A public data set of human balance evaluations

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The goal of this study was to create a public data set with results of qualitative and quantitative evaluations related to human balance. Subject's balance was evaluated by posturography using a force platform and by the Mini Balance Evaluation Systems Tests. In the posturography test, we evaluated subjects standing still for 60 s in four different conditions where vision and the standing surface were manipulated: on a rigid surface with eyes open; on a rigid surface with eyes closed; on an unstable surface with eyes open; on an unstable surface with eyes closed. Each condition was performed three times and the order of the conditions was randomized. In addition, the following tests were employed in order to better characterize each subject: Short Falls Efficacy Scale International; International Physical Activity Questionnaire Short Version; and Trail Making Test. The subjects were also interviewed to collect information about their socio-cultural, demographic, and health characteristics. The data set comprises signals from the force platform (raw data for the force, moments of forces, and centers of pressure) of 163 subjects plus one file with information about the subjects and balance conditions and the results of the other evaluations. All the data is available at PhysioNet and at Figshare .

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14 **Abstract**

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17 evaluations related to human balance. Subject's balance was evaluated by posturography using a

18 force platform and by the Mini Balance Evaluation Systems Tests. In the posturography test, we

19 evaluated subjects standing still for 60 s in four different conditions where vision and the

20 standing surface were manipulated: on a rigid surface with eyes open; on a rigid surface with

21 eyes closed; on an unstable surface with eyes open; on an unstable surface with eyes closed.

22 Each condition was performed three times and the order of the conditions was randomized. In

23 addition, the following tests were employed in order to better characterize each subject: Short

24 Falls Efficacy Scale International; International Physical Activity Questionnaire Short Version;

25 and Trail Making Test. The subjects were also interviewed to collect information about their

26 socio-cultural, demographic, and health characteristics. The data set comprises signals from the

27 force platform (raw data for the force, moments of forces, and centers of pressure) of 163

28 subjects plus one file with information about the subjects and balance conditions and the results

29 of the other evaluations. All the data is available at PhysioNet and at Figshare.

30

1 Introduction

31

32   Age-related disabilities and certain illnesses affect balance in humans and can negatively

33   influence their health and quality of life. There has been great effort by researchers and clinicians

34   for a greater understanding of this problem and postural control in humans has been under

35   intense scientific investigation over the past decades.

36   There is a large variety of tests to describe balance in humans (for a review see Duarte &

37   Freitas 2010; Paillard & Noe 2015; Scoppa et al. 2013; Shumway-Cook & Woollacott 2001;

38   Visser et al. 2008; Yamamoto et al. 2015). The most common quantitative measurement to

39   characterize body balance is the displacement of the center of pressure (COP); the point of

40   application of the resultant vertical forces acting on the subject's surface of support. COP

41   displacement is typically measured with a force plate and presented as time-series of numerical

42   data in the anterior-posterior (ap) and medio-lateral (ml) directions in relation to the subject's

43   orientation. The technique concerned with the measurement of COP displacement in this context

44   is commonly referred to as stabilography or posturography.

45   In stabilography, there is no consensus yet on the best techniques to analyze COP

46   displacement in order to extract meaningful information about the subject's balance. There are

47   also numerous different protocols (which include the type of task the subject performs,

48   instructions to the subject, duration of the task, type of instrument, etc.) for data collection,

49   algorithms, and variables to process and characterize COP displacement (for a review on these

50   issues see Duarte & Freitas 2010; Paillard & Noe 2015; Ruhe et al. 2010; Scoppa et al. 2013;

51   Visser et al. 2008; Yamamoto et al. 2015). Part of the lack of consensus and conflicting findings

52   might be because of the typically large intra and inter-subject variability of the COP

53   displacement data, and that some of the studies present low statistical power (typically because

54   of a small sample size) (Ruhe et al. 2010; Samson & Crowe 1996). A related problem, not

55 specific to the field of stabilography, is that researchers propose and compare new methods of

56 analysis based on data from different subjects across centers.

57 The deployment of a public data set of human balance evaluations would allow the access

58 of a normative reference for data comparison and testing analysis from different centers. In the

59 human movement science field there are few publicly available data sets (for example, see

60 Moore et al. 2015 and the references therein). However, none of the available data sets are about

61 human balance. Hence, the purpose of the present study is to describe how a publicly available of

62 balance evaluations on young and elderly adults was created.

63

2   Methods

65 This study was designed to create a public repository of data related to human balance,

66 employing quantitative and qualitative evaluations. The entire data collection for each subject

67 was performed in a single session, which lasted between one and two hours. Each subject was

68 assessed by the same experienced examiner (D.A.S.) in the Laboratory of Biomechanics and

69 Motor Control at the Federal University of ABC, Brazil. Prior to the evaluations that generated

70 this data set, we conducted pilot studies with five subjects for training with the equipment and

71 experimental protocol. The data of these subjects are not included in this data set. This study was

72 approved by the local ethics committee of the Federal University of ABC (#842529/2014).

73

2.1   Subjects

75 We evaluated a convenience sample of 163 subjects (116 females and 47 males) who

76 voluntarily participated in this study. The subjects were recruited via flyers, advertising on social

77 networks and word to mouth from local communities and included students, professors, and

78 technicians from the university, the local neighborhood, and a community center for older adults.

79   The subjects were first interviewed to collect information about their socio-cultural,

80   demographic, and health characteristics. Their ages varied from 18 to 85 years, body masses

81   from 44.0 to 75.9 kg, heights from 140.0 to 189.8 cm, and body-mass indexes (BMI) from 17.2

82   to 31.9 kg/m^2. Of the 163 subjects, 16 of them were classified as having at least one severe

83   disability or more (eight with hearing and vestibular deficits; two with visual deficits; three with

84   musculoskeletal deficits, one with visual and musculoskeletal deficits, one with hearing and

85   visual deficits, and one with intellectual disability). All this information for each subject are

86   presented in the public data set (see later on how to obtain it).

87

88   **2.2   Stabilography**

89   The stabilography evaluation was based on the most common practices used in research

90   laboratories and the clinical environment (for a review see Duarte & Freitas 2010; Paillard &

91   Noe 2015; Scoppa et al. 2013; Visser et al. 2008).

92   We evaluated the subjects' balance while standing still for 60 s, in each of four different

93   conditions: on a rigid surface with eyes open; on a rigid surface with eyes closed; on an unstable

94   surface, a 6 cm height foam block (Balance Pad, Airex AG, Sins, Switzerland), with eyes open;

95   on an unstable surface with eyes closed. Each condition was performed three times and the order

96   of the conditions was randomized among subjects. The randomization was performed before the

97   data collection by the examiner using a computerized random number generator. In all

98   conditions, the subjects were required to stand, barefoot and as still as possible with their arms at

99   their sides, and to look at a 5 cm round black target placed on the subject's eye-height on a wall

100 3 m ahead. For the trials where the eyes were kept closed, subjects were first instructed to look at

101 the target with eyes open, find a stable and comfortable posture given the requirements, and

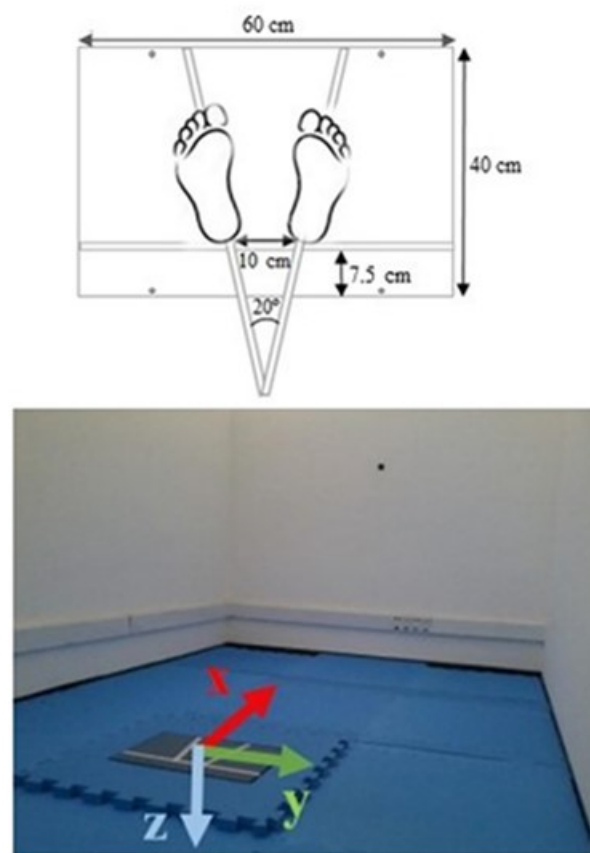
102   close their eyes. A few seconds later, the data acquisition started. For all trials, the subject's feet

103   were placed with an angle of 20 degrees between them and their heels were kept 10 cm apart by

104   requesting the subjects to stand on lines marked on the top of the force platform (see Figure 1).

105   The trials were acquired in an empty 4.5 x 2.8 m room with white walls and adequate

106   illumination (see Figure 1).

107

108   Figure 1. Top: Marks for the subject's feet placement on the force platform. Bottom: Data

109   collection room for the stabilography (note the 5 cm black target at the wall 3 m ahead) and the

110   force platform with its coordinate system convention.

111

112   **2.2.1   Protocol**

113   We followed the following procedure for the stabilography:

114   1.   The researcher explained to the subject about the data collection with the force plate. The

115   subject was also informed that during the data collection, he or she would be monitored,

116   there should not be any verbal communication during the trials, but he or she could interrupt

117   the data collection if desired and that assistance would be given if necessary;

118   2.   The researcher recorded subject's name and identification number, the force platform was

119   zeroed and the subject was requested to stand on the force platform to record her or his

120   weight;

121   3.   The researcher gave instructions on how the subject should stand on the force platform

122   according to the task (open or closed eyes, firm or form surface). The subject's feet was

123   positioned on the marks at the force platform (see Figure 1);

124   4.   The researcher instructed the subject to maintain their arms along their body and to stand as

125   still as possible;

126   5.   During the trials with eyes open, the subjects were told to fix their gaze on the round black

127   target placed on the wall ahead at the eye level;

128   6.   During the trials with eyes closed, the subjects were told to fix their gaze at the target placed

129   ahead, close their eyes when they felt ready and only open them when the researcher

130   informed them of end of the trial;

131   7.   The researcher started the data collection around 5 s later when the subject said he or she was

132   ready;

133   8.   At the end of the trial, the subject was assisted to step from the force platform and he or she

134   could rest (and sit if desired) for about one minute before the next trial.

135 9. If the subject was unable to complete a 60 s trial, the test was stopped and that trial was

136  immediately repeated up to two times if necessary. If, after the second attempt, the subject

137  was still unable to complete the 60 s trial, that trial was considered missing.

138

2.2.2 Data acquisition and processing

140  The force platform signals were collected employing a 40 cm x 60 cm commercial force

141 platform (OPT400600-1000, AMTI, Watertown, MA, USA) and amplifier (Optima Signal

142 Conditioner, AMTI, Watertown, MA, USA) at a sampling frequency of 100 Hz. The Optima

143 force plate was factory-calibrated and presented an average COP accuracy of 0.02 cm. However,

144 we did not check this calibration after the force platform installation in our laboratory, and it has

145 been shown that the installation procedure might have deteriorated the force platform calibration

146 (see for example, Cappello et al. 2011). The fluctuation of the COP displacement (an indication

147 of the measurement precision) was estimated as the standard-deviation value of the COP data

148 when a 30 kg static load was placed on the force plate for 30 s and was equal to 0.005 cm. The

149 data acquisition was performed employing NetForce software (Version 3.5.3, AMTI, Watertown,

150 MA, USA). The NetForce software outputs the calibrated forces and moments of forces (Fx, Fy,

151 Fz, Mx, My, Mz) from the Optima platform to a file with a proprietary binary format. All

152 subsequent steps, reading these binary files, data processing, analysis and visualization, and

153 exporting data to text files, were implemented in Python language using the SciPy Stack

154 (https://www.scipy.org/) and are available as Jupyter Notebooks (http://jupyter.org/) in a GitHub

155 repository (https://github.com/demotu/datasets).

156  The force platform data were smoothed with a 10 Hz 4th order zero lag low-pass

157 Butterworth filter and the center of pressure in the anterior–posterior (x-positive is anterior) and

158 medio–lateral (y-positive is to the right) directions (see Figure 1) were calculated according to

159 the standard formulas (also described in the force platform manual):

160
$$COP_x = -\frac{M_y}{F_z}$$

161
$$COP_y = \frac{M_x}{F_z}$$

162   Note that the force platform data are expressed as forces and moments of forces in the

163 force platform co-ordinate system and they refer to the forces and moments of forces the subject

164 is applying on the force platform. This is the inverse of the ground reaction forces, where the

165 forces act on the subject (Newton's Third Law).

166

167 **2.3   Mini Balance Evaluation Systems Tests**

168   Each subject's balance was also evaluated by the Mini Balance Evaluation Systems Tests

169 (Mini-BESTest). The Mini-BESTest contains 14 items classified in four different domains of the

170 human balance: Anticipatory Postural Adjustment; Reactive Postural Response; Sensorial

171 Organization; and Gait Stability; its maximum score is 28 points and each item varies from 0

172 (abnormal performance) to 2 (normal performance) points (Franchignoni et al. 2010). It has been

173 shown that the Mini-BESTest, in general, presents excellent to good reliability and validity

174 (Potter & Brandfass 2015). The tasks in the Mini BESTest requiring the subjects' gaze fixed at a

175 target were performed with the target placed 3 m ahead.

176

177 **2.4   Other evaluations**

178   In order to assess the subject's concern about falling, we applied the Short Falls Efficacy

179 Scale International (Short FES-I), which is a scale with seven items. The subjects rank their level

180   of concern that they might fall if doing a hypothetical activity (Kempen et al. 2008). The Short

181   FES-I has excellent reliability and validity (Kempen et al. 2008). In order to characterize the

182   subject's practice of health-related physical activity, we applied the International Physical

183   Activity Questionnaire - Short Version (IPAQ-SV), which has eight questions about the time the

184   subject spends being physically active (Craig et al. 2003). The IPAQ-SV presents acceptable

185   reliability and validity (Craig et al. 2003). In order to characterize the subject's cognitive

186   functions, we applied the Trail Making Test (TMT), which instructs the subject to connect a set

187   of dots as quickly as possible (Reitan 1958). In general, the TMT has acceptable reliability and

188   validity (Poreh et al. 2012). These evaluations were conducted with personal interviews

189   performed in an empty 7.5 x 5.7 m room with adequate illumination. We followed the

190   instructions of each evaluation test. For the IPAQ-SV, the last seven days prior to the interview

191   were considered. For the TMT, we followed the orientations by (Bowie & Harvey 2006) to

192   administer parts A and B with the following details: the letter "K" was excluded in the evaluation

193   because it is less common to Brazilians and part B of the TMT was composed by 24 circles with

194   numbers from "1" to "12" and letters from "A" to "M".

195

3   Results

197   All the data is available at PhysioNet (DOI: 10.13026/C2WW2W) and at Figshare (DOI:

198   10.6084/m9.figshare.3394432). The data at PhysioNet (Goldberger et al. 2000) are stored in a

199   binary format that can be read using for example, the WFDB software package or online using

200   the physiobank ATM software and are made available under the ODC Public Domain Dedication

201   and License v1.0 (http://opendatacommons.org/licenses/pddl/1.0/). The data at Figshare are

202   stored in ASCII (text) format that can be downloaded as a single compressed file and are made

203   available under the CC-BY license (https://creativecommons.org/licenses/by/4.0/).

204   The data set comprises files with the force platform data of 163 subjects plus one file

205   named BDSinfo (in two different formats, .txt or .xlsx) with meta data about each file, subject

206   and the evaluation results. The data files and the BDSinfo.txt file are in ASCII format with tab-

207   separated columns. The files with the force platform data have the following columns: Time, Fx,

208   Fy, Fz, Mx, My, Mz, COPx, COPy, and contain the force platform signals (see Methods). Each

209   file has the following header: Time[s] Fx[N] Fy[N] Fz[N] Mx[Nm] My[Nm] Mz[Nm]

210   COPx[cm] COPy[cm], followed by 6000 rows by 9 columns of data with 6-digit numeric

211   precision (with the exception of the time column, which has a 3-digit numeric precision). These

212   files are named as BDSxxxxx.txt, where BDS stands for the project's name, Balance Data Set,

213   and xxxxx refers to the number of the trial; from 00001 to 01956. For each subject there are 12

214   trials and the numbers in the file names are grouped in sets of 12, e.g., the first subject has files

215   from 00001 to 00012 and the last subject (the 163rd), from 01945 to 01956. A total of 26 files

216   (trials) are missing for five subjects who were unable to complete the most challenging

217   conditions.

218   The BDSinfo file contains meta data describing the conditions of the stabilography trials,

219   the information from the anamnesis, and the results of the qualitative evaluations. Because a

220   subject has 12 files for the force platform data, there are 12 rows for each subject in this file. In

221   these 12 rows, the only column that has rows with different values is the column identifying the

222   trial (the file name). The content of all the other columns are simply repeated over the 12 rows.

223   As result, the BDSdata file has the header plus 1930 rows and 64 columns. Here is the coding for

224   the meta data (the first word identifies the name of the column in the header):

225   1. **Trial:** file name of the stabilography trial (BDSxxxxx, where xxxxx varies from 00001 to

226   01956).

227 2. **Subject:** number of the subject (from 1 to 163).

228 3. **Vision:** visual condition (Open or Closed).

229 4. **Surface:** surface support condition (Firm or Foam).

230 5. **Age:** subject's age in years.

231 6. **AgeGroup:** age group (Young: **Age** < 60; Old: **Age** $\geq$ 60).

232 7. **Gender:** gender (F or M).

233 8. **Height:** height in centimeters (measured with a calibrated stadiometer).

234 9. **Weight:** weight in kilograms (measured with a calibrated scale).

235 10. **BMI:** body mass index in kg/m^2.

236 11. **FootLen:** foot length in centimeters (average of the two feet, measured with a calibrated

237   paquimeter).

238 12. **Nationality:** country where the subject was born.

239 13. **SkinColor:** self-reported skin color.

240 14. **Ystudy:** years of regular study.

241 15. **Footwear:** most common type of footwear the subject wears daily.

242 16. **Illness:** whether the subject has any illness, as declared by themselves (Yes or No).

243 17. **Illness2:** type of illness of the subject ('No' if the subjects doesn't have any illness).

244 18. **Nmedication:** total number of medications the subject takes per day, if any.

245 19. **Medication:** name of the medication(s) the subject takes ('No' if the subject doesn't take any

246   medication).

247 20. **Ortho-Prosthesis:** whether the subject wears any type of orthosis or prosthesis, as declared

248   themselves (Yes or No).

249   21. **Ortho-Prosthesis2:** name of the orthosis or prosthesis the subject wears ('No' if the subject

250   doesn't take any orthosis or prosthesis).

251   22. **Disability:** whether the subject has any deficit, as declared by themselves (Yes or No).

252   23. **Disability2:** name of the disability of the subject ('No' if the subject doesn't take any

253   disability).

254   24. **Falls12m:** how many non-intentional falls the subject had in the last 12 months, as declared

255   by themselves (from 0 to …).

256   25. **FES_1:** answer for the first question of the Short Falls Efficacy Scale International test (FES-

257   I).

258   26. **FES_2:** answer for the second question of the FES-I.

259   27. **FES_3:** answer for the third question of the FES-I.

260   28. **FES_4:** answer for the fourth question of the FES-I.

261   29. **FES_5:** answer for the fifth question of the FES-I.

262   30. **FES_6:** answer for the sixth question of the FES-I.

263   31. **FES_7:** answer for the seventh question of the FES-I.

264   32. **FES_T:** answer for the total score question of the FES-I.

265   33. **FES_S:** answer for the scoring question of the FES-I, see

266   http://www.profane.eu.org/fesi.html.

267   34. **IPAQ_1a:** answer for the 1a question of the International Physical Activity Questionnaire

268   Short Version test (IPAQ).

269   35. **IPAQ_1b:** answer for the 1b question of the IPAQ.

270   36. **IPAQ_2a:** answer for the 2a question of the IPAQ.

271   37. **IPAQ_2b:** answer for the 2b question of the IPAQ.

272   38. **IPAQ_3a:** answer for the 3a question of the IPAQ.

273   39. **IPAQ_3b:** answer for the 3b question of the IPAQ.

274   40. **IPAQ_4a:** answer for the 4a question of the IPAQ.

275   41. **IPAQ_4b:** answer for the 4b question of the IPAQ.

276   42. **IPAQ_S:** score in the IPAQ (Low, Moderate, or High), see

277   https://sites.google.com/site/theipaq/.

278   43. **TMT_timeA:** time in seconds taken to complete part A of the Trail Making Test (TMT). We

279   didn't measure times longer than 5 minutes (for these cases we report a time of 300 s).

280   44. **TMT_errorsA:** number of errors in part A of the TMT.

281   45. **TMT_timeB:** time in seconds taken to complete part B of the TMT. We did not measure

282   times longer than 5 minutes (for these cases we report a time of 300 s).

283   46. **TMT_errorsB:** number of errors in part B of the TMT.

284   47. **Best_1:** score for the first task of the Mini Balance Evaluation Systems Test (Mini-BESTest).

285   48. **Best_2:** score for the second task of the Mini-BESTest.

286   49. **Best_3l:** score for the third task (left side) of the Mini-BESTest.

287   50. **Best_3r:** score for the third task (right side) of the Mini-BESTest.

288   51. **Best_4:** score for the fourth task of the Mini-BESTest.

289   52. **Best_5:** score for the fifth task of the Mini-BESTest.

290   53. **Best_6l:** score for the sixth task (left side) of the Mini-BESTest.

291   54. **Best_6r:** score for the sixth task (right side) of the Mini-BESTest.

292   55. **Best_7:** score for the seventh task of the Mini-BESTest.

293   56. **Best_8:** score for the eighth task of the Mini-BESTest.

294   57. **Best_9:** score for the ninth task of the Mini-BESTest.

295 58. **Best_10:** score for the tenth task of the Mini-BESTest.

296 59. **Best_11:** score for the eleventh task of the Mini-BESTest.

297 60. **Best_12:** score for the twelfth task of the Mini-BESTest.

298 61. **Best_13:** score for the thirteenth task of the Mini-BESTest.

299 62. **Best_14:** score for the fourteenth task of the Mini-BESTest.

300 63. **Best_T:** total score of the Mini-BESTest, see http://www.bestest.us/.

301 64. **Date:** date and time of the subject's evaluation (yyyy-mm-dd hh:mm:ss.sss 24-hour local

302   time format).

303

304 **3.1   Data exploration**

305   To exemplify how these data can be explored, shown in Figure 2 are histograms and

306 scatter plots for the variables: age, body mass, height, and BMI, and in Figure 3 are similar plots

307 for the variables: FES_T, Best_T, IPAQ_S, TMT_timeA, and TMT_timeB. A representative

308 example of the force platform data is shown in Figure 4 and plots for the variables: COP area,

309 COP velocity, and COP mean frequency for each subject and standing condition are shown in

310 Figure 5 (see Duarte 2015; Duarte & Freitas 2010 for the algorithms to calculate these variables).

311 The programming scripts to generate these figures, as well as other examples on how to work

312 with these data, are available in a GitHub repository (https://github.com/demotu/datasets).

313

314   Figure 2. Histogram plots on the main diagonal and scatter plots outside the diagonal for the

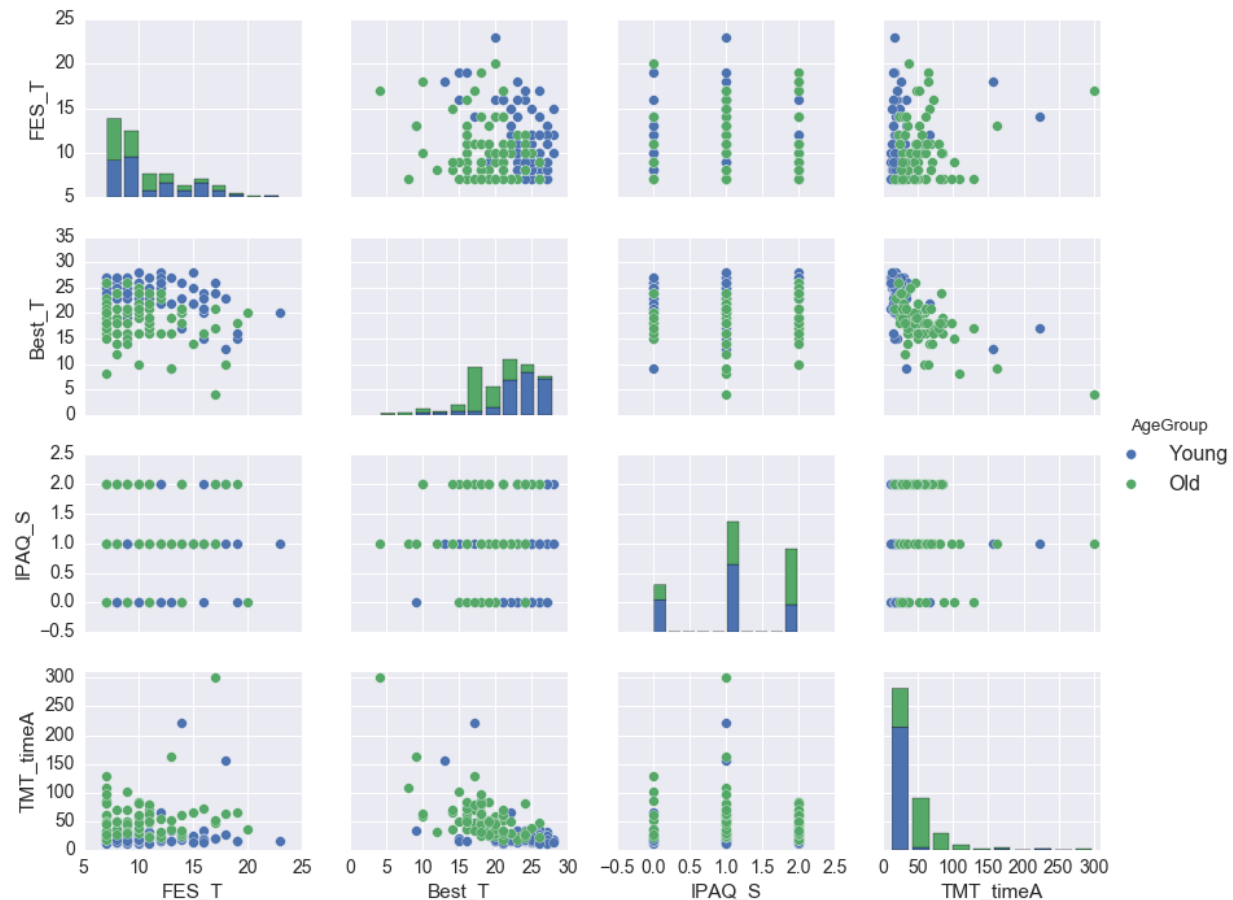
315   following variables: age (years), body mass (kg), height (m), and BMI (kg/m^2) for each subject.

316   These are color-coded by gender (116 females and 47 males). Note that, for the histograms on

317   the main diagonal, the actual vertical axes (the frequencies of observations occurring in certain

318   ranges of the variables shown on the bottom horizontal axes) are not shown. The name of the

319   variables plotted in each scatter plot outside the main diagonal are shown in the legends on the

320   left side and the bottom of the 4x4 panel.

321

322   Figure 3. Histogram plots on the main diagonal and scatter plots outside the diagonal for the

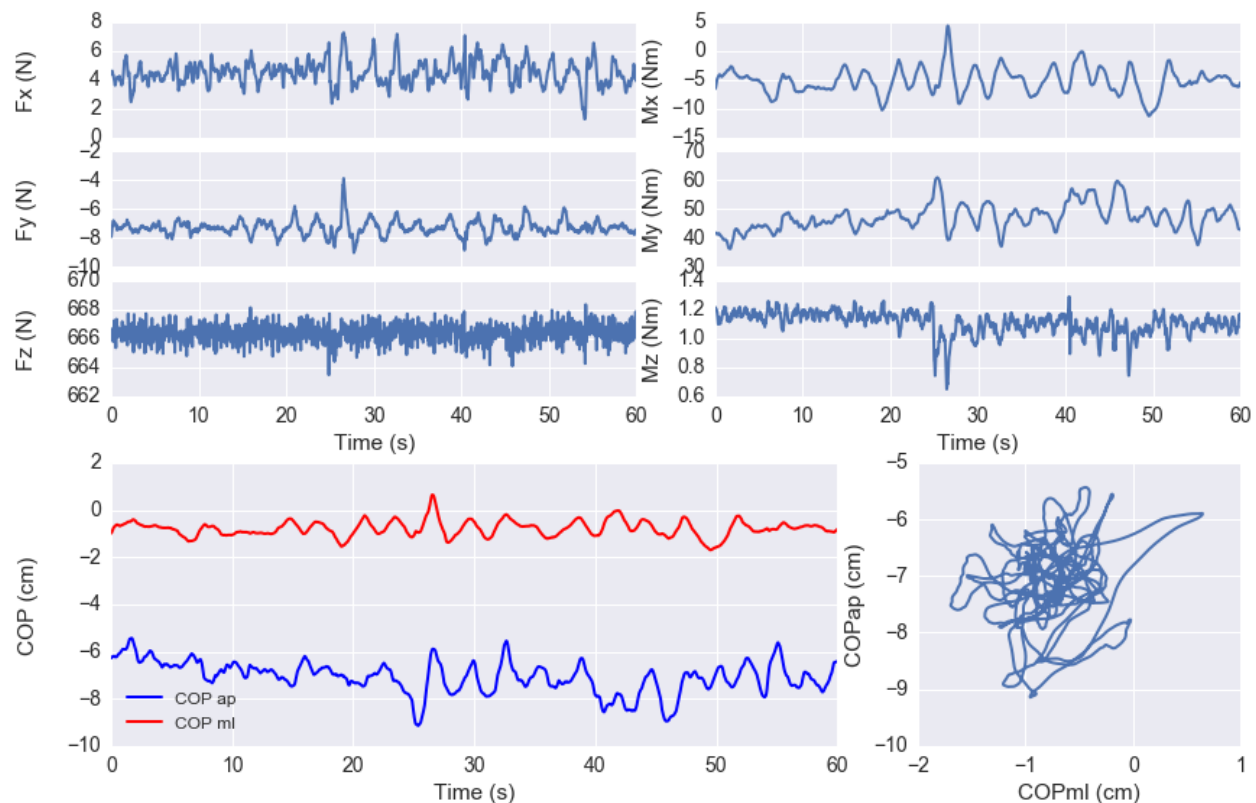
323   following variables: FES_T, Best_T, IPAQ_S, and TMT_timeA. These are color-coded by age

324   group (87 young adults and 76 older adults). Note that, for the histograms on the main diagonal,

325   the actual vertical axes (the frequencies of observations occurring in certain ranges of the

326   variables shown on the bottom horizontal axes) are not shown. The name of the variables plotted

327   in each scatter plot outside the main diagonal are shown in the legends on the left side and the

328   bottom of the 4x4 panel.

329

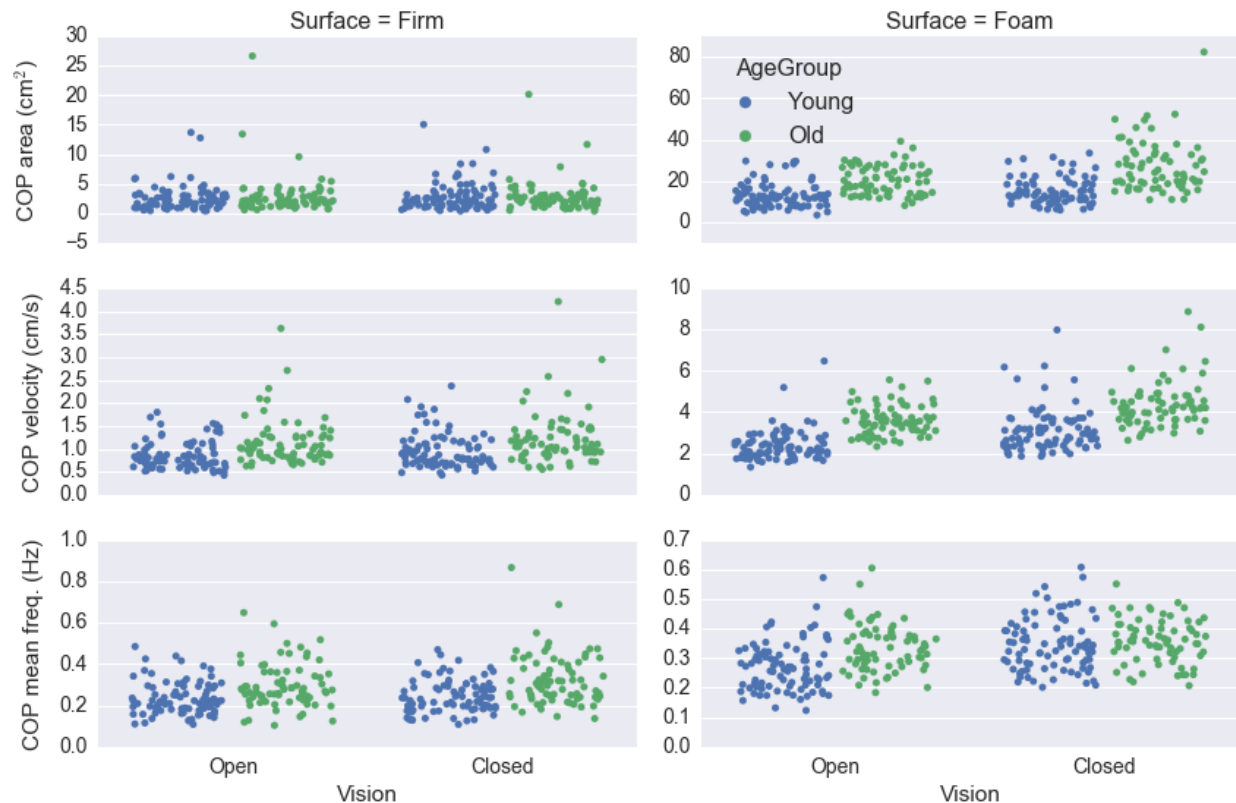
330 Figure 4: Top: exemplary forces and moments of forces at the horizontal and vertical anterior-

331 posterior (x), medio-lateral (y), and vertical (z) directions versus time. Bottom-left: center of

332 pressure (COP) displacements at the ap and ml directions versus time. Bottom-right: plot of COP

333 ap versus COP ml. Subject: 61-year-old male adult during quiet standing on a rigid surface with

334 open eyes.

335

336   Figure 5. Plot of the median value across trials of the variables: COP area, resultant COP

337   velocity, and resultant COP mean frequency for each subject at the different visual and support

338   surface conditions color-coded by age group (87 young adults and 76 older adults).

339

340   **4   Discussion**

341   This study provides a publicly available data set with qualitative and quantitative

342   evaluations related to the balance of young and elderly adults (a total of 163 subjects). All the

343   data is available at PhysioNet (DOI: 10.13026/C2WW2W) and at Figshare (DOI:

344   10.6084/m9.figshare.3394432).

345   A limitation of this study is that we did not perform quantitative evaluations of the

346   subjects' health conditions, particularly of their motor and sensory integrity. However, through

347   the careful anamnesis we performed by interview, we were able to determine the history and

348   current status of the subjects' health, and together with the different qualitative evaluations

349   performed, we believe the subjects are relatively well characterized. Nevertheless, the potential

350   user of this data set should bear this limitation in mind. We studied a convenience sample of

351   subjects who voluntarily accepted to participate in our study, which was conducted at a

352   university laboratory; as such, the sample might be unintentionally biased. Even though, we

353   classified 16 of the 163 investigated subjects as people with disabilities. If one is looking for

354   reference data on balance by healthy people, the data of these 16 subjects should be excluded.

355   One unintended characteristic of the data set is that the subjects can be roughly grouped in two

356   age groups: 20–40 and 60–90 years old.

357   The Balance Data Set is the first public repository containing data of quantitative and

358   qualitative evaluations of human balance. Possible applications of this data set include: to test

359   new variables to describe the center of pressure displacement in methodological studies; to serve

360   as reference (normative) data for a new sample of subjects in a research of clinics context; for

361   training and education regarding the analysis of balance data, among others. Examples on how to

362   work with this data set are publicly available in a GitHub repository

363   (https://github.com/demotu/datasets).

364

5   References

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