Gender differences in post-stroke aphasia rates are caused by age. A meta-analysis and database query

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Abstract

Background: Studies have suggested that aphasia rates are different in men and women following stroke. One hypothesis says that men have more lateralized language function than women. Given unilateral stroke, this would lead to a prediction of men having higher aphasia rates than women. Another line of observations suggest that women are more severely affected by stroke, which leads to a higher aphasia rate, but in an unspecific manner. An additional potential confounding variable could be age at stroke, given that women are typically older at the time of stroke.

Methods & Procedures: This study consists of two parts. First, a meta-analysis of the available reports of aphasia rates in the two genders was conducted. A comprehensive literature search yielded 25 studies with sufficient aphasia and gender information. These studies included a total of 48,362 stroke patients for which aphasia rates were calculated. Second, data were analysed from an American health database with 1,655,295 stroke patients, in order to include age differences at stroke between the genders and stroke severity into a regression analysis of gender differences in aphasia rates.

Outcomes & Results: Both analyses revealed significantly larger aphasia rates in women than in men. This speaks against the idea that women should be more lateralized in their language function. Furthermore, when age and stroke severity were included as covariates, gender failed to explain any aphasia rate gender difference above and beyond that which is explained by age differences at time of stroke.

Introduction

A stroke is a medical condition in which blood flow to the brain is restricted, due to occlusion (ischemic stroke) or haemorrhage (haemorrhagic stroke), resulting in cell death (WHO). In the US alone, approximately 800,000 people experience a stroke each year, according to the American Heart Association (Benjamin, et al., 2017). Stroke is the leading cause of motor and cognitive disability in western countries and aphasia, the inability to comprehend and formulate language because of brain damage, is one of the most common deficits after stroke. A large variability in the reported frequency of aphasia can be found in the literature (e.g. Ellis, et al., 2018; Godefroy, et al., 2002; Inatomi, et al., 2008; Tsouli, et al., 2009), ranging from 15 to 68 percent of acute patients. A recent meta-analysis, however, concluded that aphasia is present in approximately 30 % of acute patients and 34 % in rehabilitation settings (Flowers, et al., 2016).

The variability of measured prevalence of aphasia has many causes. The method for aphasia identification differs between hospitals and countries and some sub-scores for aphasia in stroke scales have been found to be limited in their accuracy and reliability (Meyer & Lyden, 2009; Thommessen, et al., 2002). The meta-analysis also did not take gender differences into account.

Stroke affects the genders differently. Stroke is more common among men (Appelros, et al., 2009). The symptoms of stroke have also been found to differ somewhat between men and women. Women are often more severely affected overall, more often experience paralysis, impaired consciousness and altered mental status together with a generalized weakness, while men more often experience dysarthria, diplopia, sensory loss, ataxia and balancing problems

(Berglund, et al., 2017). An association between pre-stroke dementia, which is more prevalent in women, and stroke severity has also been noted (Gall, et al., 2010).

Aphasia following stroke has also been reported to affect women to a larger degree than men (see Berglund, et al., 2017 for a review), although evidence has been conflicting (e.g. Bersano, et al., 2009; Miceli, et al., 1981; Pedersen, et al., 1995).

Gender differences in certain linguistic domains are also known to exist within the normal population, with differences in first language acquisition speed (Bleses, et al., 2008) and reading and writing abilities (Reilly, et al., in press) being the most consistent, favouring girls/women over boys/men. Differences in word use have also been documented (Schwartz, et al., 2013). The underlying causes for these differences are probably complex and research trying to tie them to brain structure and function has yielded inconsistent results (Wallentin, 2009).

Some studies have argued for the hypothesis that language is more bilaterally organised in the brains of women than in men (e.g. Baron-Cohen, et al., 2005; Hausmann, 2016; Kansaku & Kitazawa, 2001; Shaywitz, et al., 1995), although this is highly controversial (Hirnstein, et al., 2018; Sommer, et al., 2004; Wallentin, 2009). A difference in language lateralization would ultimately lead to a difference in aphasia following unilateral stroke. If men's language is more lateralized in the brain than women's, we would expect them to be more prone to aphasia following unilateral stroke and vice versa, if women have greater language lateralization than men, we would expect their language function to be more vulnerable to stroke.

In this paper I conduct a meta-analysis on aphasia prevalence given stroke for the two genders across published papers and compare it to data from a large American patient database (Healthcare Cost and Utilization Project (HCUP) under Agency for Healthcare Research and Quality, U.S. Department of Health & Human Services: https://hcupnet.ahrq.gov).

Meta-analysis methods

A pub-med search including the terms "stroke" AND "aphasia" AND "gender" generated 211 citations. References in review articles on stroke and aphasia were also investigated. A total of 419 titles were considered. 90 papers were selected for further inspection on the basis of their title and abstract.

Tventy-five studies were included in the final dataset (Bersano, et al., 2009; Brkić, et al., 2009; Brust, et al., 1976; Chang, et al., 2015; Croquelois & Bogousslavsky, 2011; Di Carlo, et al., 2003; Dickey, et al., 2010; Engelter, et al., 2006; Flowers, et al., 2013; Gall, et al., 2010; Gialanella, et al., 2011; Godefroy, et al., 2002; Hier, et al., 1994; Jerath, et al., 2011; Kadojić, et al., 2012; Kelly-Hayes, et al., 2003; Kyrozis, et al., 2009; Laska, et al., 2001; Miceli, et al., 1981; Pedersen, et al., 1995; Roquer, et al., 2003; Scarpa, et al., 1987; Siirtola, et al., 1977; Tsouli, et al., 2009; Wasserman, et al., 2015). One study (Bersano, et al., 2009) contained information about gender prevalence for different age bands. These groups were included separately (see table 1 and figure 1).

Studies were included on the basis of the overall number of stroke patients being available for calculation of prevalence, excluding reviews (Appelros, et al., 2009; Berglund, et al., 2017; Crinion & Leff, 2007; Ellis & Urban, 2016; Ferro, et al., 1999; Flowers, et al., 2016; Jongbloed, 1986; Lazar & Boehme, 2017; Plowman, et al., 2011; Vuković, et al., 2009; Watila & Balarabe, 2015), studies with insufficient gender information (Ali, et al., 2014;

Bogousslavsky, et al., 1988; Candelise, et al., 2007; Ellis, et al., 2018; Fennis, et al., 2013; Gialanella, et al., 2013; Giaquinto, et al., 1999; González-Fernández, et al., 2011; Hachioui, et al., 2012; Haselbach, et al., 2014; Hillis & Heidler, 2002; Hoffmann & Chen, 2013; Kauhanen, et al., 2000; Kemper, et al., 2011; Kremer, et al., 2013; Lazar, et al., 2008; Leśniak, et al., 2008; Lloyd-Jones, et al., 2010; Lubart, et al., 2005; Maas, et al., 2012; Maehlum, et al., 1990; Miller, et al., 2014; Ojala-Oksala, et al., 2012; Paolucci, et al., 1996; Pedersen, et al., 2004; Stegmayr, et al., 1994; Stürmer, et al., 2002; Tilling, et al., 2001; Troisi, et al., 2002; Vidović, et al., 2011; Wade, et al., 1986; Wade, et al., 1984; Worrall, et al., 2017; Yuan & Humuruola, 2015), studies with insufficient aphasia information (Fuh, et al., 1996; Kelly, et al., 2003; Kunitz, et al., 1984; Matsumoto, et al., 1973; Safaz, et al., 2016; Ween, et al., 2000), studies with insufficiently specified sampling procedure for aphasia patients from stroke cohorts (Basso, et al., 1982; Bhatnagar, et al., 2002; De Renzi, et al., 1980; Eslinger & Damasio, 1981; Jodzio, et al., 2005; Kertesz & Benke, 1989; Kertesz & Sheppard, 1981; Law, et al., 2009; McGlone & Kertesz, 1973; Oliveira & Damasceno, 2009; Pickersgill & Lincoln, 1983; Pizzamiglio, et al., 1985; Sarno, et al., 1985; Sundet, 1988), or studies with repetition of data use (Gialanella, et al., 2011).

Given that the analysis is based on fully anonymized and publicly available data, the study poses no ethical concerns.

Table 1

Study	Place	Note	N(stroke)	Aphasia Rate (Female)	Aphasia Rate (Male)	Ratio	95% CI lower	95% CI upper
Brust et al. 1976	New York, USA	acute stroke	850	18.4	23.8	0.774	0.580	1.040
Siirtola et al. 1977	Turku, Finland	acute stroke	338	28.7	28.2	1.016	0.670	1.540
Miceli et al. 1981	Rome, Italy	223 CVA, 128 tumours, 29 traumas etc	390	60.8	62.3	0.975	0.750	1.280
Scarpa et al. 1987	Modena, Italy	left hemisphere stroke, post 14 days	196	62.5	50.0	1.250	0.860	1.820
Hier et al. 1994	four sites, USA	acute stroke	1805	22.6	19.4	1.103	0.920	1.330
Pedersen et al. 1995	Copenhagen, Denmark	acute stroke	881	39.7	34.8	1.140	0.920	1.420
Laska et al. 2001	Danderyd, Sweden	acute stroke	106	33.3	34.7	0.961	0.500	1.850
Godefroy et al. 2002	Lille, France	Acute stroke, Aphasia	308	68.5	66.1	1.037	0.790	1.360
Di Carlo et al. 2003	7 European countries	acute stroke	4499	34.8	30.3	1.337	1.060	1.690
Kelly-Hayes et al. 2003	Framingham MA, USA	at 6 months post stroke	108	23.8	11.6	2.143	0.780	5.900
Roquer et al. 2003	Barcelona, Spain	acute stroke	1581	28.9	21.6	1.335	1.100	1.630
Engelter et al. 2006	Basel, Switzerland	acute ischemic stroke	269	34.0	23.9	1.422	0.890	2.260
Kyrozis et al. 2009	Acadia, Greece	28 days post-stroke	555	27.6	18.8	1.473	1.040	2.090
Tsouli et al. 2009	Athens, Greece	acute stroke	2297	41.3	31.5	1.313	1.140	1.510
Brkic et al. 2009	Tuzla, Bosnia and Herzegovina	acute stroke	993	23.0	17.6	1.309	0.990	1.730
Bersano et al. 2009a, <64 years	seven regions, Italy	acute stroke, <64 years	1751	21.0	20.0	1.044	0.840	1.300
Bersano et al. 2009b, 64-74 years	seven regions, Italy	acute stroke, 64-74 years	2663	26.0	24.0	1.081	0.930	1.260
Bersano et al. 2009c, 75-84 years	seven regions, Italy	acute stroke, 75-84 years	2853	31.0	27.0	1.160	1.010	1.330
Bersano et al. 2009d, >84 years	seven regions, Italy	acute stroke, 84< years	1581	43.0	35.0	1.223	1.030	1.450
Dickey et al. 2010	Ontario, Canada	at discharge	15327	33.4	31.0	1.078	1.020	1.140
Gall et al. 2010	Melbourne, Australia	acute stroke, Dysphasia	843	46.1	35.6	1.294	1.040	1.600
Gialanella et al. 2011	Lumezzane, Italy	acute stroke	262	55.9	44.4	1.258	0.890	1.770
Croquelois & Bogousslavsky 2011	Lausanne, Switzerland	acute stroke	5880	28.1	24.9	1.128	1.020	1.250
Jerath et al. 2011	Rochester, USA	acute stroke	449	45.8	37.4	1.222	0.910	1.640
Kadojic et al. 2012	Osijek, Croatia	acute ischemic stroke	177	48.2	37.2	1.294	0.820	2.040
Flowers et al. 2013	Toronto, Canada	acute ischemic stroke	221	35.7	26.0	1.373	0.850	2.220
Wasserman et al. 2015	Ottawa, Canada	isolated aphasia as only deficit of stroke	1155	4.1	3.0	1.347	0.720	2.510
Chang et al. 2015	Colombo, Sri Lanka	data from questionnaire	24	62.5	56.2	1.111	0.370	3.320
ALL			**48362**	**29.6**	**26.0**	**1.139**	**1.100**	**1.180**

Table 1. Overview of studies included in the meta-analysis on gender differences in post-stroke aphasia rate.

Results of meta-analysis

The 25 studies included a total of 48,362 stroke patients (23,085 women, 25,297 men). Of these 13,398 (6,828 women, 6,570 men) were diagnosed with aphasia (27.7%). 29.6 % of female stroke patients were diagnosed, while 26 % of males were diagnosed with aphasia (see table 1 and figure 1). This difference was found to be statistically significant using a paired and weighted t-test on the aphasia rates across studies, weighted to add emphasis on studies with more patients, $t(27)=6.76$, $p<0.001$, forcing a rejection of the null-hypothesis that there is no difference in aphasia rate between women and men. The overall gender aphasia rate ratio was found to be 1.14 (1.10-1.18 95% CI) with a Cohen's *d* of 0.37 which is usually considered a small effect (Cohen, 1992).

Figure 1

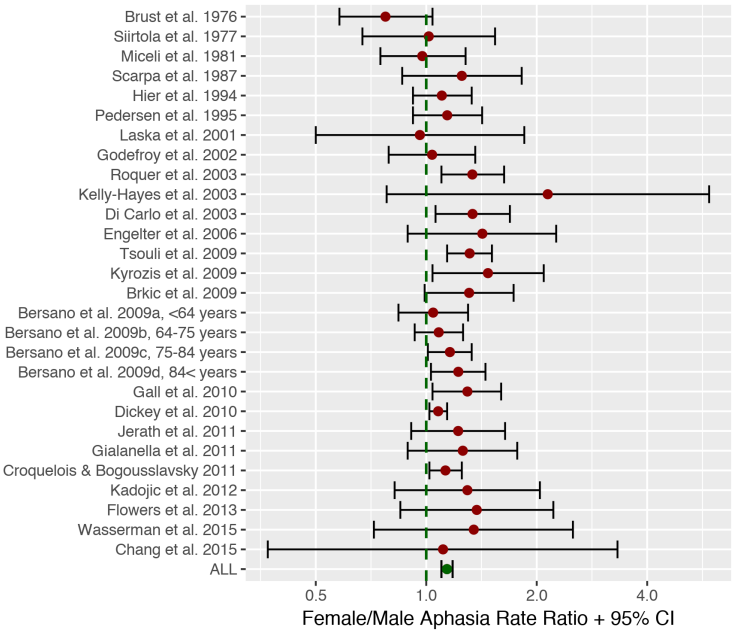

Figure 1. Uncorrected aphasia rate ratios for the 25 studies included in the meta-analysis (total n=48,362), showing that across studies a small but significant effect of gender exists, indicating that women are more likely to get aphasia from stroke. This effect, however, does not take age or stroke severity into account.

Interim discussion

The aphasia rate across studies (27.7%) was comparable to that reported in a recent meta-analysis (30%) (Flowers, et al., 2016). The slightly lower estimate may in part be related to the inclusion of a study of cases with isolated aphasia (Wasserman, et al., 2015) which had a much smaller aphasia rate than studies with a regular aphasia diagnosis (see table 1). The aphasia rate ratio for the genders in this study, however, was comparable to that of most other studies in the sample.

A higher aphasia rate after stroke for women than for men was found across studies in the meta-analysis. This finding is at odds with the notion that language in men is more lateralized than in women (see introduction). If women have more lateralized language, one would expect their language to be more vulnerable to unilateral stroke than women's language. But the findings are also at odds with previous critical suggestions that there are no gender differences in language lateralization between women and men (e.g. see Wallentin, 2009; Wallentin, et al., 2014). At face value, the findings would suggest that women in fact have more lateralized language than men. There are, however, reasons to be sceptical about such a conclusion, based on the present analysis.

As mentioned in the introduction, stroke is known to affect the genders differently on a number of accounts, including general severity. The genders also differ on general health levels, meaning that women on average are older when they are hit by stroke (Appelros, et al., 2009). Age has previously been found to be a predictor of experiencing aphasia (Ellis & Urban, 2016). In order to investigate if the gender effects found in the meta-analysis are specific to language or may relate to more general differences that are unlikely to be caused by a gender difference in language, an investigation of aphasia rates that take these considerations into account is needed. Unfortunately, very few studies in the current cohort

make detailed, gender-stratified reports of age effects on aphasia. One exception is Bersano et al. (2009) who report aphasia rates for 4 different age groups. Here an interaction between age and gender differences seemingly can be observed. The gender difference is almost non-existing in the youngest age group (under 64), but gradually grows larger and larger in older age groups. It thus seems that taking age into account is important when trying to understand the gender difference in aphasia rates.

Another possible explanation for the increased aphasia rate is that women are simply affected more severely by stroke in a non-discriminant manner (Berglund, et al., 2017). If aphasia rates can be explained by severity alone, it would again suggest that the gender difference is not restricted to language in any meaningful way. But again, this type of information is not reported in the papers included in the present meta-analysis.

I have therefore added a 2nd dataset from an American healthcare database (see below) that will allow me to investigate aphasia rates while taking into account age and stroke severity.

Methods for database analysis

Data from the Healthcare Cost and Utilization Project (HCUP) from community hospitals in the United States were used for the analysis. The database (https://hcupnet.ahrq.gov/) contains inpatient diagnostic information using the International Classification of Diseases and Health Related Problems (ICD-9) codes from 35 US American states from the years 2011-2014. The ICD system is used by US hospitals for reimbursement purposes and subsequent research, e.g. to study patterns and outcome of disease (O'Malley, et al., 2005). Data from each year for each state, stratified by gender, was used in the analysis. Data from this database has previously been used to study post-stroke aphasia rates (Ellis, et al., 2018), but here we add

gender as an explanatory variable and incorporate all available states for all the years in which the ICD-9 diagnoses were used (i.e. 10 times more patients).

To identify number of patients with stroke, the combined number of diagnoses from the database related to stroke was obtained. Cases with the following IDC-9 codes were included: “434.00 Crbl Thrmbs Wo Infrct”, “434.01 Crbl Thrmbs W Infrct”, “434.10 Crbl Emblsm Wo Infrct”, “434.11 Crbl Emblsm W Infrct”, “434.90 Crbl Art Oc Nos Wo Infrc”, “434.91 Crbl Art Ocl Nos W Infrc”, “436 Cva”. To identify the number of patients with aphasia, the IDC-9 code: “784.3 Aphasia” was used. As a proxy for stroke severity, the number of hemiplegia diagnoses were included (using the IDC-9 code: “342.90 Unsp Hemiplga Unspf Side”). Hemiplegia and aphasia are comorbid deficits (Boehme, et al., 2016), but if a gender difference in number of aphasias is accompanied by a similar gender difference in hemiplegia diagnoses, then the difference is likely to be explained by stroke severity rather than being a specific language related phenomenon.

The database allows for two different ways to draw data. Either one can draw "Principal" diagnoses or “all-listed” diagnoses. As aphasia is often unlikely to be the principal diagnosis in a hospital visit, “all-listed” diagnoses were used. However, age information is only available with “principal” diagnoses, and age information was therefore drawn from this data. The assumption is that age differences in principal diagnosis will be representative for age differences in the “all-listed” diagnoses as well.

To evaluate statistical significance of these findings, a linear mixed-effects regression analysis was conducted, fit by REML, using the *lmertest* package in R (Kuznetsova, et al., 2017). P-values were estimated using Satterthwaite's method. The model incorporated aphasia rate as the dependent variable and gender as the main fixed dependent variable. Age and rate of

hemiplegia diagnoses (proxy for stroke severity) were z-score scaled and added as additional covariates. The model also included all possible interactions between the three variables. US state and year for each data-point were included as random effects. The regression was weighted by number of stroke cases in a particular state/year, to put more weight on data-points from larger states.

Given that the analysis is based on fully anonymized and publicly available data, the study poses no ethical concerns.

Results of database analysis

A total of 1,655,295 stroke patients were found in the database (863,612 women, 791,683 men) in the period from 2011 to 2014. Aphasia was diagnosed in 623,942 cases (336,604 women, 287,338 men) or 37.7%.

Using this method, 38.9 % of female stroke patients were diagnosed, while 36.2 % of males were diagnosed with aphasia (see figure 2).

The overall gender aphasia rate ratio was found to be 1.073 (1.068-1.079 95% CI) with a Cohen's *d* effect size across states of 0.63 which is usually considered a medium effect size (Cohen, 1992).

A paired t-test again yielded support to the existence of a gender difference, $t(143)=-13.74$, $p<0.001$.

Figure 2

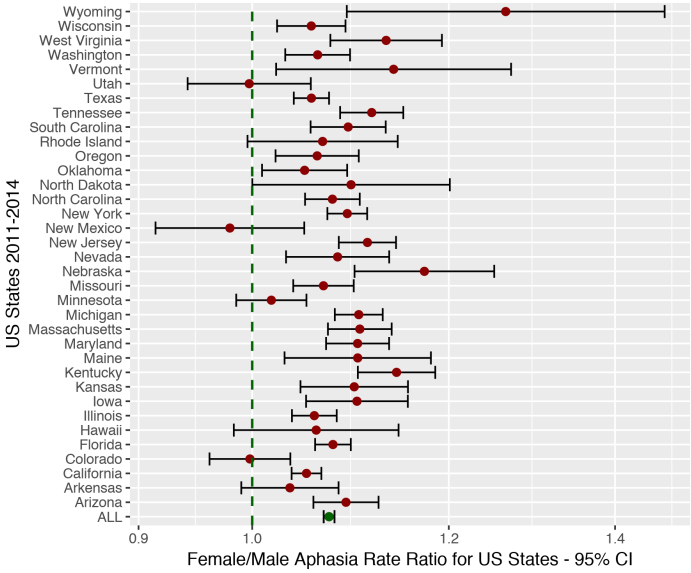

Figure 2. Uncorrected aphasia rate ratios for each US state in the HCUP database from 2011-2014. This analysis replicates the findings from the meta-analysis and provides unequivocal evidence for a higher aphasia rate among women compared to men given stroke (see figure 1). However, as figure 3 shows, this effect can be explained completely by the gender difference in age at stroke.

When including age and stroke severity in a regression analysis, however, no significant effect of gender over and above that explained by age and severity could be observed, $t(272.33)=-0.826$, $p=0.4$. We did see significant effects of age, $t(275.23)=2.21$, *p(uncorrected)*<0.05, and a significant effect of stroke severity, $t(268.66)=5.34$, $p<0.001$. Figure 3 displays how gender is completely confounded by age of stroke and does not add any explanatory power to the analysis. A significant interaction between age and stroke severity was also observed, $t(275.9)=-2.30$, *p(uncorrected)*<0.05. No other interactions were significant.

Figure 3.

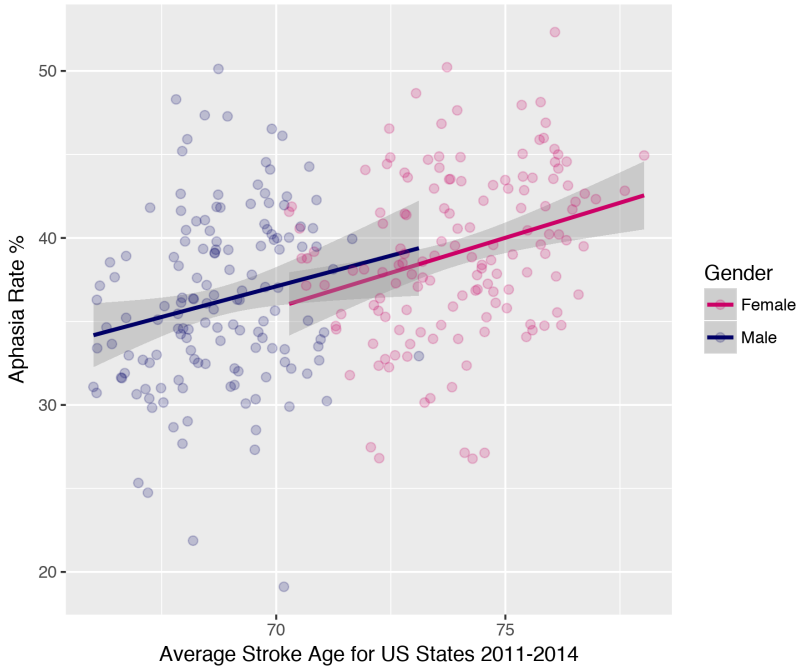

Figure 3. A scatterplot of stroke average age against aphasia rate for each US state and year (2011-2014) in the HCUP database. The plot illustrates the large age difference between men and women in stroke diagnoses. It also shows a positive correlation between average age and aphasia rate, suggesting that older stroke patients more often get aphasia. When this relationship is taken into account, gender effects are no longer significant in the aphasia rates.

Discussion

On this very large cohort of patients, we replicate the findings from the meta-analysis. Based on raw aphasia rates, women are more likely to get an aphasia diagnosis following stroke than men. The sizes of the effects vary somewhat across the two analyses. This is likely due to the fact that the database data is more homogeneous than the data included in the meta-analysis, where the time of diagnosis post-stroke differs and also to some extent the definition of aphasia (e.g. one study includes dysphasia as well as aphasia and one study only looks at isolated aphasia cases – see table 1 for details).

At the same time, our 2nd analysis completely revokes the conclusion that one could have been tempted to draw from the meta-analysis. In the database, we find no evidence for any gender difference in aphasia rates over and above that which can be explained by the age differences between the genders when they are affected by stroke. This replicates previous findings that age is a predictor of aphasia following stroke (Ellis & Urban, 2016), and given that age is a more fundamental causal variable than language (i.e. your language cannot change your age, but the opposite may be true), it is likely that most if not all of the gender difference in aphasia rates is caused by the age difference in stroke between women and men.

We also find an independent effect of stroke severity on aphasia rates as measured by diagnoses of hemiplegia. Aphasia and hemiplegia are known to be highly co-morbid. In this study we find that severity effects on aphasia are independent of the gender effects. The gender differences thus do not seem to be related to stroke severity per se. It has to be said, however, that this analysis uses a somewhat crude proxy for stroke severity. Other measures, such as general stroke scale scores (Hantson, et al., 1994; Lindenstrøm, et al., 1991) might interact more with gender.

Bersano et al. (Bersano, et al., 2009) found indications of increasing gender differences in aphasia rates with age. Contrary to this, the database analysis shows no indication of an interaction between gender and age. Bersano and co-workers did not report inferential statistics documenting an actual interaction, but looking at their data, the increasing discrepancy in aphasia between males and females with age is striking. For patients below 64 years the aphasia rate gender ratio is 1.04 and grows to 1.08 in 64-74 year old patients, 1.16 in 75-84 and 1.22 in patients above 84 years of age (see table 1). How does this fit with the current data not showing any interaction between age and gender? One possible explanation is

that there is an inherent gender bias in the way that the Bersano and co-workers' age data is distributed. When lumping the data into 10 year age bins, one needs to take into account that the different genders may not be equally distributed within each bin. The data from the Bersano et al. study were collected in 2001 in Italy. If one looks at the gender and age distribution of the Italian population in January 2002 (http://demo.istat.it/pop2002/index_e.html), one finds that because women live longer than men, the average age of women within the different age bins from middle age and onwards is higher than that of men and that this difference gets larger for the older groups. For the 54 to 64 year old Italians, the mean age difference between men and women is 0.07 years, but for the age group above 84 years, it has grown to 0.52 years. There is a very strong linear correlation between these mean age differences in the Italian population in these age bins and the reported differences in aphasia rate (r= 0.96, data available from author on request), which suggests that at least some of the interaction between gender and age is based on unequal sampling of the different ages. This relationship may explain some of the interaction observed in the Bersano et al. data. This is not to say that there could not be age effects that are not picked up by the current analysis. The data from the database is distributed on a state by year basis and each data-point for age is the result of averaging across many individual patients. Underneath this gross simplification may be hidden lots of interesting phenomena. Further studies are needed in order to rule out a potential interaction between gender, age and aphasia. The present analyses are also limited in that they say nothing about the different types of aphasia symptoms that patients may suffer from and the potential interactions that might be found with gender if one looks more carefully at aphasia subtypes.

Taken together, the results are in line with a critical stance towards the brain base of gender differences in language (Wallentin, 2009). This, of course, does not mean that the observed gender differences in language related behavior (see introduction) do not have brain

correlates, just that these differences will be dynamic, complex and to a large extent dependent on gender differences in experience and context rather than being tied to genetic sex.

Conclusion

We have found that women more often are diagnosed with aphasia following stroke. This is in direct opposition to the hypothesis that women have less lateralized language function than men. The gender difference is most likely caused by age differences in the two groups at the time of stroke.

Disclosure statement

The author has no conflict of interests to report.

References

Ali, M., Bath, P. M., Lyden, P. D., Bernhardt, J., & Brady, M. (2014). Representation of People with Aphasia in Randomized Controlled Trials of Acute Stroke Interventions. *International Journal of Stroke, 9*, 174-182.

Appelros, P., Stegmayr, B., & Terént, A. (2009). Sex differences in stroke epidemiology: a systematic review. *Stroke, 40*, 1082-1090.

Baron-Cohen, S., Knickmeyer, R. C., & Belmonte, M. K. (2005). Sex Differences in the Brain: Implications for Explaining Autism. *Science, 310*, 819-823.

Basso, A., Capitani, E., & Moraschini, S. (1982). Sex Differences in Recovery from Aphasia. *Cortex, 18*, 469-475.

Benjamin, E. J., Blaha, M. J., Chiuve, S. E., Cushman, M., Das, S. R., Deo, R., de Ferranti, S. D., Floyd, J., Fornage, M., Gillespie, C., Isasi, C. R., Jiménez, M. C., Jordan, L. C., Judd, S. E., Lackland, D., Lichtman, J. H., Lisabeth, L., Liu, S., Longenecker, C. T., Mackey, R. H., Matsushita, K., Mozaffarian, D., Mussolino, M. E., Nasir, K., Neumar, R. W., Palaniappan, L., Pandey, D. K., Thiagarajan, R. R., Reeves, M. J., Ritchey, M., Rodriguez, C. J., Roth, G. A., Rosamond, W. D., Sasson, C., Towfighi, A., Tsao, C. W., Turner, M. B., Virani, S. S., Voeks, J. H., Willey, J. Z., Wilkins, J. T., Wu, J. H., Alger, H. M., Wong, S. S., Muntner, P., American Heart Association Statistics, C., & Stroke Statistics, S. (2017). Heart Disease and Stroke Statistics-2017 Update: A Report From the American Heart Association. *Circulation, 135*, e146-e603.

Berglund, A., Schenck-Gustafsson, K., & von Euler, M. (2017). Sex differences in the presentation of stroke. *Maturitas, 99*, 47-50.

Bersano, A., Burgio, F., Gattinoni, M., & Candelise, L. (2009). Aphasia Burden to Hospitalised Acute Stroke Patients: Need for an Early Rehabilitation Programme. *International Journal of Stroke, 4*, 443-447.

Bhatnagar, S. C., Jain, S. K., Bihari, M., Bansal, N. K., Pauranik, A., Jain, D. C., Bhatnagar, M. K., Meheshwari, M. C., Gupta, M., & Padma, M. V. (2002). Aphasia type and aging in Hindi-speaking stroke patients. *Brain and Language, 83*, 353-361.

Bleses, D., Vach, W., Slott, M., Wehberg, S., Thomsen, P., Madsen, T., & Basbøll, H. (2008). The Danish Communicative Developmental Inventories: validity and main developmental trends. *J. Child Lang., 35*, 1-19.

Boehme, A. K., Martin-Schild, S., Marshall, R. S., & Lazar, R. M. (2016). Effect of aphasia on acute stroke outcomes. *Neurology, 87*, 2348-2354.

Bogousslavsky, J., Van Melle, G., & Regli, F. (1988). The Lausanne Stroke Registry: analysis of 1,000 consecutive patients with first stroke. *Stroke (1970), 19*, 1083-1092.

Brkić, E., Sinanović, O., Vidović, M., & Smajlović, D. (2009). Incidence and clinical phenomenology of aphasic disorders after stroke [Ucestalost i klinicka fenomenologija afazickih poremećaja nakon mozdanog udara.]. *Medicinski arhiv, 63*, 197-199.

Brust, J. C., Shafer, S. Q., Richter, R. W., & Bruun, B. (1976). Aphasia in acute stroke. *Stroke, 7*, 167.

Candelise, L., Gattinoni, M., Bersano, A., Micieli, G., Sterzi, R., & Morabito, A. (2007). Stroke-unit care for acute stroke patients: an observational follow-up study. *The Lancet, 369*, 299-305.

Chang, T., Gajasinghe, S., & Arambepola, C. (2015). Prevalence of Stroke and Its Risk Factors in Urban Sri Lanka. *Stroke, 46*, 2965.

Cohen, J. (1992). A power primer. *Psychological bulletin, 112*, 155-159.

Crinion, J. T., & Leff, A. P. (2007). Recovery and treatment of aphasia after stroke: functional imaging studies. *Current Opinion in Neurology, 20*, 667-673.

Croquelois, A., & Bogousslavsky, J. (2011). Stroke Aphasia: 1,500 Consecutive Cases. *Cerebrovascular Diseases, 31*, 392-399.

De Renzi, E., Faglioni, P., & Ferrari, P. (1980). The Influence of Sex and Age on the Incidence and Type of Aphasia. *Cortex, 16*, 627-630.

Di Carlo, A., Lamassa, M., Baldereschi, M., Pracucci, G., Basile, A. M., Wolfe, C. D. A., Giroud, M., Rudd, A., Ghetti, A., & Inzitari, D. (2003). Sex Differences in the Clinical Presentation, Resource Use, and 3-Month Outcome of Acute Stroke in Europe. *Stroke, 34*, 1114.

Dickey, L., Kagan, A., Lindsay, M. P., Fang, J., Rowland, A., & Black, S. (2010). Incidence and Profile of Inpatient Stroke-Induced Aphasia in Ontario, Canada. *Archives of Physical Medicine and Rehabilitation, 91*, 196-202.

Ellis, C., Hardy, R. Y., Lindrooth, R. C., & Peach, R. K. (2018). Rate of aphasia among stroke patients discharged from hospitals in the United States. *Aphasiology, 32*, 1075-1086.

Ellis, C., & Urban, S. (2016). Age and aphasia: a review of presence, type, recovery and clinical outcomes. *Topics in Stroke Rehabilitation, 23*, 430-439.

Engelter, S. T., Gostynski, M., Papa, S., Frei, M., Born, C., Ajdacic-Gross, V., Gutzwiller, F., & Lyrer, P. A. (2006). Epidemiology of Aphasia Attributable to First Ischemic Stroke. *Stroke, 37*, 1379.

Eslinger, P. J., & Damasio, A. R. (1981). Age and type of aphasia in patients with stroke. *Journal of Neurology, Neurosurgery & Psychiatry, 44*, 377.

Fennis, T. F. M., Compter, A., van den Broek, M. W. C., Koudstaal, P. J., Algra, A., & Koehler, P. J. (2013). Is Isolated Aphasia a Typical Presentation of Presumed Cardioembolic Transient Ischemic Attack or Stroke? *Cerebrovascular Diseases, 35*, 337-340.

Ferro, J. M., Mariano, G., & Madureira, S. (1999). Recovery from Aphasia and Neglect. *Cerebrovascular Diseases, 9(suppl 5)*, 6-22.

Flowers, H. L., Silver, F. L., Fang, J., Rochon, E., & Martino, R. (2013). The incidence, co-occurrence, and predictors of dysphagia, dysarthria, and aphasia after first-ever acute ischemic stroke. *Journal of Communication Disorders, 46*, 238-248.

Flowers, H. L., Skoretz, S. A., Silver, F. L., Rochon, E., Fang, J., Flamand-Roze, C., & Martino, R. (2016). Poststroke Aphasia Frequency, Recovery, and Outcomes: A Systematic Review and Meta-Analysis. *Archives of Physical Medicine and Rehabilitation, 97*, 2188-2201.e2188.

Fuh, J. L., Wang, S. J., Larson, E. B., & Liu, H. C. (1996). Prevalence of Stroke in Kinmen. *Stroke, 27*, 1338.

Gall, S. L., Donnan, G., Dewey, H. M., Macdonell, R., Sturm, J., Gilligan, A., Srikanth, V., & Thrift, A. G. (2010). Sex differences in presentation, severity, and management of stroke in a population-based study. *Neurology, 74*, 975.

Gialanella, B., Bertolinelli, M., Lissi, M., & Prometti, P. (2011). Predicting outcome after stroke: the role of aphasia. *Disability and Rehabilitation, 33*, 122-129.

Gialanella, B., Santoro, R., & Ferlucci, C. (2013). Predicting outcome after stroke: the role of basic activities of daily living predicting outcome after stroke. *European Journal of Physical and Rehabilitation Medicine, 49*, 629-637.

Giaquinto, S., Buzzelli, S., Francesco, L., Lottarini, A., Montenero, P., In, P. T., & Nolfe, G. (1999). On the prognosis of outcome after stroke. *Acta Neurologica Scandinavica, 100*, 202-208.

Godefroy, O., Dubois, C., Debachy, B., Leclerc, M., & Kreisler, A. (2002). Vascular Aphasias. Main Characteristics of Patients Hospitalized in Acute Stroke Units. *Stroke, 33*, 702.

González-Fernández, M., Davis, C., Molitoris, J. J., Newhart, M., Leigh, R., & Hillis, A. E. (2011). Formal Education, Socioeconomic Status, and the Severity of Aphasia After Stroke. *Archives of Physical Medicine and Rehabilitation, 92*, 1809-1813.

Hachioui, H. E., van de Sandt-Koenderman, M. W. M. E., Dippel, D. W. J., Koudstaal, P. J., & Visch-Brink, E. G. (2012). The Screeling: Occurrence of Linguistic Deficits in Acute Aphasia Post-Stroke. *Journal of Rehabilitation Medicine, 44*, 429-435.

Hantson, L., De Weerdt, W., De Keyser, J., Diener, H. C., Franke, C., Palm, R., Van Orshoven, M., Schoonderwalt, H., De Klippel, N., & Herroelen, L. (1994). The European Stroke Scale. *Stroke, 25*, 2215-2219.

Haselbach, D., Renggli, A., Carda, S., & Croquelois, A. (2014). Determinants of Neurological Functional Recovery Potential after Stroke in Young Adults. *Cerebrovascular Diseases Extra, 4*, 77-83.

Hausmann, M. (2016). Why sex hormones matter for neuroscience: A very short review on sex, sex hormones, and functional brain asymmetries. *Journal of Neuroscience Research, 95*, 40-49.

Hier, D. B., Yoon, W. B., Mohr, J. P., Price, T. R., & Wolf, P. A. (1994). Gender and Aphasia in the Stroke Data Bank. *Brain and Language, 47*, 155-167.

Hillis, A. E., & Heidler, J. (2002). Mechanisms of early aphasia recovery. *Aphasiology, 16*, 885-895.

Hirnstein, M., Hugdahl, K., & Hausmann, M. (2018). Cognitive sex differences and hemispheric asymmetry: A critical review of 40 years of research. *Laterality: Asymmetries of Body, Brain and Cognition*, 1-49.

Hoffmann, M., & Chen, R. (2013). The Spectrum of Aphasia Subtypes and Etiology in Subacute Stroke. *Journal of Stroke and Cerebrovascular Diseases, 22*, 1385-1392.

Inatomi, Y., Yonehara, T., Omiya, S., Hashimoto, Y., Hirano, T., & Uchino, M. (2008). Aphasia during the acute phase in ischemic stroke. *Cerebrovasc Dis, 25*, 316-323.

Jerath, N. U., Reddy, C., Freeman, W. D., Jerath, A. U., & Brown, R. D. (2011). Gender Differences in Presenting Signs and Symptoms of Acute Ischemic Stroke: A Population-Based Study. *Gender Medicine, 8*, 312-319.

Jodzio, K., Drumm, D. A., Nyka, W. M., Lass, P., & Gąsecki, D. (2005). The contribution of the left and right hemispheres to early recovery from aphasia: A SPECT prospective study. *Neuropsychological Rehabilitation, 15*, 588-604.

Jongbloed, L. (1986). Prediction of function after stroke: a critical review. *Stroke, 17*, 765.

Kadojić, D., Rostohar Bijelić, B., Radanović, R., Porobić, M., Rimac, J., & Dikanović, M. (2012). Aphasia in Patients with Ischemic Stroke. *Acta clinica Croatica, 51*, 221-224.

Kansaku, K., & Kitazawa, S. (2001). Imaging studies on sex differences in the lateralization of language. *Neuroscience Research, 41*, 333-337.

Kauhanen, M. L., Korpelainen, J. T., Hiltunen, P., Määttä, R., Mononen, H., Brusin, E., Sotaniemi, K. A., & Myllylä, V. V. (2000). Aphasia, Depression, and Non-Verbal Cognitive Impairment in Ischaemic Stroke. *Cerebrovascular Diseases, 10*, 455-461.

Kelly, P. J., Furie, K. L., Shafqat, S., Rallis, N., Chang, Y., & Stein, J. (2003). Functional recovery following rehabilitation after hemorrhagic and ischemic stroke11No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated. *Archives of Physical Medicine and Rehabilitation, 84*, 968-972.

Kelly-Hayes, M., Beiser, A., Kase, C. S., Scaramucci, A., D'Agostino, R. B., & Wolf, P. A. (2003). The influence of gender and age on disability following ischemic stroke: the Framingham study. *Journal of Stroke and Cerebrovascular Diseases, 12*, 119-126.

Kemper, C., Koller, D., Glaeske, G., & van den Bussche, H. (2011). Mortality and Nursing Care Dependency One Year After First Ischemic Stroke: An Analysis of German Statutory Health Insurance Data. *Topics in Stroke Rehabilitation, 18*, 172-178.

Kertesz, A., & Benke, T. (1989). Sex equality in intrahemispheric language organization. *Brain and Language, 37*, 401-408.

Kertesz, A., & Sheppard, A. N. N. (1981). The Epidemiology of Aphasic and Cognitive impairment in Stroke: Age, Sex, Aphasia Type and Laterality Differences. *Brain, 104*, 117-128.

Kremer, C., Perren, F., Kappelin, J., Selariu, E., & Abul-Kasim, K. (2013). Prognosis of aphasia in stroke patients early after iv thrombolysis. *Clinical Neurology and Neurosurgery, 115*, 289-292.

Kunitz, S. C., Gross, C. R., Heyman, A., Kase, C. S., Mohr, J. P., Price, T. R., & Wolf, P. A. (1984). The pilot Stroke Data Bank: definition, design, and data. *Stroke, 15*, 740-746.

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software, 82*.

Kyrozis, A., Potagas, C., Ghika, A., Tsimpouris, P. K., Virvidaki, E. S., & Vemmos, K. N. (2009). Incidence and predictors of post-stroke aphasia: The Arcadia Stroke Registry. *European Journal of Neurology, 16*, 733-739.

Laska, A. C., Hellblom, A., Murray, V., Kahan, T., & Von Arbin, M. (2001). Aphasia in acute stroke and relation to outcome. *Journal of Internal Medicine, 249*, 413-422.

Law, J., Rush, R., Pringle, A. M., Irving, A. M., Huby, G., Smith, M., Conochie, D., Haworth, C., & Burston, A. (2009). The incidence of cases of aphasia following first stroke referred to speech and language therapy services in Scotland. *Aphasiology, 23*, 1266-1275.

Lazar, R. M., & Boehme, A. K. (2017). Aphasia As a Predictor of Stroke Outcome. *Current neurology and neuroscience reports, 17*, 83.

Lazar, R. M., Speizer, A. E., Festa, J. R., Krakauer, J. W., & Marshall, R. S. (2008). Variability in language recovery after first-time stroke. *Journal of Neurology, Neurosurgery & Psychiatry, 79*, 530.

Leśniak, M., Bak, T., Czepiel, W., Seniów, J., & Członkowska, A. (2008). Frequency and Prognostic Value of Cognitive Disorders in Stroke Patients. *Dementia and geriatric cognitive disorders, 26*, 356-363.

Lindenstrøm, E., Boysen, G., Waage Christiansen, L., à Rogvi Hansen, B., & Würtzen Nielsen, P. (1991). Reliability of Scandinavian Neurological Stroke Scale. *Cerebrovascular Diseases, 1*, 103-107.

Lloyd-Jones, D., Adams, R. J., Brown, T. M., Carnethon, M., Dai, S., De Simone, G., Ferguson, T. B., Ford, E., Furie, K., Gillespie, C., Go, A., Greenlund, K., Haase, N., Hailpern, S., Ho, P. M., Howard, V., Kissela, B., Kittner, S., Lackland, D., Lisabeth, L., Marelli, A., McDermott, M. M., Meigs, J., Mozaffarian, D., Mussolino, M., Nichol, G., Roger, V. L., Rosamond, W., Sacco, R., Sorlie, P., Stafford, R., Thom, T., Wasserthiel-Smoller, S., Wong, N. D., & Wylie-Rosett, J. (2010). Heart Disease and Stroke Statistics—2010 Update. *Circulation, 121*, e46.

Lubart, E., Leibovitz, A., Baumoehl, Y., Klein, C., Gil, I., Abramovitz, I., Gurevitz, A., & Habot, B. (2005). Progressing stroke with neurological deterioration in a group of Israeli elderly. *Archives of Gerontology and Geriatrics, 41*, 95-100.

Maas, M. B., Lev, M. H., Ay, H., Singhal, A. B., Greer, D. M., Smith, W. S., Harris, G. J., Halpern, E. F., Koroshetz, W. J., & Furie, K. L. (2012). The Prognosis for Aphasia in Stroke. *Journal of Stroke and Cerebrovascular Diseases, 21*, 350-357.

Maehlum, S., Roaldsen, K., Kolsrud, M., & Dahl, M. (1990). Rehabilitering etter hjerneslag [Rehabilitation after a stroke]. *Tidsskrift for Den norske legeforening, 110*, 2657-2659.

Matsumoto, N., Whisnant, J. P., Kurland, L. T., & Okazaki, H. (1973). Natural History of Stroke in Rochester, Minnesota, 1955 Through 1969: An Extension of a Previous Study, 1945 Through 1954. *Stroke, 4*, 20.

McGlone, J., & Kertesz, A. (1973). Sex Differences in Cerebral Processing of Visuospatial Tasks. *Cortex, 9*, 313-320.

Meyer, B. C., & Lyden, P. D. (2009). The modified National Institutes of Health Stroke Scale: Its Time Has Come. *International Journal of Stroke, 4*, 267-273.

Miceli, G., Caltagirone, C., Gainotti, G., Masullo, C., Silveri Maria, C., & Villa, G. (1981). Influence of age, sex, literacy and pathologic lesion on incidence, severity and type of aphasia. *Acta Neurologica Scandinavica, 64*, 370-382.

Miller, N., Gray, W. K., Howitt, S. C., Jusabani, A., Swai, M., Mugusi, F., Jones, M. P., & Walker, R. W. (2014). Aphasia and Swallowing Problems in Subjects With Incident Stroke in Rural Northern Tanzania: A Case-Control Study. *Topics in Stroke Rehabilitation, 21*, 52-62.

O'Malley, K. J., Cook, K. F., Price, M. D., Wildes, K. R., Hurdle, J. F., & Ashton, C. M. (2005). Measuring Diagnoses: ICD Code Accuracy. *Health Services Research, 40*, 1620-1639.

Ojala-Oksala, J., Jokinen, H., Kopsi, V., Lehtonen, K., Luukkonen, L., Paukkunen, A., Seeck, L., Melkas, S., Pohjasvaara, T., Karhunen, P., Hietanen, M., Erkinjuntti, T., & Oksala, N. (2012). Educational History Is an Independent Predictor of Cognitive Deficits and Long-Term Survival in Postacute Patients With Mild to Moderate Ischemic Stroke. *Stroke, 43*, 2931.

Oliveira, F. F., & Damasceno, B. P. (2009). Short-term prognosis for speech and language in first stroke patients. *Arquivos de Neuro-Psiquiatria, 67*, 849-855.

Paolucci, S., Antonucci, G., Gialloreti, L. E., Traballesi, M., Lubich, S., Pratesi, L., & Palombi, L. (1996). Predicting Stroke Inpatient Rehabilitation Outcome: The Prominent Role of Neuropsychological Disorders. *European Neurology, 36*, 385-390.

Pedersen, P. M., Jørgensen, H. S., Nakayama, H., Raaschou, H. O., & Olsen, T. S. (1995). Aphasia in acute stroke: incidence, determinants, and recovery. *Annals of Neurology, 38*, 659-666.

Pedersen, P. M., Vinter, K., & Olsen, T. S. (2004). Aphasia after Stroke: Type, Severity and Prognosis. *Cerebrovascular Diseases, 17*, 35-43.

Pickersgill, M. J., & Lincoln, N. B. (1983). Prognostic indicators and the pattern of recovery of communication in aphasic stroke patients. *Journal of Neurology, Neurosurgery & Psychiatry, 46*, 130.

Pizzamiglio, L., Mammucari, A., & Razzano, C. (1985). Evidence for sex differences in brain organization in recovery in aphasia. *Brain and Language, 25*, 213-223.

Plowman, E., Hentz, B., & Ellis, C. (2011). Post-stroke aphasia prognosis: a review of patient-related and stroke-related factors. *Journal of Evaluation in Clinical Practice, 18*, 689-694.

Reilly, D., Neumann, D. L., & Andrews, G. (in press). Gender differences in reading and writing achievement: Evidence from the National Assessment of Educational Progress (NAEP). *American Psychologist*.

Roquer, J., Campello, A. R., & Gomis, M. (2003). Sex Differences in First-Ever Acute Stroke. *Stroke, 34*, 1581.

Safaz, I., Kesikburun, S., Adigüzel, E., & Yilmaz, B. (2016). Determinants of disease-specific health-related quality of life in Turkish stroke survivors. *International Journal of Rehabilitation Research, 39*.

Sarno, M. T., Buonaguro, A., & Levita, E. (1985). Gender and recovery from aphasia after stroke. *The Journal of nervous and mental disease, 173*, 605-609.

Scarpa, M., Colombo, A., Sorgato, P., & De Renzi, E. (1987). The Incidence of Aphasia and Global Aphasia in Left Brain-Damaged Patients. *Cortex, 23*, 331-336.

Schwartz, H. A., Eichstaedt, J. C., Kern, M. L., Dziurzynski, L., Ramones, S. M., Agrawal, M., Shah, A., Kosinski, M., Stillwell, D., Seligman, M. E. P., & Ungar, L. H. (2013). Personality, gender, and age in the language of social media: the open-vocabulary approach. *PLoS ONE, 8*, e73791.

Shaywitz, B. A., Shaywitz, S. E., Pugh, K. R., Constable, R. T., Skudlarski, P., Fulbright, R. K., Bronen, R. A., Fletcher, J. M., Shankweiler, D. P., & Katz, L. (1995). Sex differences in the functional organization of the brain for language. *Nature, 373*, 607-609.

Siirtola, M., Narva, E. V., & Siirtola, T. (1977). On the occurrence and prognosis of aphasia in patients with cerebral infarction. *Scandinavian journal of social medicine. Supplementum, 14*, 128-133.

Sommer, I. E. C., Aleman, A., Bouma, A., & Kahn, R. S. (2004). Do women really have more bilateral language representation than men? A meta-analysis of functional imaging studies. *Brain, 127*, 1845-1852.

Stegmayr, B., Asplund, K., & Wester, P. O. (1994). Trends in incidence, case-fatality rate, and severity of stroke in northern Sweden, 1985-1991. *Stroke, 25*, 1738.

Stürmer, T., Schlindwein, G., Kleiser, B., Roempp, A., & Brenner, H. (2002). Clinical Diagnosis of Ischemic versus Hemorrhagic Stroke: Applicability of Existing Scores in the Emergency Situation and Proposal of a New Score. *Neuroepidemiology, 21*, 8-17.

Sundet, K. (1988). Sex differences in severity and type of aphasia1. *Scandinavian journal of psychology, 29*, 168-179.

Thommessen, B., Thoresen, G. E., Bautz-Holter, E., & Laake, K. (2002). Validity of the Aphasia Item from the Scandinavian Stroke Scale. *Cerebrovascular Diseases, 13*, 184-186.

Tilling, K., Sterne, J. A. C., Rudd, A. G., Glass, T. A., Wityk, R. J., & Wolfe, C. D. A. (2001). A New Method for Predicting Recovery After Stroke. *Stroke, 32*, 2867.

Troisi, E., Paolucci, S., Silvestrini, M., Matteis, M., Vernieri, F., Grasso, M. G., & Caltagirone, C. (2002). Prognostic factors in stroke rehabilitation: the possible role of pharmacological treatment. *Acta Neurologica Scandinavica, 105*, 100-106.

Tsouli, S., Kyritsis, A. P., Tsagalis, G., Virvidaki, E., & Vemmos, K. N. (2009). Significance of Aphasia after First-Ever Acute Stroke: Impact on Early and Late Outcomes. *Neuroepidemiology, 33*, 96-102.

Vidović, M., Sinanović, O., Šabaškić, L., Hatičić, A., & Brkić, E. (2011). Incidence and Types of Speech Disorders in Stroke Patients. *Acta clinica Croatica, 50*, 491-493.

Vuković, V., Galinović, I., Lovrenčić-Huzjan, A., Budišić, M., & Demarin, V. (2009). Women and Stroke: How Much do Women and Men Differ? A Review – Diagnostics, Clinical Differences, Therapy and Outcome. *Collegium antropologicum, 33*, 977-984.

Wade, D. T., Hewer, R. L., David, R. M., & Enderby, P. M. (1986). Aphasia after stroke: natural history and associated deficits. *Journal of Neurology, Neurosurgery & Psychiatry, 49*, 11.

Wade, D. T., Hewer, R. L., & Wood, V. A. (1984). Stroke: influence of patient's sex and side of weakness on outcome. *Archives of Physical Medicine and Rehabilitation, 65*, 513-516.

Wallentin, M. (2009). Putative sex differences in verbal abilities and language cortex: a critical review. *Brain and Language, 108*, 175-183.

Wallentin, M., Michaelsen, J. L. D., Rynne, I., & Nielsen, R. H. (2014). Lateralized task shift effects in Broca's and Wernicke's regions and in visual word form area are selective for conceptual content and reflect trial history. *NeuroImage, 101*, 276-288.

Wasserman, J. K., Perry, J. J., Dowlatshahi, D., Stotts, G., Sivilotti, M. L. A., Worster, A., Emond, M., Sutherland, J., Stiell, I. G., & Sharma, M. (2015). Isolated transient aphasia at emergency presentation is associated with a high rate of cardioembolic embolism. *CJEM, 17*, 624-630.

Watila, M. M., & Balarabe, S. A. (2015). Factors predicting post-stroke aphasia recovery. *Journal of the neurological sciences, 352*, 12-18.

Ween, J. E., Mernoff, S. T., & Alexander, M. P. (2000). Recovery Rates after Stroke and Their Impact on Outcome Prediction. *Neurorehabilitation and Neural Repair, 14*, 229-235.

Worrall, L. E., Hudson, K., Khan, A., Ryan, B., & Simmons-Mackie, N. (2017). Determinants of Living Well With Aphasia in the First Year Poststroke: A Prospective Cohort Study. *Archives of Physical Medicine and Rehabilitation, 98*, 235-240.

Yuan, S.-M., & Humuruola, G. (2015). Stroke of a cardiac myxoma origin. *Brazilian Journal of Cardiovascular Surgery, 30*, 225-234.