 2) | (DSQ$dsq_42s < 2)] <- 0
```

```
CCC$CCC_43[(DSQ$dsq_43f >= 2) & (DSQ$dsq_43s >= 2)] <- 1
```

```
CCC$CCC_43[(DSQ$dsq_43f < 2) | (DSQ$dsq_43s < 2)] <- 0
```

```
CCC$CCC_44[(DSQ$dsq_44f >= 2) & (DSQ$dsq_44s >= 2)] <- 1
```

```
CCC$CCC_44[(DSQ$dsq_44f < 2) | (DSQ$dsq_44s < 2)] <- 0
```

```
CCC$CCC_Neurocog[rowSums(CCC[,c("CCC_32", "CCC_33", "CCC_34", "CCC_35", "CCC_36", "CCC_37",  
"CCC_38", "CCC_39", "CCC_40", "CCC_41", "CCC_42", "CCC_43", "CCC_44")], na.rm = TRUE) >= 2] <- 1
```

```
CCC$CCC_Neurocog[rowSums(CCC[,c("CCC_32", "CCC_33", "CCC_34", "CCC_35", "CCC_36", "CCC_37",  
"CCC_38", "CCC_39", "CCC_40", "CCC_41", "CCC_42", "CCC_43", "CCC_44")], na.rm = TRUE) < 2] <- 0
```

```
#Autonomic
```

```
CCC$CCC_45[(DSQ$dsq_45f >= 2) & (DSQ$dsq_45s >= 2)] <- 1
```

```
CCC$CCC_45[(DSQ$dsq_45f < 2) | (DSQ$dsq_45s < 2)] <- 0
```

```
CCC$CCC_46[(DSQ$dsq_46f >= 2) & (DSQ$dsq_46s >= 2)] <- 1
```

```
CCC$CCC_46[(DSQ$dsq_46f < 2) | (DSQ$dsq_46s < 2)] <- 0
```

```
CCC$CCC_47[(DSQ$dsq_47f >= 2) & (DSQ$dsq_47s >= 2)] <- 1
```

```
CCC$CCC_47[(DSQ$dsq_47f < 2) | (DSQ$dsq_47s < 2)] <- 0
```

```
CCC$CCC_48[(DSQ$dsq_48f >= 2) & (DSQ$dsq_48s >= 2)] <- 1
```

```
CCC$CCC_48[(DSQ$dsq_48f < 2) | (DSQ$dsq_48s < 2)] <- 0
```

```
CCC$CCC_49[(DSQ$dsq_49f >= 2) & (DSQ$dsq_49s >= 2)] <- 1
```



```
CCC$CCC_49[(DSQ$dsq_49f < 2) | (DSQ$dsq_49s < 2)] <- 0
```

```
CCC$CCC_50[(DSQ$dsq_50f >= 2) & (DSQ$dsq_50s >= 2)] <- 1
```

```
CCC$CCC_50[(DSQ$dsq_50f < 2) | (DSQ$dsq_50s < 2)] <- 0
```

```
CCC$CCC_51[(DSQ$dsq_51f >= 2) & (DSQ$dsq_51s >= 2)] <- 1
```

```
CCC$CCC_51[(DSQ$dsq_51f < 2) | (DSQ$dsq_51s < 2)] <- 0
```

```
CCC$CCC_Auto[rowSums(CCC[,c("CCC_45", "CCC_46", "CCC_47", "CCC_48", "CCC_49", "CCC_50",  
"CCC_51")], na.rm = TRUE) >= 1] <- 1
```

```
CCC$CCC_Auto[rowSums(CCC[,c("CCC_45", "CCC_46", "CCC_47", "CCC_48", "CCC_49", "CCC_50",  
"CCC_51")], na.rm = TRUE) < 1] <- 0
```

```
#Neuroendocrine
```

```
CCC$CCC_52[(DSQ$dsq_52f >= 2) & (DSQ$dsq_52s >= 2)] <- 1
```

```
CCC$CCC_52[(DSQ$dsq_52f < 2) | (DSQ$dsq_52s < 2)] <- 0
```

```
CCC$CCC_53[(DSQ$dsq_53f >= 2) & (DSQ$dsq_53s >= 2)] <- 1
```

```
CCC$CCC_53[(DSQ$dsq_53f < 2) | (DSQ$dsq_53s < 2)] <- 0
```

```
CCC$CCC_54[(DSQ$dsq_54f >= 2) & (DSQ$dsq_54s >= 2)] <- 1
```

```
CCC$CCC_54[(DSQ$dsq_54f < 2) | (DSQ$dsq_54s < 2)] <- 0
```

```
CCC$CCC_55[(DSQ$dsq_55f >= 2) & (DSQ$dsq_55s >= 2)] <- 1
```

```
CCC$CCC_55[(DSQ$dsq_55f < 2) | (DSQ$dsq_55s < 2)] <- 0
```

```
CCC$CCC_56[(DSQ$dsq_56f >= 2) & (DSQ$dsq_56s >= 2)] <- 1
```

```
CCC$CCC_56[(DSQ$dsq_56f < 2) | (DSQ$dsq_56s < 2)] <- 0
```

```
CCC$CCC_57[(DSQ$dsq_57f >= 2) & (DSQ$dsq_57s >= 2)] <- 1
```

```
CCC$CCC_57[(DSQ$dsq_57f < 2) | (DSQ$dsq_57s < 2)] <- 0
```

```
CCC$CCC_58[(DSQ$dsq_58f >= 2) & (DSQ$dsq_58s >= 2)] <- 1
```

```
CCC$CCC_58[(DSQ$dsq_58f < 2) | (DSQ$dsq_58s < 2)] <- 0
```

```
CCC$CCC_59[(DSQ$dsq_59f >= 2) & (DSQ$dsq_59s >= 2)] <- 1
```

```
CCC$CCC_59[(DSQ$dsq_59f < 2) | (DSQ$dsq_59s < 2)] <- 0
```

```
CCC$CCC_60[(DSQ$dsq_60f >= 2) & (DSQ$dsq_60s >= 2)] <- 1
```

```
CCC$CCC_60[(DSQ$dsq_60f < 2) | (DSQ$dsq_60s < 2)] <- 0
```

```
CCC$CCC_61[(DSQ$dsq_61f >= 2) & (DSQ$dsq_61s >= 2)] <- 1
```

```
CCC$CCC_61[(DSQ$dsq_61f < 2) | (DSQ$dsq_61s < 2)] <- 0
```

```
CCC$CCC_Neuroendo[rowSums(CCC[,c("CCC_52", "CCC_53", "CCC_54", "CCC_55", "CCC_56",  
"CCC_57", "CCC_58", "CCC_59", "CCC_60", "CCC_61")], na.rm = TRUE) >= 1] <- 1
```

```
CCC$CCC_Neuroendo[rowSums(CCC[,c("CCC_52", "CCC_53", "CCC_54", "CCC_55", "CCC_56",  
"CCC_57", "CCC_58", "CCC_59", "CCC_60", "CCC_61")], na.rm = TRUE) < 1] <- 0
```

```
#Immune
```

```
CCC$CCC_62[(DSQ$dsq_62f >= 2) & (DSQ$dsq_62s >= 2)] <- 1
```

```
CCC$CCC_62[(DSQ$dsq_62f < 2) | (DSQ$dsq_62s < 2)] <- 0
```

```
CCC$CCC_63[(DSQ$dsq_63f >= 2) & (DSQ$dsq_63s >= 2)] <- 1
```

```
CCC$CCC_63[(DSQ$dsq_63f < 2) | (DSQ$dsq_63s < 2)] <- 0
```

```
CCC$CCC_64[(DSQ$dsq_64f >= 2) & (DSQ$dsq_64s >= 2)] <- 1
```

```
CCC$CCC_64[(DSQ$dsq_64f < 2) | (DSQ$dsq_64s < 2)] <- 0
```

```
CCC$CCC_65[(DSQ$dsq_65f >= 2) & (DSQ$dsq_65s >= 2)] <- 1
```

```
CCC$CCC_65[(DSQ$dsq_65f < 2) | (DSQ$dsq_65s < 2)] <- 0
```

```
CCC$CCC_66[(DSQ$dsq_66f >= 2) & (DSQ$dsq_66s >= 2)] <- 1
```

```
CCC$CCC_66[(DSQ$dsq_66f < 2) | (DSQ$dsq_66s < 2)] <- 0
```

```
CCC$CCC_Immune[rowSums(CCC[,c("CCC_62", "CCC_63", "CCC_64", "CCC_65", "CCC_66")], na.rm = TRUE) >= 1] <- 1
```

```
CCC$CCC_Immune[rowSums(CCC[,c("CCC_62", "CCC_63", "CCC_64", "CCC_65", "CCC_66")], na.rm = TRUE) < 1] <- 0
```

```
CCC$CCC_ANI2[rowSums(CCC[,c("CCC_Auto", "CCC_Neuroendo", "CCC_Immune")], na.rm = TRUE) >= 2] <- 1
```

```
CCC$CCC_ANI2[rowSums(CCC[,c("CCC_Auto", "CCC_Neuroendo", "CCC_Immune")], na.rm = TRUE) < 2] <- 0
```

```
###Canadian ME/CFS Case Definition
```

```
CCC$CCC_Case_Definition[(rowSums(CCC[,c("CCC_SR", "CCC_Fatigue", "CCC_PEM", "CCC_Sleep", "CCC_Pain", "CCC_Neurocog", "CCC_ANI2")], na.rm = TRUE) == 7)] <- 1
```

```
CCC$CCC_Case_Definition[(rowSums(CCC[,c("CCC_SR", "CCC_Fatigue", "CCC_PEM", "CCC_Sleep", "CCC_Pain", "CCC_Neurocog", "CCC_ANI2")], na.rm = TRUE) < 7)] <- 0
```

```
CCC$CCC_Case_Definition <- factor(CCC$CCC_Case_Definition, levels = c(0, 1), labels = c("Does Not Meet Canadian MECFS Criteria", "Meets Canadian MECFS Criteria"))
```

```
return(CCC)
```

```
}
```

```
###International Consensus Criteria for ME (ME-ICC; Carruthers et al., 2011)
```

```
###ME-ICC Criteria Scoring Function
```

```
DSQ_1_MEICC <- function(DSQ){
```

```
  MEICC <- DSQ[,1, drop = F]
```

```
  #50 percent reduction in activity
```

```
  MEICC$MEICC_SR[(DSQ$dsq_97 == 1)] <- 1
```

```
  MEICC$MEICC_SR[(DSQ$dsq_97 != 1)] <- 0
```

```
  #Post-Exertional Neuroimmune Exhaustion
```

```
  MEICC$MEICC_14[(DSQ$dsq_14f >= 2) & (DSQ$dsq_14s >= 2)] <- 1
```

```
  MEICC$MEICC_14[(DSQ$dsq_14f < 2) | (DSQ$dsq_14s < 2)] <- 0
```

```
  MEICC$MEICC_15[(DSQ$dsq_15f >= 2) & (DSQ$dsq_15s >= 2)] <- 1
```

```
  MEICC$MEICC_15[(DSQ$dsq_15f < 2) | (DSQ$dsq_15s < 2)] <- 0
```

```
  MEICC$MEICC_16[(DSQ$dsq_16f >= 2) & (DSQ$dsq_16s >= 2)] <- 1
```

```
  MEICC$MEICC_16[(DSQ$dsq_16f < 2) | (DSQ$dsq_16s < 2)] <- 0
```

```
  MEICC$MEICC_17[(DSQ$dsq_17f >= 2) & (DSQ$dsq_17s >= 2)] <- 1
```

```
  MEICC$MEICC_17[(DSQ$dsq_17f < 2) | (DSQ$dsq_17s < 2)] <- 0
```

```
  MEICC$MEICC_18[(DSQ$dsq_18f >= 2) & (DSQ$dsq_18s >= 2)] <- 1
```

```
  MEICC$MEICC_18[(DSQ$dsq_18f < 2) | (DSQ$dsq_18s < 2)] <- 0
```

```
  MEICC$MEICC_PENE[rowSums(MEICC[,c("MEICC_14", "MEICC_15", "MEICC_16", "MEICC_17",  
"MEICC_18")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_PENE[rowSums(MEICC[,c("MEICC_14", "MEICC_15", "MEICC_16", "MEICC_17",  
"MEICC_18")], na.rm = TRUE) < 1] <- 0
```

```
#Neurological Impairments
```

```
#Neurocognitive
```

```
MEICC$MEICC_36[(DSQ$dsq_36f >= 2) & (DSQ$dsq_36s >= 2)] <- 1
```

```
MEICC$MEICC_36[(DSQ$dsq_36f < 2) | (DSQ$dsq_36s < 2)] <- 0
```

```
MEICC$MEICC_37[(DSQ$dsq_37f >= 2) & (DSQ$dsq_37s >= 2)] <- 1
```

```
MEICC$MEICC_37[(DSQ$dsq_37f < 2) | (DSQ$dsq_37s < 2)] <- 0
```

```
MEICC$MEICC_38[(DSQ$dsq_38f >= 2) & (DSQ$dsq_38s >= 2)] <- 1
```

```
MEICC$MEICC_38[(DSQ$dsq_38f < 2) | (DSQ$dsq_38s < 2)] <- 0
```

```
MEICC$MEICC_39[(DSQ$dsq_39f >= 2) & (DSQ$dsq_39s >= 2)] <- 1
```

```
MEICC$MEICC_39[(DSQ$dsq_39f < 2) | (DSQ$dsq_39s < 2)] <- 0
```

```
MEICC$MEICC_40[(DSQ$dsq_40f >= 2) & (DSQ$dsq_40s >= 2)] <- 1
```

```
MEICC$MEICC_40[(DSQ$dsq_40f < 2) | (DSQ$dsq_40s < 2)] <- 0
```

```
MEICC$MEICC_41[(DSQ$dsq_41f >= 2) & (DSQ$dsq_41s >= 2)] <- 1
```

```
MEICC$MEICC_41[(DSQ$dsq_41f < 2) | (DSQ$dsq_41s < 2)] <- 0
```

```
MEICC$MEICC_42[(DSQ$dsq_42f >= 2) & (DSQ$dsq_42s >= 2)] <- 1
```

```
MEICC$MEICC_42[(DSQ$dsq_42f < 2) | (DSQ$dsq_42s < 2)] <- 0
```

```
MEICC$MEICC_43[(DSQ$dsq_43f >= 2) & (DSQ$dsq_43s >= 2)] <- 1
```

```
MEICC$MEICC_43[(DSQ$dsq_43f < 2) | (DSQ$dsq_43s < 2)] <- 0
```

```
MEICC$MEICC_44[(DSQ$dsq_44f >= 2) & (DSQ$dsq_44s >= 2)] <- 1
```

```
MEICC$MEICC_44[(DSQ$dsq_44f < 2) | (DSQ$dsq_44s < 2)] <- 0
```

```
MEICC$MEICC_Neurocog[rowSums(MEICC[,c("MEICC_36", "MEICC_37", "MEICC_38", "MEICC_39",  
"MEICC_40", "MEICC_41", "MEICC_42", "MEICC_43", "MEICC_44")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Neurocog[rowSums(MEICC[,c("MEICC_36", "MEICC_37", "MEICC_38", "MEICC_39",  
"MEICC_40", "MEICC_41", "MEICC_42", "MEICC_43", "MEICC_44")], na.rm = TRUE) < 1] <- 0
```

```
#Pain
```

```
MEICC$MEICC_25[(DSQ$dsq_25f >= 2) & (DSQ$dsq_25s >= 2)] <- 1
```

```
MEICC$MEICC_25[(DSQ$dsq_25f < 2) | (DSQ$dsq_25s < 2)] <- 0
```

```
MEICC$MEICC_26[(DSQ$dsq_26f >= 2) & (DSQ$dsq_26s >= 2)] <- 1
```

```
MEICC$MEICC_26[(DSQ$dsq_26f < 2) | (DSQ$dsq_26s < 2)] <- 0
```

```
MEICC$MEICC_27[(DSQ$dsq_27f >= 2) & (DSQ$dsq_27s >= 2)] <- 1
```

```
MEICC$MEICC_27[(DSQ$dsq_27f < 2) | (DSQ$dsq_27s < 2)] <- 0
```

```
MEICC$MEICC_28[(DSQ$dsq_28f >= 2) & (DSQ$dsq_28s >= 2)] <- 1
```

```
MEICC$MEICC_28[(DSQ$dsq_28f < 2) | (DSQ$dsq_28s < 2)] <- 0
```

```
MEICC$MEICC_31[(DSQ$dsq_31f >= 2) & (DSQ$dsq_31s >= 2)] <- 1
```

```
MEICC$MEICC_31[(DSQ$dsq_31f < 2) | (DSQ$dsq_31s < 2)] <- 0
```

```
MEICC$MEICC_Pain[rowSums(MEICC[,c("MEICC_25", "MEICC_26", "MEICC_27", "MEICC_28",  
"MEICC_31")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Pain[rowSums(MEICC[,c("MEICC_25", "MEICC_26", "MEICC_27", "MEICC_28",  
"MEICC_31")], na.rm = TRUE) < 1] <- 0
```

```
#Sleep disturbances
```

```
MEICC$MEICC_19[(DSQ$dsq_19f >= 2) & (DSQ$dsq_19s >= 2)] <- 1
```

```
MEICC$MEICC_19[(DSQ$dsq_19f < 2) | (DSQ$dsq_19s < 2)] <- 0
```

```
MEICC$MEICC_20[(DSQ$dsq_20f >= 2) & (DSQ$dsq_20s >= 2)] <- 1
```

```
MEICC$MEICC_20[(DSQ$dsq_20f < 2) | (DSQ$dsq_20s < 2)] <- 0
```

```
MEICC$MEICC_21[(DSQ$dsq_21f >= 2) & (DSQ$dsq_21s >= 2)] <- 1
```

```
MEICC$MEICC_21[(DSQ$dsq_21f < 2) | (DSQ$dsq_21s < 2)] <- 0
```

```
MEICC$MEICC_22[(DSQ$dsq_22f >= 2) & (DSQ$dsq_22s >= 2)] <- 1
```

```
MEICC$MEICC_22[(DSQ$dsq_22f < 2) | (DSQ$dsq_22s < 2)] <- 0
```

```
MEICC$MEICC_23[(DSQ$dsq_23f >= 2) & (DSQ$dsq_23s >= 2)] <- 1
```

```
MEICC$MEICC_23[(DSQ$dsq_23f < 2) | (DSQ$dsq_23s < 2)] <- 0
```

```
MEICC$MEICC_24[(DSQ$dsq_24f >= 2) & (DSQ$dsq_24s >= 2)] <- 1
```

```
MEICC$MEICC_24[(DSQ$dsq_24f < 2) | (DSQ$dsq_24s < 2)] <- 0
```

```
MEICC$MEICC_Sleep[rowSums(MEICC[,c("MEICC_19", "MEICC_20", "MEICC_21", "MEICC_22",  
"MEICC_23", "MEICC_24")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Sleep[rowSums(MEICC[,c("MEICC_19", "MEICC_20", "MEICC_21", "MEICC_22",  
"MEICC_23", "MEICC_24")], na.rm = TRUE) < 1] <- 0
```

```
#Neurosensory, perceptual and motor disturbances
```



```
MEICC$MEICC_32[(DSQ$dsq_32f >= 2) & (DSQ$dsq_32s >= 2)] <- 1
```

```
MEICC$MEICC_32[(DSQ$dsq_32f < 2) | (DSQ$dsq_32s < 2)] <- 0
```

```
MEICC$MEICC_33[(DSQ$dsq_33f >= 2) & (DSQ$dsq_33s >= 2)] <- 1
```

```
MEICC$MEICC_33[(DSQ$dsq_33f < 2) | (DSQ$dsq_33s < 2)] <- 0
```

```
MEICC$MEICC_34[(DSQ$dsq_34f >= 2) & (DSQ$dsq_34s >= 2)] <- 1
```

```
MEICC$MEICC_34[(DSQ$dsq_34f < 2) | (DSQ$dsq_34s < 2)] <- 0
```

```
MEICC$MEICC_35[(DSQ$dsq_35f >= 2) & (DSQ$dsq_35s >= 2)] <- 1
```

```
MEICC$MEICC_35[(DSQ$dsq_35f < 2) | (DSQ$dsq_35s < 2)] <- 0
```

```
MEICC$MEICC_48[(DSQ$dsq_48f >= 2) & (DSQ$dsq_48s >= 2)] <- 1
```

```
MEICC$MEICC_48[(DSQ$dsq_48f < 2) | (DSQ$dsq_48s < 2)] <- 0
```

```
MEICC$MEICC_Neurosensory[rowSums(MEICC[,c("MEICC_32", "MEICC_33", "MEICC_34", "MEICC_35",  
"MEICC_48")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Neurosensory[rowSums(MEICC[,c("MEICC_32", "MEICC_33", "MEICC_34", "MEICC_35",  
"MEICC_48")], na.rm = TRUE) < 1] <- 0
```

```
MEICC$MEICC_Neurological[rowSums(MEICC[,c("MEICC_Neurocog", "MEICC_Pain", "MEICC_Sleep",  
"MEICC_Neurosensory")], na.rm = TRUE) >= 3] <- 1
```

```
MEICC$MEICC_Neurological[rowSums(MEICC[,c("MEICC_Neurocog", "MEICC_Pain", "MEICC_Sleep",  
"MEICC_Neurosensory")], na.rm = TRUE) < 3] <- 0
```

```
#Immune, Gastro-Intestinal and Genitourinary Impairments
```

```
#Flu-like symptoms
```

```
MEICC$MEICC_62[(DSQ$dsq_62f >= 2) & (DSQ$dsq_62s >= 2)] <- 1
```

```
MEICC$MEICC_62[(DSQ$dsq_62f < 2) | (DSQ$dsq_62s < 2)] <- 0
```

```
MEICC$MEICC_63[(DSQ$dsq_63f >= 2) & (DSQ$dsq_63s >= 2)] <- 1
```

```
MEICC$MEICC_63[(DSQ$dsq_63f < 2) | (DSQ$dsq_63s < 2)] <- 0
```

```
MEICC$MEICC_64[(DSQ$dsq_64f >= 2) & (DSQ$dsq_64s >= 2)] <- 1
```

```
MEICC$MEICC_64[(DSQ$dsq_64f < 2) | (DSQ$dsq_64s < 2)] <- 0
```

```
MEICC$MEICC_65[(DSQ$dsq_65f >= 2) & (DSQ$dsq_65s >= 2)] <- 1
```

```
MEICC$MEICC_65[(DSQ$dsq_65f < 2) | (DSQ$dsq_65s < 2)] <- 0
```

```
MEICC$MEICC_Flu[rowSums(MEICC[,c("MEICC_62", "MEICC_63", "MEICC_64", "MEICC_65")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Flu[rowSums(MEICC[,c("MEICC_62", "MEICC_63", "MEICC_64", "MEICC_65")], na.rm = TRUE) < 1] <- 0
```

```
#Susceptibility to viral infections with prolonged recovery periods
```

```
MEICC$MEICC_Viral[DSQ$dsq_98 == 1] <- 1
```

```
MEICC$MEICC_Viral[DSQ$dsq_98 != 1] <- 0
```

```
#Gastro-intestinal tract
```

```
MEICC$MEICC_29[(DSQ$dsq_29f >= 2) & (DSQ$dsq_29s >= 2)] <- 1
```

```
MEICC$MEICC_29[(DSQ$dsq_29f < 2) | (DSQ$dsq_29s < 2)] <- 0
```

```
MEICC$MEICC_30[(DSQ$dsq_30f >= 2) & (DSQ$dsq_30s >= 2)] <- 1
```

```
MEICC$MEICC_30[(DSQ$dsq_30f < 2) | (DSQ$dsq_30s < 2)] <- 0
```

```
MEICC$MEICC_46[(DSQ$dsq_46f >= 2) & (DSQ$dsq_46s >= 2)] <- 1
```

```
MEICC$MEICC_46[(DSQ$dsq_46f < 2) | (DSQ$dsq_46s < 2)] <- 0
```

```
MEICC$MEICC_47[(DSQ$dsq_47f >= 2) & (DSQ$dsq_47s >= 2)] <- 1
```

```
MEICC$MEICC_47[(DSQ$dsq_47f < 2) | (DSQ$dsq_47s < 2)] <- 0
```

```
MEICC$MEICC_Gastro[rowSums(MEICC[,c("MEICC_29", "MEICC_30", "MEICC_46", "MEICC_47")],  
na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Gastro[rowSums(MEICC[,c("MEICC_29", "MEICC_30", "MEICC_46", "MEICC_47")],  
na.rm = TRUE) < 1] <- 0
```

```
#Genitourinary
```

```
MEICC$MEICC_Genito[(DSQ$dsq_45f >= 2) & (DSQ$dsq_45s >= 2)] <- 1
```

```
MEICC$MEICC_Genito[(DSQ$dsq_45f < 2) | (DSQ$dsq_45s < 2)] <- 0
```

```
#Sensitivities to food, medications, odours or chemicals
```

```
MEICC$MEICC_61[(DSQ$dsq_61f >= 2) & (DSQ$dsq_61s >= 2)] <- 1
```

```
MEICC$MEICC_61[(DSQ$dsq_61f < 2) | (DSQ$dsq_61s < 2)] <- 0
```

```
MEICC$MEICC_66[(DSQ$dsq_66f >= 2) & (DSQ$dsq_66s >= 2)] <- 1
```

```
MEICC$MEICC_66[(DSQ$dsq_66f < 2) | (DSQ$dsq_66s < 2)] <- 0
```

```
MEICC$MEICC_Sensitivities[rowSums(MEICC[,c("MEICC_61", "MEICC_66")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Sensitivities[rowSums(MEICC[,c("MEICC_61", "MEICC_66")], na.rm = TRUE) < 1] <- 0
```

```
MEICC$MEICC_IGG[rowSums(MEICC[,c("MEICC_Flu", "MEICC_Viral", "MEICC_Gastro",  
"MEICC_Genito", "MEICC_Sensitivities")], na.rm = TRUE) >= 3] <- 1
```

```
MEICC$MEICC_IGG[rowSums(MEICC[,c("MEICC_Flu", "MEICC_Viral", "MEICC_Gastro",  
"MEICC_Genito", "MEICC_Sensitivities")], na.rm = TRUE) < 3] <- 0
```

#Energy Production/Transportation Impairments

#Cardiovascular

```
MEICC$MEICC_50[(DSQ$dsq_50f >= 2) & (DSQ$dsq_50s >= 2)] <- 1
```

```
MEICC$MEICC_50[(DSQ$dsq_50f < 2) | (DSQ$dsq_50s < 2)] <- 0
```

```
MEICC$MEICC_51[(DSQ$dsq_51f >= 2) & (DSQ$dsq_51s >= 2)] <- 1
```

```
MEICC$MEICC_51[(DSQ$dsq_51f < 2) | (DSQ$dsq_51s < 2)] <- 0
```

```
MEICC$MEICC_Cardio[rowSums(MEICC[,c("MEICC_50", "MEICC_51")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Cardio[rowSums(MEICC[,c("MEICC_50", "MEICC_51")], na.rm = TRUE) < 1] <- 0
```

#Respiratory

```
MEICC$MEICC_Resp[(DSQ$dsq_49f >= 2) & (DSQ$dsq_49s >= 2)] <- 1
```

```
MEICC$MEICC_Resp[(DSQ$dsq_49f < 2) | (DSQ$dsq_49s < 2)] <- 0
```

#Loss of thermostatic stability

```
MEICC$MEICC_54[(DSQ$dsq_54f >= 2) & (DSQ$dsq_54s >= 2)] <- 1
```

```
MEICC$MEICC_54[(DSQ$dsq_54f < 2) | (DSQ$dsq_54s < 2)] <- 0
```

```
MEICC$MEICC_55[(DSQ$dsq_55f >= 2) & (DSQ$dsq_55s >= 2)] <- 1
```

```
MEICC$MEICC_55[(DSQ$dsq_55f < 2) | (DSQ$dsq_55s < 2)] <- 0
```

```
MEICC$MEICC_56[(DSQ$dsq_56f >= 2) & (DSQ$dsq_56s >= 2)] <- 1
```

```
MEICC$MEICC_56[(DSQ$dsq_56f < 2) | (DSQ$dsq_56s < 2)] <- 0
```

```
MEICC$MEICC_57[(DSQ$dsq_57f >= 2) & (DSQ$dsq_57s >= 2)] <- 1
```

```
MEICC$MEICC_57[(DSQ$dsq_57f < 2) | (DSQ$dsq_57s < 2)] <- 0
```

```
MEICC$MEICC_58[(DSQ$dsq_58f >= 2) & (DSQ$dsq_58s >= 2)] <- 1
```

```
MEICC$MEICC_58[(DSQ$dsq_58f < 2) | (DSQ$dsq_58s < 2)] <- 0
```

```
MEICC$MEICC_59[(DSQ$dsq_59f >= 2) & (DSQ$dsq_59s >= 2)] <- 1
```

```
MEICC$MEICC_59[(DSQ$dsq_59f < 2) | (DSQ$dsq_59s < 2)] <- 0
```

```
MEICC$MEICC_60[(DSQ$dsq_60f >= 2) & (DSQ$dsq_60s >= 2)] <- 1
```

```
MEICC$MEICC_60[(DSQ$dsq_60f < 2) | (DSQ$dsq_60s < 2)] <- 0
```

```
MEICC$MEICC_Thermo[rowSums(MEICC[,c("MEICC_54", "MEICC_55", "MEICC_56", "MEICC_57",  
"MEICC_58", "MEICC_59", "MEICC_60")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Thermo[rowSums(MEICC[,c("MEICC_54", "MEICC_55", "MEICC_56", "MEICC_57",  
"MEICC_58", "MEICC_59", "MEICC_60")], na.rm = TRUE) < 1] <- 0
```

```
#Intolerance of extremes of temperature
```

```
MEICC$MEICC_Temp[DSQ$dsq_99 == 1] <- 1
```

```
MEICC$MEICC_Temp[DSQ$dsq_99 != 1] <- 0
```

```
MEICC$MEICC_Energy[rowSums(MEICC[,c("MEICC_Cardio", "MEICC_Resp", "MEICC_Thermo",  
"MEICC_Temp")], na.rm = TRUE) >= 1] <- 1
```

```
MEICC$MEICC_Energy[rowSums(MEICC[,c("MEICC_Cardio", "MEICC_Resp", "MEICC_Thermo",  
"MEICC_Temp")], na.rm = TRUE) < 1] <- 0
```

```
###ME-ICC Case Definition
```

```
MEICC$MEICC_Case_Definition[(rowSums(MEICC[,c("MEICC_SR", "MEICC_PENE",  
"MEICC_Neurological", "MEICC_IGG", "MEICC_Energy")], na.rm = TRUE) == 5)] <- 1
```

```
MEICC$MEICC_Case_Definition[(rowSums(MEICC[,c("MEICC_SR", "MEICC_PENE",  
"MEICC_Neurological", "MEICC_IGG", "MEICC_Energy")], na.rm = TRUE) < 5)] <- 0
```

```
MEICC$MEICC_Case_Definition <- factor(MEICC$MEICC_Case_Definition, levels = c(0, 1), labels =  
c("Does Not Meet MEICC Criteria", "Meets MEICC Criteria"))
```

```
return(MEICC)
```

```
}
```

```
###Institute of Medicine Criteria (IOM, 2015)
```

```
###IOM Scoring Function
```

```
DSQ_1_IOM <- function(DSQ, SF){
```

```
  IOM <- DSQ[,1, drop = F]
```

```
  #Substantial Reduction in Functioning Criteria, SF-36
```

```
  IOM$IOM_RP[(SF$RolePhysical <= 50)] <- 1
```

```
  IOM$IOM_RP[(SF$RolePhysical > 50)] <- 0
```

```
  IOM$IOM_SF[SF$SocialFunctioning <= 62.5] <- 1
```

```
  IOM$IOM_SF[SF$SocialFunctioning > 62.5] <- 0
```

```
  IOM$IOM_V[SF$Vitality <= 35] <- 1
```

```
  IOM$IOM_V[SF$Vitality > 35] <- 0
```

```
  IOM$IOM_SR[rowSums(IOM[,c("IOM_RP", "IOM_SF", "IOM_V")]) >= 2] <- 1
```

```
  IOM$IOM_SR[rowSums(IOM[,c("IOM_RP", "IOM_SF", "IOM_V")]) < 2] <- 0
```

```
  #Fatigue, not Lifelong, Not Result of Exertion
```

```
  IOM$IOM_Six[(DSQ$dsq_69 == 2) | (DSQ$dsq_69 == 3) | (DSQ$dsq_69 == 4) | (DSQ$dsq_69 == 5)] <- 1
```

```
  IOM$IOM_Six[(DSQ$dsq_69 == 1) | (DSQ$dsq_69 == 6)] <- 0
```

```
  IOM$IOM_Life[(DSQ$dsq_67 == 1) & (DSQ$dsq_69 == 5) & (DSQ$dsq_77 == 7)] <- 1
```

```
  IOM$IOM_Life[DSQ$dsq_67 != 1 | DSQ$dsq_69 != 5 | DSQ$dsq_77 != 7] <- 0
```

```
  IOM$IOM_Exert[rowSums(DSQ[,c("dsq_89a", "dsq_89d")]) >= 60] <- 1
```

```
  IOM$IOM_Exert[rowSums(DSQ[,c("dsq_89a", "dsq_89d")]) < 60] <- 0
```

```
IOM$IOM_Fatigue[(IOM$IOM_Six == 1) & (IOM$IOM_Life == 0) & (IOM$IOM_Exert == 0)] <- 1
```

```
IOM$IOM_Fatigue[(IOM$IOM_Six != 1) | (IOM$IOM_Life != 0) | (IOM$IOM_Exert != 0)] <- 0
```

```
#Post-Exertional Malaise
```

```
IOM$IOM_14[(DSQ$dsq_14f >= 2) & (DSQ$dsq_14s >= 2)] <- 1
```

```
IOM$IOM_14[(DSQ$dsq_14f <= 1) | (DSQ$dsq_14s <= 1)] <- 0
```

```
IOM$IOM_15[(DSQ$dsq_15f >= 2) & (DSQ$dsq_15s >= 2)] <- 1
```

```
IOM$IOM_15[(DSQ$dsq_15f <= 1) | (DSQ$dsq_15s <= 1)] <- 0
```

```
IOM$IOM_16[(DSQ$dsq_16f >= 2) & (DSQ$dsq_16s >= 2)] <- 1
```

```
IOM$IOM_16[(DSQ$dsq_16f <= 1) | (DSQ$dsq_16s <= 1)] <- 0
```

```
IOM$IOM_17[(DSQ$dsq_17f >= 2) & (DSQ$dsq_17s >= 2)] <- 1
```

```
IOM$IOM_17[(DSQ$dsq_17f <= 1) | (DSQ$dsq_17s <= 1)] <- 0
```

```
IOM$IOM_18[(DSQ$dsq_18f >= 2) & (DSQ$dsq_18s >= 2)] <- 1
```

```
IOM$IOM_18[(DSQ$dsq_18f <= 1) | (DSQ$dsq_18s <= 1)] <- 0
```

```
IOM$IOM_PEM[rowSums(IOM[,c("IOM_14", "IOM_15", "IOM_16", "IOM_17", "IOM_18")], na.rm = TRUE) >= 1] <- 1
```

```
IOM$IOM_PEM[rowSums(IOM[,c("IOM_14", "IOM_15", "IOM_16", "IOM_17", "IOM_18")], na.rm = TRUE) < 1] <- 0
```

```
#Unrefreshing Sleep
```

```
IOM$IOM_19[(DSQ$dsq_19f >= 2) & (DSQ$dsq_19s >= 2)] <- 1
```



```
IOM$IOM_19[(DSQ$dsq_19f <= 1) | (DSQ$dsq_19s <= 1)] <- 0
```

```
IOM$IOM_20[(DSQ$dsq_20f >= 2) & (DSQ$dsq_20s >= 2)] <- 1
```

```
IOM$IOM_20[(DSQ$dsq_20f <= 1) | (DSQ$dsq_20s <= 1)] <- 0
```

```
IOM$IOM_21[(DSQ$dsq_21f >= 2) & (DSQ$dsq_21s >= 2)] <- 1
```

```
IOM$IOM_21[(DSQ$dsq_21f <= 1) | (DSQ$dsq_21s <= 1)] <- 0
```

```
IOM$IOM_22[(DSQ$dsq_22f >= 2) & (DSQ$dsq_22s >= 2)] <- 1
```

```
IOM$IOM_22[(DSQ$dsq_22f <= 1) | (DSQ$dsq_22s <= 1)] <- 0
```

```
IOM$IOM_23[(DSQ$dsq_23f >= 2) & (DSQ$dsq_23s >= 2)] <- 1
```

```
IOM$IOM_23[(DSQ$dsq_23f <= 1) | (DSQ$dsq_23s <= 1)] <- 0
```

```
IOM$IOM_24[(DSQ$dsq_24f >= 2) & (DSQ$dsq_24s >= 2)] <- 1
```

```
IOM$IOM_24[(DSQ$dsq_24f <= 1) | (DSQ$dsq_24s <= 1)] <- 0
```

```
IOM$IOM_Sleep[rowSums(IOM[,c("IOM_19", "IOM_20", "IOM_21", "IOM_22", "IOM_23", "IOM_24")],  
na.rm = TRUE) >= 1] <- 1
```

```
IOM$IOM_Sleep[rowSums(IOM[,c("IOM_19", "IOM_20", "IOM_21", "IOM_22", "IOM_23", "IOM_24")],  
na.rm = TRUE) < 1] <- 0
```

```
#Cognitive Impairment
```

```
IOM$IOM_36[(DSQ$dsq_36f >= 2) & (DSQ$dsq_36s >= 2)] <- 1
```

```
IOM$IOM_36[(DSQ$dsq_36f <= 1) | (DSQ$dsq_36s <= 1)] <- 0
```

```
IOM$IOM_37[(DSQ$dsq_37f >= 2) & (DSQ$dsq_37s >= 2)] <- 1
```

```
IOM$IOM_37[(DSQ$dsq_37f <= 1) | (DSQ$dsq_37s <= 1)] <- 0
```

```
IOM$IOM_38[(DSQ$dsq_38f >= 2) & (DSQ$dsq_38s >= 2)] <- 1
```

```
IOM$IOM_38[(DSQ$dsq_38f <= 1) | (DSQ$dsq_8s <= 1)] <- 0
```

```
IOM$IOM_39[(DSQ$dsq_39f >= 2) & (DSQ$dsq_39s >= 2)] <- 1
```

```
IOM$IOM_39[(DSQ$dsq_39f <= 1) | (DSQ$dsq_39s <= 1)] <- 0
```

```
IOM$IOM_40[(DSQ$dsq_40f >= 2) & (DSQ$dsq_40s >= 2)] <- 1
```

```
IOM$IOM_40[(DSQ$dsq_40f <= 1) | (DSQ$dsq_40s <= 1)] <- 0
```

```
IOM$IOM_43[(DSQ$dsq_43f >= 2) & (DSQ$dsq_43s >= 2)] <- 1
```

```
IOM$IOM_43[(DSQ$dsq_43f <= 1) | (DSQ$dsq_43s <= 1)] <- 0
```

```
IOM$IOM_44[(DSQ$dsq_44f >= 2) & (DSQ$dsq_44s >= 2)] <- 1
```

```
IOM$IOM_44[(DSQ$dsq_44f <= 1) | (DSQ$dsq_44s <= 1)] <- 0
```

```
IOM$IOM_Cognitive[rowSums(IOM[,c("IOM_36", "IOM_37", "IOM_38", "IOM_39", "IOM_40",  
"IOM_43", "IOM_44")], na.rm = TRUE) >= 1] <- 1
```

```
IOM$IOM_Cognitive[rowSums(IOM[,c("IOM_36", "IOM_37", "IOM_38", "IOM_39", "IOM_40",  
"IOM_43", "IOM_44")], na.rm = TRUE) == 0] <- 0
```

```
#Orthostatic Intolerance
```

```
IOM$IOM_48[(DSQ$dsq_48f >= 2) & (DSQ$dsq_48s >= 2)] <- 1
```

```
IOM$IOM_48[(DSQ$dsq_48f <= 1) | (DSQ$dsq_48s <= 1)] <- 0
```

```
IOM$IOM_49[(DSQ$dsq_49f >= 2) & (DSQ$dsq_49s >= 2)] <- 1
```

```
IOM$IOM_49[(DSQ$dsq_49f <= 1) | (DSQ$dsq_49s <= 1)] <- 0
```

```
IOM$IOM_50[(DSQ$dsq_50f >= 2) & (DSQ$dsq_50s >= 2)] <- 1
```

```
IOM$IOM_50[(DSQ$dsq_50f <= 1) | (DSQ$dsq_50s <= 1)] <- 0
```

```
IOM$IOM_51[(DSQ$dsq_51f >= 2) & (DSQ$dsq_51s >= 2)] <- 1
```

```
IOM$IOM_51[(DSQ$dsq_51f <= 1) | (DSQ$dsq_51s <= 1)] <- 0
```

```
IOM$IOM_OI[rowSums(IOM[,c("IOM_48", "IOM_49", "IOM_50", "IOM_51")], na.rm = TRUE) >= 1] <- 1
```

```
IOM$IOM_OI[rowSums(IOM[,c("IOM_48", "IOM_49", "IOM_50", "IOM_51")], na.rm = TRUE) == 0] <- 0
```

```
###IOM Case Definition
```

```
IOM$IOM_Case_Definition[(rowSums(IOM[,c("IOM_SR", "IOM_Fatigue", "IOM_PEM", "IOM_Sleep")],  
na.rm = TRUE) == 4) & (rowSums(IOM[,c("IOM_Cognitive", "IOM_OI")], na.rm = TRUE) >= 1)] <- 1
```

```
IOM$IOM_Case_Definition[(rowSums(IOM[,c("IOM_SR", "IOM_Fatigue", "IOM_PEM", "IOM_Sleep")],  
na.rm = TRUE) != 4) | (rowSums(IOM[,c("IOM_Cognitive", "IOM_OI")], na.rm = TRUE) == 0)] <- 0
```

```
IOM$IOM_Case_Definition <- factor(IOM$IOM_Case_Definition, levels = c(0, 1), labels = c("Does Not  
Meet IOM Criteria", "Meets IOM Criteria"))
```

```
return(IOM)
```

```
}
```

```
#import dataframe as 'df' for purposes of the script

#replace numeric NA in df with '0'
df <- mutate_if(df, is.numeric, ~replace(., is.na(.), 0))

#Subset DSQ and SF by column
df_SF <- df[,###:###]
df_DSQ <- df[,###:###]

#Run Case Definition functions
df_Fukuda <- DSQ_1_Fukuda(df_DSQ, df_SF)
df_CCC <- DSQ_1_CCC(df_DSQ, df_SF)
df_MEICC <- DSQ_1_MEICC(df_DSQ)
df_IOM <- DSQ_1_IOM(df_DSQ, df_SF)

#combine all dataframes into one for simpler analyses
df <- df %>%
  cbind(df_Fukuda) %>%
  cbind(df_CCC) %>%
  cbind(df_MEICC) %>%
  cbind(df_IOM)
```