

# Eating disorders: What age at onset?

Umberto Volpe<sup>a,\*</sup>, Alfonso Tortorella<sup>a</sup>, Mirko Manchia<sup>b,c</sup>, Alessio M. Monteleone<sup>a</sup>,  
Umberto Albert<sup>d</sup>, Palmiero Monteleone<sup>a,e</sup>

<sup>a</sup> Department of Psychiatry, University of Naples SUN, Largo Madonna delle Grazie, 80138 Naples, Italy

<sup>b</sup> Section of Psychiatry, Department of Public Health, University of Cagliari, Italy

<sup>c</sup> Department of Pharmacology, Dalhousie University, Halifax, NS, Canada

<sup>d</sup> Rita Levi Montalcini Department of Neuroscience, Anxiety and Mood Disorders Unit, University of Turin, Italy

<sup>e</sup> Department of Medicine and Surgery, University of Salerno, Italy

---

## ARTICLE INFO

Accepted 21 February 2016

---

### Keywords:

Eating disorders  
Age at onset  
Prognosis

---

## ABSTRACT

Age at onset (AAO) of eating disorders has classically been described in adolescence. We analyzed data from 806 subjects with anorexia nervosa (AN) or bulimia nervosa (BN) and performed a normal distribution admixture analysis to determine their AAO. No significant differences were found concerning the AAO functions of AN and BN subjects. Both groups had a mean AAO of about 18 years. Most of the subjects with AN (75.3%) and BN (83.3%) belonged to the early onset group. The definition of AAO for ED may be crucial for planning treatment modalities, with specific consideration of their clinical history and course.

---

## 1. Introduction

Eating disorders (ED) are a heterogeneous group of psychiatric diseases, with no single cause nor a predictable course, whose age at onset (AAO) has been classically situated to adolescence and young adulthood (Halmi, 2005). Initial studies, conducted in clinical populations, described a bimodal distribution of AAO for anorexia nervosa (AN), with two peaks at 14 and 18 years of age (Halmi et al., 1979), and a slightly later onset for bulimia nervosa (BN), nearing young adulthood with rare cases beginning before adolescence (Fairburn and Cooper, 1984; Mitchell et al., 1985). Subsequent epidemiological research challenged this evidence: several clinical studies did not find a bimodal distribution of AAO for AN (Matsumoto et al., 2001; Abbate-Daga et al., 2007; Favaro et al., 2009) and reported a unimodal distribution for BN, with an AAO between 18 and 19 years (Mitchell et al., 1985; Fairburn and Harrison, 2003). Such discrepancies underline that no univocal definition of AAO for ED exists to date. A possible avenue for overcoming this issue is to estimate AAO thresholds for AN and BN by means of a validated statistical procedure. Therefore, in the present study we assessed AAO of AN and BN in a clinical sample of ED patients by using the admixture analysis method, which is a statistical procedure already successfully applied in a number of psychiatric disorders to define AAO (Aderka et al., 2012; Anholt

et al., 2014; Azorin et al., 2013; Liu et al., 2013; Nowrouzi et al., 2015; Ortiz et al., 2011; Tibi et al., 2015; Tozzi et al., 2011). This procedure tests for the presence of subgroups with higher inner homogeneity within the studied variable and it allows the identifications of point of rarities (i.e. cut offs) between subgroups.

## 2. Methods

ED patients consecutively admitted to the outpatient unit of the Eating Disorders Center of the Department of Psychiatry of the University of Naples SUN were enrolled into the study. Diagnosis of AN and BN were ascertained according to the DSM-IV-TR criteria (APA, 2000) by means of the Structured Clinical Interview for DSM-IV – Patient Edition (SCID-IP; First et al., 2002). A total of 806 ED patients (792 females, 14 males) were recruited before entering the usual treatment program; subjects gave informed consent to provide their clinical and socio-demographical data, after having received a detailed description of the analytical procedures. AAO was assessed by a direct clinical interview performed by a trained psychiatrist and this information was matched with a systematic review of medical records. AAO was defined as the age at which each patient first met the DSM-IV diagnostic criteria for AN or BN.

Testing different numbers of AAO subgroups, we used a normal distribution admixture analysis, performed with the statistical package MCLUST implemented in the software R (R Development Core Team, USA, 2008). This package performs the decomposition of the variable distribution into the mixture of normal

---

\* Corresponding author.

E-mail address: [umberto.volpe@unina2.it](mailto:umberto.volpe@unina2.it) (U. Volpe).

components, testing a range of number of AAO subgroups (1–9) using the expectation-maximization algorithm. The choice of the mixture model that best fitted the AAO distribution was made according to the Schwarz's Bayesian Information Criteria (BIC; Fraley and Raftery, 1999) using the highest BIC among the fitted models (Fraley and Raftery, 2007). The admixture analysis was performed on the AN and BN subgroups and the identified AAO functions were then compared with the Kolmogorov-Smirnov (K-S) test.

### 3. Results

The whole sample included 379 AN individuals and 427 BN subjects. The AN sample had a mean AAO of 18.0 years ( $SD=5.4$ ) and a two normal components model best fitted the observed distribution of AAO ( $BIC=-2186.1$ ). The AN group had an early onset (EO) component (75.3%) with mean 16.2 years ( $SD=2.6$ ) and a late onset (LO) component (21%) with mean of 23.6 years ( $SD=7.8$ ); the cut-off point for AN was at 22 years (EO group < 22 years; LO group  $\geq$  22 years). No improvement of the fit was observed with three and four components models (3 components:  $BIC=-2194.8$ ; 4 components:  $BIC=-2209.4$ ).

The BN group had a mean AAO of 18.2 years ( $SD=5.2$ ) and a two normal components model best fitted the observed distribution of AAO ( $BIC=-2436.0$ ), with an EO component (83.3%) with mean 16.7 years ( $SD=2.7$ ) and a LO component (16.7%) with mean of 25.3 ( $SD=7.9$ ); the cut-off point was at 24 years (EO group < 24 years; LO group  $\geq$  24 years). Again, there was no improvement of the fit with a three ( $BIC=-2443.9$ ) and a four ( $BIC=-2455.6$ ) components model.

The K-S test showed that the theoretical AAO functions of AN and BN samples did not differ significantly ( $D=0.05$ ,  $p=0.4$ ).

### 4. Discussion

To our knowledge, this is the first study that applied admixture analysis to identify AAO subgroups in AN and BN subjects. Although limited by a relatively small clinical sample, in our study, we were able to identify a bimodal normal distribution of AAO with an EO and LO component for both ED. Moreover, we did not confirm a significantly earlier AAO of AN, with respect to BN. Our data tend to support the idea that, at least in our catchment area, individuals suffering from AN and BN do not differ in terms of AAO. However, these findings should be treated with some caution as we analyzed our cases retrospectively and that data were collected in a clinic specialized in ED. Indeed, Micali et al. (2013), in a case-register study assessing the incidence of ED in the general population, found that the peak age at incident diagnosis of AN was between the ages of 10–14 years whereas diagnoses of BN peaked between 15 and 19 years. While the study of ED cases from the general population allows to identify also age when presenting to primary care and eventually the obstacles along the pathways to care, in that study the peak ages at incident diagnoses were based only on the 'first-time' diagnosis for an ED, which could be not strictly correspondent to the true AAO of the disorder. To our knowledge, although our study may suffer from the same limitation regarding the "first time" diagnosis of ED, no previously published study applied admixture analysis to investigate AAO of ED and thus further studies conducted with this approach in the general population might provide a reliable support to present findings, which, if confirmed, may have relevant implications for the classification and treatment of ED.

AAO represents a crucial clinical feature of psychiatric disorders, since its identification allows refining the phenotypic

characterization of the disorder, possibly empowering the search for genetic determinants of risk (Manchia et al., 2013). Indeed, an early AAO of a psychiatric disorder is thought to be related to greater symptoms' severity (Sanchez-Gistau et al., 2013), worse cognitive functioning (Hoff et al., 1996), higher comorbidity (Hoff et al., 1996) and suboptimal clinical outcomes (Hollis, 2000). Furthermore, as repeatedly recognized by literature, the treatment of ED should be based on a multimodal model (Halmi, 2005), which should require knowledge of the epidemiology of ED, and the planning of ED services should adapt to the characteristics of the local catchment area (Hoek, 2009) in order to ensure to this heterogeneous clinical population the most appropriate treatment options, rooted in their real clinical history and course. Thus, the definition of AAO thresholds for AN and BN with statistical validation of proposed cut-offs could help to better characterize their clinical characteristics, which could be relevant to afford the unmet needs for treatment, implement tailored treatment programs and identify barriers to treatment (Kessler et al., 2007).

In conclusion, our study provides for the first time AAO cut-off points for AN and BN identified by a robust analytical approach. Further research, possibly conducted in primary care or in the general population, is needed to further validate the proposed cut-offs and to verify if and how subgroups of ED patients, identified by the above proposed AAO cut-off points, may differ in their clinical and prognostic aspects. The narrower clinical delineation of AAO-based subgroups might enable a more accurate prognosis and guide in treatment decision-making for ED.

### References

- Abbate-Daga, G., Pierò, A., Rigardetto, R., Gandione, M., Gramaglia, C., Fassino, S., 2007. Clinical, psychological and personality features related to age of onset of anorexia nervosa. *Psychopathology* 40, 261–268.
- Aderka, I.M., Nickerson, A., Hofmann, S.G., 2012. Admixture analysis of the diagnostic subtypes of social anxiety disorder: implications for the DSM-V. *J. Behav. Ther. Exp. Psychiatry* 43, 752–757.
- American Psychiatric Association, 2000. *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. APA, Washington, DC.
- Anholt, G.E., Aderka, I.M., van Balkom, A.J.L.M., Smit, J.H., Schruers, K., van der Wee, N.J.A., et al., 2014. Age of onset in obsessive-compulsive disorder: admixture analysis with a large sample. *Psychol. Med.* 44, 185–194.
- Azorin, J.M., Bellivier, F., Kaladjian, A., Adida, M., Belzeaux, R., Fakra, E., 2013. Characteristics and profiles of bipolar I patients according to age-at-onset: findings from an admixture analysis. *J. Affect. Disord.* 150, 993–1000.
- Fairburn, C.G., Cooper, P.J., 1984. The clinical features of bulimia nervosa. *Br. J. Psychiatry* 144, 238–246.
- Fairburn, C.G., Harrison, P.J., 2003. Eating disorders. *Lancet* 361, 407–416.
- Favaro, A., Caregari, L., Tenconi, E., Bosello, R., Santonastaso, P., 2009. Time trends in age at onset of anorexia nervosa and bulimia nervosa. *J. Clin. Psychiatry* 70, 1715–1721.
- First, M.B., Spitzer, R.L., Gibbon, M., Williams, J.B.W., 2002. *Structured Clinical Interview for DSM-IV-TR Axis I Disorders*, Research Version, Patient Edition. (SCID-I/P). New York, Biometrics Research, New York State Psychiatric Institute.
- Fraley, C., Raftery, A.E., 1999. Mclust: software for model-based cluster analysis. *J. Classif.* 16, 297–306.
- Fraley, C., Raftery, A.E., 2007. Model-based methods of classification: using the mclust software in chemometrics. *J. Stat. Softw.* 18, 1–13.
- Halmi, K.A., Casper, R.C., Eckert, E.D., Goldberg, S.C., Davis, J.M., 1979. Unique features associated with age of onset of anorexia nervosa. *Psychiatry Res.* 1, 209–215.
- Halmi, K.A., 2005. The multimodal treatment of eating disorders. *World Psychiatry* 4, 69–73.
- Hoek, W.H., 2009. Planning an eating disorder service on the basis of epidemiological data. *World Psychiatry* 8, 157–158.
- Hoff, A.L., Harris, D., Faustman, W.O., Beal, M., DeVilliers, D., Mone, R.D., et al., 1996. A neuropsychological study of early onset schizophrenia. *Schizophr. Res.* 20, 21–28.
- Hollis, C., 2000. Adult outcomes of child- and adolescent-onset schizophrenia: diagnostic stability and predictive validity. *Am. J. Psychiatry* 157, 1652–1659.
- Kessler, R.C., Amminger, G.P., Aguilar-Gaxiola, S., Alonso, J., Lee, S., Ustun, T.B., 2007. Age of onset of mental disorders: a review of recent literature. *Curr. Opin. Psychiatry* 20, 359–364.
- Liu, J.J., Norman, R.M., Manchanda, R., De Luca, V., 2013. Admixture analysis of age at onset in schizophrenia: evidence of three subgroups in a first-episode sample. *Gen. Hosp. Psychiatry* 35, 664–667.

- Manchia, M., Cullis, J., Turecki, G., Rouleau, G.A., Uher, R., Alda, M., 2013. The impact of phenotypic and genetic heterogeneity on results of genome wide association studies of complex diseases. *PLoS One* 8, e76295.
- Matsumoto, H., Takei, N., Kawai, M., Saito, F., Kachi, K., Ohashi, Y., 2001. Differences of symptoms and standardized weight index between patients with early-onset and late-onset anorexia nervosa. *Acta Psychiatr. Scand.* 104, 66–71.
- Micali, N., Hagberg, K.W., Petersen, I., Treasure, J.L., 2013. The incidence of eating disorders in the UK in 2000-2009: findings from the General Practice Research Database. *BMJ Open* 3 (5), e002646.
- Mitchell, J.E., Hatsukami, D., Eckert, E.D., Pyle, R.L., 1985. Characteristics of 275 patients with bulimia. *Am. J. Psychiatry* 142, 482–485.
- Nowrouzi, B., Kamhi, R., Hu, J., Kennedy, J.L., Matmari, M., De Luca, V., 2015. Age at onset mixture analysis and systematic comparison in schizophrenia spectrum disorders: is the onset heterogeneity dependent on heterogeneous diagnosis? *Schizophr. Res.* 164, 83–91.
- Ortiz, A., Bradler, K., Slaney, C., Garnham, J., Ruzickova, M., O'Donovan, C., et al., 2011. An admixture analysis of the age at index episodes in bipolar disorder. *Psychiatry Res.* 188, 34–39.
- Sanchez-Gistau, V., Baeza, I., Arango, C., González-Pinto, A., de la Serna, E., et al., 2013. Predictors of suicide attempt in early-onset, first-episode psychoses: a longitudinal 24-month follow-up study. *J. Clin. Psychiatry* 74, 59–66.
- Tibi, L., van Oppen, P., Aderka, I.M., van Balkom, N.M., Batelaan, N.M., et al., 2015. An admixture analysis of age of onset in agoraphobia. *J. Affect. Disord.* 180, 112–115.
- Tozzi, F., Manchia, M., Galwey, N.W., Severino, G., Del Zompo, M., Day, R., et al., 2011. Admixture analysis of age at onset in bipolar disorder. *Psychiatry Res.* 185 (1–2), 27–32.