

# Predictors for Work Participation in Individuals with an Autism Spectrum Disorder: A Systematic Review

Anja Holwerda · Jac J. L. van der Klink ·  
Johan W. Groothoff · Sandra Brouwer

Published online: 24 January 2012  
© The Author(s) 2012. This article is published with open access at Springerlink.com

**Abstract** *Introduction* Research shows that only about 25% of people with autism are employed. *Method* We conducted a systematic review on factors facilitating or hindering work participation of people with autism in longitudinal studies. An extensive search in biomedical and psychological databases yielded 204 articles and 18 satisfied all inclusion criteria. We assessed the methodological quality of included studies using an established criteria list. *Results* Seventeen factors were identified and categorized as disease-related factors, personal factors or external factors. Limited cognitive ability was the only significant predictor consistently found for work outcome. Functional independence and institutionalization were both reported by one study to be significantly related to work outcome. Inconsistent findings or non significant findings were reported for the other fourteen factors. *Conclusion* These findings emphasize the need for more high quality cohort studies focussing on work participation as the main outcome among people with Autism.

**Keywords** Autism · Work participation · Predictors

## Introduction

Work participation is considered as an increasingly important health outcome [1]. On the individual level it contributes to health and welfare [2]. On the societal level demographic pressure due to ageing and shrinking populations make a broad participation more and more imperative. At the same time participation in work by vulnerable groups is complicated by increasing demands in work. Young disabled people willing to enter the workforce experience barriers in acquiring and retaining work. Despite the relevance and although the impact of autism on social outcomes has been described in quite a few studies in the existing literature [3–7], the body of knowledge regarding factors facilitating or hindering work participation of people with autism is limited.

## Autism

Autism, a life-long lasting developmental disability, affects social functioning, behavior, learning and cognition [8, 9]. According to Kobayashi et al. [3] three in four individuals with autism also have intellectual disabilities. Autism spectrum disorders (ASD) seem to be more prevalent in boys than girls [10].

## Autism and Work Participation

Adults with autism have typically not been considered suitable candidates for employment in the work force [8, 11, 12]. Especially the social deficits typical for most

---

A. Holwerda · J. J. L. van der Klink · J. W. Groothoff ·  
S. Brouwer

Department of Health Sciences, Community and Occupational  
Medicine, University Medical Centre Groningen, University of  
Groningen, Building 3217, Room 621, P.O. Box 196, 9700 AD  
Groningen, The Netherlands

A. Holwerda (✉)  
Department of Health Sciences, Community and Occupational  
Medicine, University Medical Centre Groningen, University of  
Groningen, Building 3217, Room 621, Antonius Deusinglaan 1,  
9713 AV Groningen, The Netherlands  
e-mail: a.holwerda@med.umcg.nl

people with autism hinder their integration in the work force [4, 13]. Research shows that only about 25% of people with autism are employed. These are mostly the more high-functioning individuals. Unemployment rates for individuals with ASD as well as mental retardation are especially high [14]. They are mostly in sheltered employment, if employed at all [15].

Notwithstanding these limitations, there are several opportunities for work for these young disabled people, like regular work (including supported employment), sheltered employment, daytime activity or voluntary work [8]. People with autism can benefit from employment socially as well as personally [11]. Employment can provide a daytime structure that is helpful for this group as well as social contacts that are otherwise difficult for them to maintain [8, 11, 16]. Having a job also may facilitate their self-confidence, self-worth, independence and autonomy [11, 17].

### Factors Associated with Autism and Work Participation

The available reviews describing autism and social outcome suggest that the majority of individuals with autism is unable to lead an independent life, including employment [13, 18–20]. Most individuals suffer (severe) persisting impairments in communication and social life limiting their independence and social functioning considerable, especially as demands on social adaptation and functioning increase with age [7, 13, 19]. Howlin [6] suggests that, as far as high functioning individuals are concerned, employment levels may be more dependent on the area individuals live in and the available support services than on any other factors. Also access to supported employment programs for this group may increase chances to find and retain appropriate jobs [6, 21]. IQ, communicative speech at 5–6 years of age, the level of mental retardation, and other comorbidity are mentioned as important predictors for outcome in individuals with ASD [18–20, 22]. Of those with a comorbid intellectual disability (IQ scores <50) few are capable of employment. Outcome for individuals with an IQ between 50 and 70 is more variable, but not much better. Outcome for individuals with an IQ of 70 or more seemed to be more promising but also more difficult to predict [6, 18–20, 22]. Besides deficits in cognitive and social functioning, limited independent performance and high dependence on caregiver support are considered important contributors to restricted outcome for individuals with ASD [9, 13].

To our knowledge, the literature on factors associated with work participation in adulthood for people with ASD has not yet been reviewed systematically. In a recent review factors influencing the work participation of young disabled starters entering the labor market were identified [23]. They found that male gender, higher education, high

psychosocial level of functioning, low depression and high dispositional optimism were promoting factors in relation to employment. However, in their review no studies on autism were included.

The aim of this review is to systematically investigate the prognostic factors facilitating or hindering work participation of people with ASD.

### Methods

We started conducting a systematic review of the scientific literature on prognostic factors related to work participation of people with ASD. However, we found only one study focussing on factors in relation to work outcome as a primary outcome measure; in most studies work outcome measures were incorporated in an overall social outcome. Therefore, we decided to include also studies looking at overall social outcome, incorporating employment, which provided valuable information about work outcome as well. Studies on overall social outcome including employment, not reporting on work outcome specifically, were not included. The International Classification of Functioning was selected as an underlying framework because it takes the multidimensional nature of work participation into account and provides a broad view on predictors [1].

The first (AH) and second reviewer (SB) discussed search strategy, criteria for selecting studies, quality assessment and data extraction to reach consensus. In case of disagreement the third reviewer (JvdK) made the final decision.

### Literature Search

An extensive search in biomedical and psychological databases was performed (PubMed, PsycINFO, Embase, Cinahl, ERIC, SocINDEX) to find relevant articles, using MeSH terms, subheadings and free text words. Original studies (in English, Dutch, German and French) were identified that were published till June 2011. Only longitudinal studies were included to be able to distinguish predictors of work outcome. The search strategy consisted of an autism component and a work-related outcome measure.

In Table 1 the search terms are presented.

To select relevant studies for this review, the following eligibility criteria were defined: (1) Studies reported on factors related to work participation or social outcome in people with autism, only if information about work participation or employment status were included; (2) autism had to be diagnosed during childhood by an expert (e.g. following DSM-IV or ICD-10 criteria). The inclusion criteria are:

**Table 1** Search terms (\* = truncated)

Terms linked to	MeSH	Free text words
Diagnosis	Child development disorders, pervasive * Asperger syndrome autistic disorder	Autism autistic disorder pervasive developmental disorder Asperger syndrome
Population		Exclusion: child and not adult
Outcome measure	Work employment (exploded) rehabilitation, vocational (exploded) vocational guidance	Career employment/employed/ employee(s) occupation vocation job
Study design	Cohort studies longitudinal studies prospective studies follow-up studies	Cohort longitudinal prospective follow-up prognostic

- *Types of studies:* Cohort studies, follow-up studies or longitudinal studies with a minimum follow-up period of 1 year.
- *Types of participants:* Persons in the age bracket 18–64 years, with disability due to autism spectrum disorder, diagnosed before the age of 18.
- *Types of outcome measures:* Dependent variables: participation in work (regular, supported or sheltered) or social outcome with a work identifiable component.

Titles and abstracts were screened independently by two reviewers (AH, SB). Full papers were retrieved if the abstract provided insufficient data to enable selection. Moreover, other relevant articles were searched on the basis of the name of the first author of included articles and the reference lists. Reviews were excluded, but their reference lists were inspected for additional studies.

**Data Extraction**

Using a standardized form, the first reviewer (AH) extracted data on study design, source population, inclusion criteria, numbers of participants, length of follow-up, loss to follow-up, outcome, prognostic factors and statistical analysis. Meta-analysis of the study results was not possible due to the descriptive nature of the included studies, the different outcome measures used and the limited availability of data which could be used for pooling.

**Assessment of Methodological Quality of Included Studies**

Two reviewers (AH, SB) independently assessed the methodological quality of all included articles in the final selection. The quality assessment of the selected studies was based on an established criteria list for assessing validity of prognostic studies, as recommended by Altman [24] and used in previous reviews [25, 26]. The internal validity was the main aspect judged to inform the reader about the quality of the studies regarding the aim of our review.

The criteria list consists of 16 items, each having yes/no/don't know answer options. We operationalized the criteria

for this review and pilot tested this operationalization on four longitudinal studies excluded for this present review. The final criteria list is presented in Appendix [27].

The quality of all included articles was scored independently by two reviewers (AH, SB). If sufficient information was available, the item was rated one point. When information was not given or the information given was unclear, the item was rated zero point. For the total quality score we added all points for each study (maximum score 16 points).

Studies with a minimum score of 11 points ( $\geq 70\%$ ) were arbitrarily considered to be of high quality and those with a score lower than 11 points ( $< 70\%$ ) of low quality. This cut-off score is in line with a previous review [26]. We calculated initial interobserver agreement on methodological quality using kappa statistics for dichotomous values.

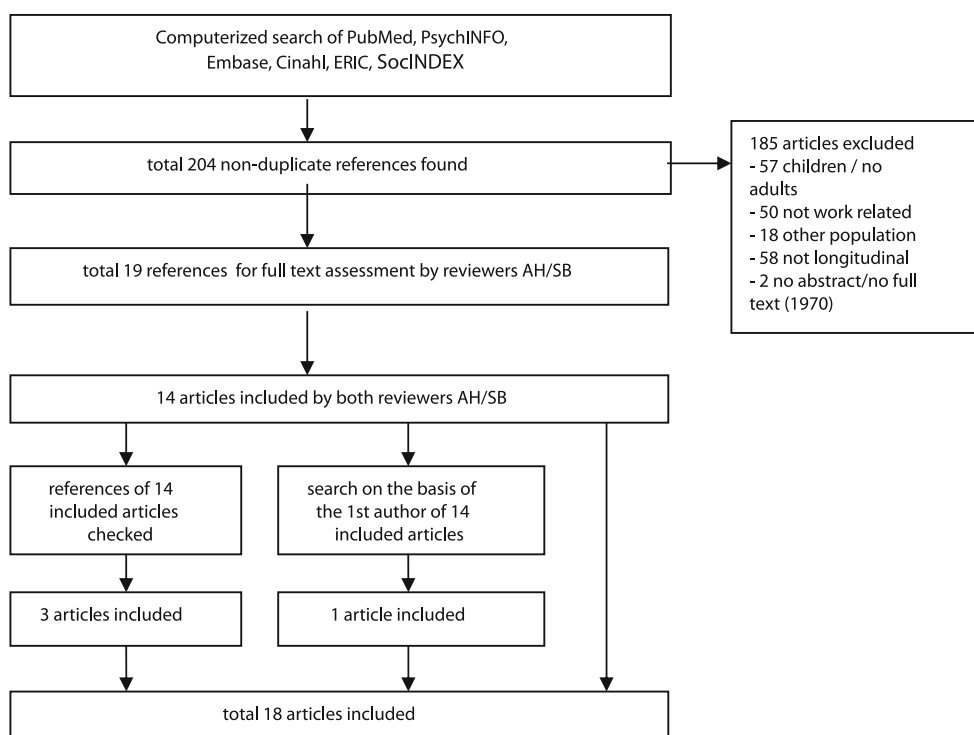
**Results**

**Selection of Studies**

The initial search yielded 204 articles (search date: June 6th, 2011). After selecting 19 references for full text reading, both reviewers agreed to include 14 articles for the present review. Two articles were excluded because they were intervention studies. Three articles did not report on specific employment outcomes. Searching the reference lists of those included articles, we found and included 3 additional articles. Based on the name of the first author of the 17 included articles, we found 1 other relevant article. Figure 1 shows a flow chart of study selection. In total we included 18 articles for the present review [3–5, 7, 28–41] (Table 2).

**Study Characteristics**

The characteristics of each study regarding country, design, measurements, population, numbers enrolled, time to follow-up and loss to follow-up are presented in Table 2. Time to follow-up varied considerably within as well as



**Fig. 1** Flow diagram of study selection

between studies, with the minimal time to follow-up being 3.2 and 35 years at most.

#### Quality Assessment and Methodological Considerations

The final overall agreement between the two reviewers on quality score was  $\kappa = 0.80$ , which is considered to be acceptable. Disagreement originated mainly from reading errors and misinterpretation of the criteria list and was readily resolved in a consensus meeting. The methodological quality of all included studies is summarized in Table 3. Four studies were considered of high methodological quality and fourteen of low quality. Statistical pooling of data in a meta-analysis was not possible because of the heterogeneity of study population and quality of the included studies.

#### Predictors for Work Participation

Seventeen different prognostic factors were identified. In Table 4 an overview of these factors related to work outcome is presented per included study. Table 5 gives an overview of these factors. The prognostic factors are categorized as disease/disorder related factors, personal factors or external factors based on the ICF-model [42, 43]. The only significant predictor for work outcome, consistently found in fifteen studies, is intelligence. Functional independence and

institutionalization were reported in two separate low quality studies to be significantly predicting work outcome. Inconsistent findings were reported for diagnosis, severity of disorder, gender, language abilities, and maladaptive behavior. Non significant findings were reported for comorbidity, social impairments, lack of drive, parental support, family income, mental illness parents, family situation, treatment/use of medication and schooling.

#### Disease Related Factors

##### *Diagnosis*

Six studies found that the more severe the disorder the lower the chance on a good outcome [5, 28, 36, 37, 39, 40]. With regard to work participation, one study reported that individuals who were competitively employed had significantly fewer autism symptoms than those who had a supported job or were participating in adult day activity programs [40].

##### *Comorbidity*

Comorbidity (psychiatric disorder, oppositional personality or epilepsy) was mentioned by five studies as negatively influencing work outcome [5, 30, 38–40]. No evidence was found that use of medication hinders a favorable work outcome [33].

**Table 2** Study characteristics

No	Study	Country	Population (diagnosis, gender and age)	Numbers enrolled	Design	Baseline at	Time to follow-up	% Lost to follow-up
1	Rutter et al. (1967) [28]	United Kingdom	Individuals diagnosed as children with child psychosis, schizophrenic syndrome, infantile autism or any synonyms of these Gender: 51 male/12 female Age: mean age 15.7 years (psychotic group)/16.5 years (control group)	63 (infantile psychosis) 63 (control)	Follow-up study 2 measurements Medical or case records, assessments, structured interviews	Childhood assessment before the onset of any signs of pubescence	5–15 years	None (psychotics) 3% controls
2	Lotter (1974) [29]	England	Individuals showing appreciable evidence of autism syndrome. Autistic group (32) with most marked criterion behavior and comparison group (22) with similar but less marked features. Gender: not reported Age: 16–18 years	54 (32 autistic/ 22 non-autistic)	Follow-up study 2 measurements Medical or case records, structured interviews	Childhood assessment at 8–10 years	8 years	7%
3	Rumsey et al. (1985) [30]	United States	Individuals with autism Gender: 14 males (100%) Age: 18–39 years	14	Follow-up study Medical or case records, assessments, structured interviews	Unclear	–	–
4	Wolf and Goldberg (1986) [31]	Canada	Autistic individuals diagnosed between 1960 and 1973 Gender: not reported Age: 31% <20 years 61% 20–30 years 7% >30 years	80	Follow-up study 2 measurements Medical or case records, questionnaires	Childhood assessment between 1960–1973 at 1–15 years of age	8–24 years	20%
5	Szatmari et al. (1989) [32]	Canada	High-functioning individuals diagnosed with autism, childhood schizophrenia or childhood psychosis before age 5 and an last IQ score of above 65 Gender: 12 male/4 female Age: 17–34 years	45	Follow-up study 2 measurements Medical or case records, assessments, structured interviews	Childhood assessment of children born in 1970 and diagnosed before age 5	Variable 11–27 years	64%
6	Fombonne et al. (1989) [33]	France	Individuals diagnosed with childhood psychosis Gender: 77 male/22 Female Age: 20–38 years (mean 27 years)	227 (Childhood psychosis n = 55)	Follow-up study 2 measurements Questionnaires	Diagnosed during childhood	Range 6–25 years	56%
7	Kobayashi et al. (1992) [3]	Japan	Autistic individuals diagnosed as children. Gender: 170 male/31 female Age: 18–33 years	201	Follow-up survey 2 measurements Medical or case records, questionnaires	Diagnosed during early childhood or school age	Range 5–28 years	13%

Table 2 continued

No	Study	Country	Population (diagnosis, gender and age)	Numbers enrolled	Design	Baseline at	Time to follow-up	% Lost to follow-up
8	Ruble and Dalrymple (1996) [34]	United States	Individuals diagnosed with autism meeting DSM-III-R criteria Gender: 33 male/13 female Age: mean age 8.5 years (range 2–19) (T1) mean age 17.1 years (range 7–26) (T2)	46	Follow-up study (retrospective) 2 measurements Medical or case records, structured interviews	Diagnosed in childhood (mean age at diagnosis 5.2 years)	Mean follow-up time 8.6 years	–
9	Ballaban-Gil et al. (1996) [4]	United States	Adolescents and young adults with autistic disorder Gender: not reported Age: 12 years or older (T2)	163	Follow-up study 2 measurements Medical or case records, structured interviews	Childhood evaluation from May 1966 to May 1988: mean age 5 years and 2 months	Range 3.2–22.7 years	39%
10	Larsen and Mouridsen (1997) [5]	Denmark	Individuals considered to be either psychotic or borderline cases and diagnosed with Pervasive Developmental Disorder (childhood autism or Asperger syndrome) Gender: 10 male/8 female Age: 32–44 years	18	Follow-up register study 2 measurements Medical or case records	Childhood assessment between 1949–1970	30 years	11%
11	Howlin et al. (2000) [35]	United Kingdom	Individuals (all male) with autism or with developmental language disorders Gender: 47 male (100%) Age: 23–24 years on average	47	Follow-up study (comparative) 2 measurements Assessments, structured interviews	Childhood assessment at 7–8 years	Around 15 years	17%
12	Howlin et al. (2004) [7]	England	Individuals diagnosed as having an autistic disorder. Gender: 61 males/7 females Age: 21–49 years	79 (68 participants)	Follow-up study 2 measurements Medical or case records, assessments, structured interviews	Childhood assessment prior to 16 years (range 3–15 years)	Variable (minimal 6 years)	14%
13	Cederlund et al. (2008) [36]	Sweden	Individuals with Asperger Syndrome and normal intelligence (IQ >70) and individuals diagnosed with autism or atypical autism before age 10 with different IQ levels Gender: 140 male (100%) Age: 16–38 years of age	140	Follow-up study (prospective) 2 measurements Medical or case records, assessments, structured interviews	AS group: Diagnosed between 1985–1999 at ages 5.5–24.4 years and born 1967–1988 Autism group: diagnosed before age 10	More than 5 years	30.0% in AS group 16.7% in autism group

**Table 2** continued

No	Study	Country	Population (diagnosis, gender and age)	Numbers enrolled	Design	Baseline at	Time to follow-up	% Lost to follow-up
14	Eaves and Ho (2008) [37]	Canada	Young adults born from 1974–1984 and diagnosed with ASD Gender: 37 males/11 females Age: mean age 6.8 (range 3–12) (T1) mean age 11.4 (range 8–17) (T2) mean age 24 (T3)	48	Follow-up study 3 measurements Assessments, structured interviews	Diagnosed as preschoolers	Unknown	37%
15	Farley et al. (2009) [38]	United States	Individuals diagnosed with AD and an IQ $\geq 70$ Gender: 38 males/3 females Age: mean age 7.2 (range 3.1–25.9) (T1) mean age 32.5 (range 22.3–46.4) (T2)	75	Follow-up study Assessments, structured interviews	Survey between 1984 and 1988 Childhood assessment except 1 participant	15–35 years	47%
16	Whitehouse et al. (2009) [39]	United Kingdom	Young adults with a childhood history of Specific Language Impairment or Pragmatic Language Impairment or with high functioning Autism Spectrum Disorder Gender: 35 male/14 female Age: 16–31 years	49	Follow-up study 2 measurements Assessments, structured interviews	Childhood assessment of children attending special speech and language schools	Not known	33%
17	Taylor and Seltzer (2010) [40]	United States	Youths with ASD who had exited the school system between 2004 and 2008 Gender: male 80% Age: 19–26 years	66	Follow-up study 5 measurements Structured interviews, questionnaires	Families of adolescents and adults with ASD of 10 years or older in 1998	10 years	Subsample of longitudinal study Not applicable
18	Billstedt et al. (2010) [41]	Sweden	Individuals with autistic disorder/infantile autism or autistic-like conditions/atypical autism diagnosed before 10 years of age Gender: 84 males/36 females Age: mean age 25.5 years (range 17–40 years)	120	Follow-up study (prospective population-based) 2 measurements Structured interviews	Childhood evaluation of children born in 1962–1984	Range 13–22 years	10%



## Personal Factors

### *Gender*

In two studies gender was mentioned as a predictor for outcome, in that females might be more likely to have a poor outcome than males [7, 31]. In a third study [33] female gender was not found to be a hindering factor for positive outcome.

### *Intelligence*

Higher IQ facilitates a positive work outcome [3–7, 28, 31–34, 36–38, 40, 41]; see also [22, 44]. One study reported that all individuals involved in competitive employment had an IQ above 70 [31] and another reported that individuals with a stable IQ above 70 were more often in some form of employment [7]. Individuals without intellectual disability were three times more likely to be competitively employed than individuals with an intellectual disability [40]. Higher IQ was significantly correlated to having a daily occupation [41]. According to Howlin [6, 7] individuals of higher IQ in general had a better outcome and problems were less pervasive (see also [4, 28, 30]). IQ <50 is often associated with poor outcome [28]. Fombonne et al. [33] found a significant worse outcome for the group with an IQ of 80 or below. In the study of Larsen and Mouridsen [5] normal intelligence predicted good outcome.

### *Language/Speech*

Language abilities and level of useful speech may influence outcome in that better linguistic abilities might support better outcome [3, 4, 6, 7, 28, 31, 38, 39]. However, speech may be highly correlated with IQ [7, 32]. Howlin compared an autism group with a developmental receptive language disorder group and found that early language abilities appeared to be closely related to later adult functioning in the autism group [6]. Kobayashi reported that the positive effect of early speech development only occurs in males and not in females [3]; Rutter found that the level of speech at 5 or 6 years of age was closely related to IQ and low IQ contributes significantly to poor outcome [28].

### *Maladaptive Behavior*

The presence of odd, challenging or ritualistic behavior, including self-injury, aggression and uncooperative behaviors, interferes with daily functioning [3, 4, 6, 7, 28, 30, 32, 34, 38–40]. Individuals in post-secondary education or competitively employed had significantly lower levels of maladaptive behaviors than individuals receiving day services [40]. Szatmari found a high correlation between

adaptive behavior and IQ [32]. According to some authors behavioral difficulties can be a critical limiting factor for functioning successfully in employment [4, 30].

### *Social Impairments*

The presence of social impairments, the lack of social skills and empathy are associated with poor outcome [4, 7, 29, 30, 32, 39]. It is suggested that social impairments are likely to affect the ability of individuals with autism to find and remain in meaningful employment [45].

### *Education*

The relationship between education and employment for individuals with autism seems to be ambiguous. The majority of people with autism have attended special education services and many left school without any formal qualifications [6, 7, 28, 30, 33, 36, 37, 39]. However, people with high functioning autism have more often completed post-secondary education than other individuals with ASD [36]. In Lotter's study [29] all individuals with good and fair outcome had had at least 7 years of education. In spite of the educational attainment of high-functioning individuals, few of them were competitively employed and if employed often in routine jobs [29, 30].

### *Lack of Drive*

Underactivity, lack of drive and lack of initiative often hinder people with ASD to find competitive employment [28]; see also [29, 30]. Lotter [29] mentioned three necessary requirements for being able to participate in regular employment: practical competence (e.g. literacy, practical skills), social competence (being able to relate to people in a meaningful way) and intentional competence (e.g. taking initiative, motivation).

## External Factors

### *Family*

Parents play a major role in the outcome of their children with ASD. Many individuals with ASD continue to live with their family well into adulthood. According to Wolf and Goldberg [31] 87 percent of the individuals residing at home were involved in schools, workshops or independent work, compared to 46 percent in institutions.

Seven articles mentioned parents searching for job opportunities and finding jobs for their children or providing a job in a family business rather than finding a job through the open job market [3, 6, 7, 28–30, 32]. Howlin et al. [7] commented that for individuals to be able to



**Table 3** Results of methodological assessment<sup>a</sup>

No	Study	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Score	Quality
1	Rutter et al. (1967) [28]	0	1	0	1	1	0	1	0	1	1	1	1	1	1	0	0	10	Low
2	Lotter (1974) [29]	1	1	0	1	1	0	1	0	0	0	0	1	1	1	0	0	8	Low
3	Rumsey et al. (1985) [30]	0	0	1	0	0	0	0	0	1	1	1	1	1	1	0	0	7	Low
4	Wolf and Goldberg (1986) [31]	0	1	0	1	0	0	1	0	1	1	1	1	1	1	0	0	9	Low
5	Szatmari et al. (1989) [32]	0	1	1	1	0	1	1	0	1	1	1	1	1	1	0	0	11	High
6	Fombonne et al. (1989) [33]	0	1	0	1	0	1	1	0	1	1	1	1	1	1	0	0	10	Low
7	Kobayashi et al. (1992) [3]	0	1	0	1	1	0	1	0	1	1	1	1	1	1	0	0	10	Low
8	Ruble and Dalrymple (1996) [34]	0	0	0	1	0	0	1	0	1	1	1	1	1	1	0	0	8	Low
9	Ballaban-Gil et al. (1996) [4]	0	0	1	1	0	1	1	0	1	1	1	1	1	1	0	0	10	Low
10	Larsen and Mouridsen (1997) [5]	0	1	0	1	1	1	1	0	1	1	1	1	1	1	0	0	11	High
11	Howlin et al. (2000) [35]	0	0	1	1	1	0	1	0	1	1	1	1	1	1	0	0	10	Low
12	Howlin et al. (2004) [7]	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	0	11	High
13	Cederlund et al. (2008) [36]	0	1	1	1	0	0	1	0	1	1	1	1	1	1	0	0	10	Low
14	Eaves and Ho (2008) [37]	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	0	10	Low
15	Farley et al. (2009) [38]	0	1	1	1	0	0	1	0	1	1	1	1	1	1	0	0	10	Low
16	Whitehouse et al. (2009) [39]	0	0	0	1	0	1	1	0	0	0	0	1	1	1	0	0	6	Low
17	Taylor and Seltzer (2010) [40]	0	1	1	1	0	0	1	0	1	1	1	1	1	1	0	0	10	Low
18	Billstedt et al. (2010) [41]	0	1	1	1	1	0	1	0	1	1	1	1	1	1	0	1	12	High
	Total	2	12	9	17	7	6	17	0	16	16	16	18	18	18	0	1		

<sup>a</sup> See Appendix for operationalization of items A–P

function adequately as adults the degree of support offered by families, social services and work environment may be as important as intellectual ability.

*Institutionalization*

Institutionalization (i.e. hospitalization) hinders a positive outcome of individuals with ASD. Especially the lower functioning individuals are living in residential care, like special institutions and hospitals where staff can attend to their specific needs. Also quite a few individuals with ASD were part of day time programs in a specialized setting [5–7, 28, 30, 31, 36]. These settings might not be the stimulating environment people need to be able to grow in their competences and work skills, although this applies to individuals with ASD as well as without [8, 16].

*Work Outcome*

The selected studies used different, but comparable, outcome measures regarding work participation and overall social outcome (incorporating education/employment, independent living and social relationships). Jobs were generally low level, unskilled and low pay jobs [4, 7, 30, 37]. Some individuals, however, managed to find a higher level job. Most individuals received special assistance in finding employment.

Few reasons are given for individuals previously employed but no longer participating in work. Rumsey [30] mentioned

one individual was fired because of inappropriate social behavior. Kobayashi [3] mentioned conflicts with fellow employees, financial crisis, motivation, hospitalization and other personal circumstances (death of a parent) as causes for quitting a job. Larsen and Mouridsen [5] mentioned loss of supportive parents, divorce and factories closing down as hindering factors for finding permanent employment.

**Conclusion and Discussion**

This study identified seventeen factors related to work outcome of people with ASD. Most of these factors are of importance for all individuals with or without autism. However, it may not be just one single factor, but the combination that leads to limited employment outcomes. Especially in individuals with ASD were a combination of these factors occurs frequently. Some of these factors may be interdependent, making interpretation of the results more complex. For example, some studies found high correlations between IQ and language abilities and IQ and adaptive behaviour in individuals with ASD. The disorder related characteristics (intensity of autistic symptoms, psychiatric comorbidity and epilepsy) and personal characteristics (limited language abilities, behavioral problems, social impairments) typical for ASD are factors which may, separately or combined, hinder individuals with ASD to participate in work in a sustainable way. Rates of

**Table 4** Work outcome and related factors

No	Study	Factors (independent variables)	Type of work outcome	Outcome	Type of work
1	Rutter et al. (1967) [28]	(1) Diagnosis of autism (D) (2) Severity of disorder (D) (3) Evidence of brain injury (D) (4) Intelligence (P) (5) Gender (P) (6) Useful speech at age 5 (P) (7) Response to sounds (P) (8) Underactivity/lack of drive/lack of initiative (P) (9) Schooling (E) (10) Family situation	Employment (psychootics) Paid jobs n = 2+1 Unpaid work n = 1 Family business n = 1 Day time activity n = 3	(8) Underactivity, lack of drive and lack of initiative was often the chief factor preventing employment.	Paid work n = 2 Unpaid typing and duplicating at home n = 1 Helping in father's shop n = 1 Various jobs n = 3 Job following attendance Industrial Rehabilitation Unit n = 1 Regular work n = 1
2	Lotter (1974) [29]	(1) Amount of Schooling (E) (2) Age excluded from school (E) (3) Age sent away from home (E)	Employment/placement history <i>Autistic group:</i> Employed n = 1 Special school n = 7 Training centre n = 5 At home n = 2 Long stay hospital n = 14	–	Employed n = 1
3	Rumsey et al. (1985) [30]	(1) Psychiatric disorders (D) (2) Stereotyped, repetitive and compulsive behavior (P) (3) Impairments in social behavior (speech and nonverbal communication) (P) (4) Parents (E)	Employment Competitive employment (routine jobs) n = 4 Sheltered employment n = 3 Job training n = 3 Education n = 1 Day program n = 1 Unemployed n = 2	(1) One patient's oppositional personality constituted an interfering factor for job success (2) One patient's compulsive habits, and rigidity constituted interfering factors for job success (3) One patient's obsessional questioning constituted an interfering factor for job success (3) One high functioning patient was fired because of his compulsive touching of other people and other inappropriate, intrusive social behavior (4) "Parent factors" were influential in determining employment outcome. Parents played a major role in finding employers willing to give their sons a chance.	Janitor n = 1 Cab driver n = 1 Library aid n = 1 Key punch operator n = 1
4	Wolf and Goldberg (1986) [31]	(1) Age of onset of symptoms (D) (2) Intelligence (P) (3) Gender (P) (4) Acquisition of speech for communication (P) (5) Living situation (home-institution) (E)	Employment Independent work n = 5 Sheltered Workshop n = 10 Education n = 23 Day program n = 21 No program n = 5	(2) The autistic adults involved in competitive employment all had an IQ above 70.	Competitive employment n = 4 Group employment outside institution n = 1

**Table 4** continued

No	Study	Factors (independent variables)	Type of work outcome	Outcome	Type of work
5	Szatmari et al. (1989) [32]	(1) Aspects of cognition (P) (2) Impairments in social behavior (P) (3) Deviant language (P) (4) Bizarre behaviors (P)	Occupation or placement Paid employment n = 6 Family business n = 1 Sheltered work n = 4 Education n = 3 Unemployed n = 2	-	Teacher-tutor n = 1 Librarian n = 1 Salesman n = 2 Library technician n = 1 Factory n = 1 Family business n = 1 Workshop n = 4 -
6	Fombonne et al. (1989) [33]	(1) Age of admission (P) (2) Length of stay (E) (3) Gender (P) (4) Intelligence at time of admission (P) (5) Treatment (E) (a.o. psychotherapeutic, speech therapy, remedial gymnastics) (6) Medication	Employment 55%	-	-
7	Kobayashi et al. (1992) [3]	(1) IQ at age 6 (P) (2) Level of speech development at age 6 (P)	Employment (21.8%) Paid jobs (mainly manual or industrial workers) n = 41 Family business n = 2 Education n = 11 Sheltered workshop n = 27 At home n = 18	-	Laundry n = 4 Bus conductor n = 1 Chikuwa maker n = 1 Paper maker n = 1 Food maker n = 9 Tatami maker n = 2 Civil servant/office worker n = 3 Auto mechanic n = 1 Helper n = 2 Industrial worker n = 9 Physical therapist n = 1 Printer n = 1 Trash collector n = 2 Tile roofer n = 1 Confectionary maker n = 1 Construction/Assistant plasterer n = 2 Dressmaker n = 1 -
8	Ruble and Dairymple (1996) [34]	(1) Cognitive level (IQ) (P) (2) Communication (P) (3) Challenging behavior (P)	Employment (adults) Supported employment n = 1 Sheltered employment n = 7 Daily living programs n = 3 No program n = 4 In institution n = 2	-	-

Table 4 continued

No	Study	Factors (independent variables)	Type of work outcome	Outcome	Type of work
9	Baillaban-Ciil et al. (1996) [4]	(1) Intelligence (P) (2) Language (P) (3) Behavior (P) (4) Social deficits/impairment (P)	Employment adults (n = 45) Open employment (menial jobs) n = 5 Sheltered workshops n = 6 Self employment n = 2 Education n = 7	–	Only 11% of adults were employed on the open market, all in menial jobs such as stock boy or mail clerk (n = 5) Sheltered workshops n = 6
10	Larsen and Mouridsen (1997) [5]	(1) Diagnosis of autism (D) (2) Intensity of autistic symptoms (D) (3) Intelligence (P) (4) Psychiatric morbidity (D) (5) Pharmacotherapy (E)	Employment <i>Asperger group</i> : Paid job n = 1 Sheltered employment n = 2 Disability pension n = 5 <i>Childhood autism group</i> : Paid job n = 2 Sheltered employment n = 1 Daytime program n = 5 Education and employment histories	(1) In middle adulthood the Childhood Autism group has a much poorer outcome regarding education and employment than the Asperger group.	Insulator n = 1 Porcelain painter n = 1 Kindergarten teacher n = 1 Received vocational training n = 4 Before working as a driver/fish industry n = 1 Fully-paid unskilled work before n = 4
11	Howlin et al. (2000) [35]	(1) Diagnosis of autism (2) Intelligence (P) (3) Psychiatric problems (D) (4) Early language abilities (P) (5) Autistic-like stereotyped and repetitive behavior patterns (P)	<i>Autism group</i> (n = 19): Independent jobs n = 1 Fulltime education n = 2 Voluntary work n = 3 Daytime centres n = 12 No occupation n = 1 Employment Independent jobs n = 8 Self employed n = 1 Sheltered employment n = 11 Daily activities by centre n = 15 Family based work activities n = 2 Voluntary work n = 1 No work activities n = 28 Not known n = 2	–	Laboratory technician n = 1
12	Howlin et al. (2004) [7]	(1) Childhood IQ (P) (2) Gender (P) (3) Speech at 5 years (P) (4) Autistic-type behaviors (P) (5) Social functioning (P)	Employment Independent jobs n = 8 Self employed n = 1 Sheltered employment n = 11 Daily activities by centre n = 15 Family based work activities n = 2 Voluntary work n = 1 No work activities n = 28 Not known n = 2	(1) Individuals with a stable IQ from childhood to adulthood above 70 were more often in some form of employment (paid, voluntary or sheltered) (P = .005)	Scientific officer oil company n = 1 Electrical work n = 1 Cartographer n = 1 Postal assistant n = 1 Factory work n = 5 Computing n = 1 Accounts n = 1 Fabric design n = 1 Washing up n = 1 Grave digger n = 1 Office/accounts assistant n = 1 Charcoal burning/gardening n = 1 Administrative assistant n = 1 Data input n = 1 Supermarket trolleys n = 1 Electronic work n = 1 Special shop n = 1 Decorating with father n = 1 Office with parents n = 1

**Table 4** continued

No	Study	Factors (independent variables)	Type of work outcome	Outcome	Type of work
13	Cederlund et al. (2008) [36]	(1) Diagnosis of autism (D) (2) Intelligence (P) (3) Psychotic disorder (D)	Employment <i>Asperger group:</i> ordinary jobs n = 7 “daily occupational activities” in a group centre n = 6 no organized daily activity n = 12 <i>Autism group:</i> ordinary job n = 1 “daily occupational activities” in a group centre n = 4 regular, individually tailored daily activities n = 33 no organized daily activity n = 13	–	Ordinary jobs n = 8 Daily occupational activities n = 10
14	Eaves and Ho (2008) [37]	(1) Diagnosis (autism score) in adolescence (D) (2) Childhood and adolescence intensity of autistic symptoms (CARS) (D) (3) Childhood and adolescence verbal and Performance IQ (P)	Employment 56% (n = 27) had ever been employed, most in volunteer, sheltered or part time work Independent job n = 2 Daytime activity n = 19 (40%)	–	Delivering papers Meals on wheels Sorting recycle
15	Farley et al. (2009) [38]	(1) Psychiatric disorders (D) (2) Epilepsy (D) (3) Other medical disorders (D) (4) Historical full scale IQ (P) (5) Level of speech development at age 6 (P) (6) Adaptive behavior (P)	Employment Independent paid jobs n = 22 Supported employment n = 3 Voluntary work n = 2 Day programs n = 10 Unemployed n = 4	(1) In spite of high IQ scores and adequate practical skills, some participants were unable to seek employment due to difficulties with anxiety.	–
16	Whitehouse et al. (2009) [39]	(1) Diagnosis of autism (D) (2) Intensity of autistic symptoms (D) (3) Psychiatric problems (D) (3) Language ability (pragmatic or structural problems) (P) (4) Stereotyped and repetitive behaviors (5) Social impairments	Employment <i>Autism group (n = 11):</i> Education n = 5 Paid employment n = 5 Never employed n = 1	(1) Stable employment proved to be an area of difficulty for the ASD group.	Factory workers n = 2 Cleaners n = 3
17	Taylor and Seltzer (2010) [40]	(1) Autistic symptoms (D) (2) Intellectual disability (P) (3) Comorbid psychiatric diagnoses (D) (4) Maladaptive behaviors (P) (5) Functional independence (P) (6) Family income (E)	Employment College/university n = 9 Competitive employment n = 4 Supported employment n = 8 Adult day services n = 37 No regular activities n = 8	(1) Young adults who were competitively employed had fewer autism symptoms than those who had a supported job or were receiving adult day services ( $P < .01$ ) (2) There was a significant relation between employment/day activity categories and ID status ( $P < .001$ )/Adults without ID were three times more likely to be competitively employed than those with ID, although percentages in supported employment were similar (4) Adults who were receiving adult day services had significantly more maladaptive behaviors than individuals who were in a post-secondary education program or competitively employed ( $P < .05$ )	Competitive: Bus boy Replacing dirty glasses with clean ones Salvation Army Bead business (self employed) Supported: Rolling silverware into napkins in restaurant Folding towels in hotel Shredding confidential information Washing dishes at a nursing Working in a grocery store

Table 4 continued

No	Study	Factors (independent variables)	Type of work outcome	Outcome	Type of work
18	Billstedt et al. (2010) [41]	(1) Intelligence (P)	Employment Regular job: n = 1 Supported employment: n = 7 Education: n = 29 Day activity centres: n = 52 No daytime occupation: n = 19	(1) Correlations were found between IQ and occupational level (higher IQ correlating to having a daily occupation, $P < .05$ )	Factory n = 1

*D* Disease/disorder related factor, *P* Personal factor, *E* External factor

employment among individuals with ASD are generally low. Often the impairments and social deficits of these individuals are emphasized leading to low expectations regarding outcome. However, these individuals may have strengths (e.g. ability to concentrate; strong focus) that can be utilized if the right tasks and settings are provided [22].

In some of the studies Asperger syndrome and Childhood Autism were separately analyzed. There is a continuing discussion whether it is possible and necessary to distinguish between childhood autism and Asperger syndrome [22, 46, 47]. A pronounced autistic disorder often leads to substantial limitations in participation in work; people with Asperger Syndrome often achieved higher education and have more abilities to work compared to childhood autism. However, this advantage in education does not always lead to higher levels of employment in later life [46].

IQ is the only childhood predictor of work outcome for which we found consistent evidence in the literature in that a higher IQ facilitates a positive work outcome. Although an IQ below 50 does almost always lead to a poor outcome [7] and this applies to individuals without ASD as well [48, 49], individuals with an IQ of 70 or higher do not necessarily have a good outcome. Outcome in individuals without intellectual disability is much more variable and less predictable. Therefore, it seems that the clinical value of IQ in predicting individual outcomes is limited.

Although education is often mentioned as an important factor for outcome, job level is rarely consistent with educational background. Also the increase in educational services for children with ASD has not necessarily led to improved outcome when they have grown up [7]. As access to education can be closely associated with the IQ of the individual, this relationship must be regarded with caution [18]. Nevertheless there is some evidence that the amount of schooling received, positively influences social adjustment in later life [18, 49].

Besides disorder-related and personal factors, several external factors are related to work outcome. Considering the low levels of independence of individuals with ASD, the degree of support offered by families, the available support services and the willingness of employers to incorporate this group in their work force may be as decisive for individuals to be able to function adequately in employment as the personal factors mentioned above [7, 50]. Especially parents play an important role in supporting their children as they continue to live with them well into adulthood, in searching for job opportunities and in being advocates for their child's well-being [6, 7].

Competitive paid employment is often regarded as successful participation. Because of increasing demands in work, employers are hesitant to hire individuals with disabilities. If working, many individuals with ASD work in unskilled, routine, industrial jobs with limited decision



**Table 5** Overview of factors associated with outcome

Prognostic factors (independent variables)	Study	Significance	Quality of study
<i>Disease/disorder related</i>			
(Autism) diagnosis			
(Autism) diagnosis	Rutter et al. (1967) [28]	n.s.	Low
	Larsen and Mouridsen (1997) [5]	–	High
	Howlin et al. (2000) [35]	–	Low
	Cederlund et al. (2008) [36]	Sig	Low
	Whitehouse et al. (2009) [39]	–	Low
Autism score in adolescence	Eaves and Ho (2008) [37]	Sig	Low
Age of onset of symptoms	Wolf and Goldberg (1986) [31]	n.s.	Low
Evidence of brain injury	Rutter et al. (1967) [28]	n.s.	Low
Severity of disorder			
Severity of disorder	Rutter et al. (1967) [28]	Sig	Low
Intensity of autistic symptoms	Wolf and Goldberg (1986) [31]	n.s.	Low
	Larsen and Mouridsen (1997) [5]	–	High
	Eaves and Ho (2008) [37]	Sig	Low
	Whitehouse et al. (2009) [39]	–	Low
	Taylor and Seltzer (2010) [40]	Sig	Low
Comorbidity			
Psychiatric disorders			
	Rumsey et al. (1985) [30]	–	Low
	Larsen and Mouridsen (1997) [5]	–	High
	Howlin et al. (2000) [35]	–	Low
	Cederlund et al. (2008) [36]	Descriptive	Low
	Farley et al. (2009) [38]	–	Low
	Whitehouse et al. (2009) [39]	Descriptive	Low
	Taylor and Seltzer (2010) [40]	n.s.	Low
Epilepsy	Rutter et al. (1967) [28]	n.s.	Low
	Farley et al. (2009) [38]	–	Low
Other medical disorders	Farley et al. (2009) [38]	–	Low
<i>Personal factors</i>			
Intelligence (IQ-level)			
Intelligence (IQ-level)	Wolf and Goldberg (1986) [31]	–	Low
	Ruble and Dalrymple (1996) [34]	Sig	Low
	Ballaban-Gil et al. (1996) [4]	Descriptive	Low
	Larsen and Mouridsen (1997) [5]	Predictor	High
	Billstedt et al. (2010) [41]	Sig	High
Full scale IQ	Szatmari et al. (1989) [32]	–	High
	Cederlund et al. (2008) [36]	–	Low
IQ at diagnosis	Rutter et al. (1967) [28]	Sig	Low
Intelligence at time of admission	Fombonne et al. (1989) [33]	Sig	Low
IQ at age 6	Kobayashi et al. (1992) [3]	Sig	Low
Performance IQ at time 1	Howlin et al. (2000) [35]	–	Low
Childhood IQ	Howlin et al. (2004) [7]	Sig	High
Childhood and adolescence verbal and performance IQ	Eaves and Ho (2008) [37]	Sig	Low
Historical full scale IQ	Farley et al. (2009) [38]	Sig	Low
Intellectual disability	Taylor and Seltzer (2010) [40]	Sig	Low
Gender			
	Rutter et al. (1967) [28]	n.s.	Low
	Wolf and Goldberg (1986) [31]	–	Low
	Howlin et al. (2004) [7]	Sig	High

**Table 5** continued

Prognostic factors (independent variables)	Study	Significance	Quality of study
<b>Language/speech</b>			
Communication	Ruble and Dalrymple (1996) [34]	Descriptive	Low
Language	Ballaban-Gil et al. (1996) [4]	Descriptive	Low
Speech and language	Rumsey et al. (1985) [30]	–	Low
	Wolf and Goldberg (1986) [31]	–	Low
Language ability (pragmatic or structural problems)	Whitehouse et al. (2009) [39]	–	Low
Acquisition of speech for communication	Wolf and Goldberg (1986) [31]	–	Low
Early language abilities	Howlin et al. (2000) [35]	Descriptive	Low
Level of speech development at age 6	Kobayashi et al. (1992) [3]	Sig (males)	Low
	Farley et al. (2009) [38]	–	Low
(Useful) speech at age 5	Rutter et al. (1967) [28]	Sig	Low
	Howlin et al. (2004) [7]	Sig	High
Deviant language	Szatmari et al. (1989) [32]	n.s.	High
Response to sounds	Rutter et al. (1967) [28]	–	Low
<b>Maladaptive behavior</b>			
Ritualistic and compulsive behavior	Rutter et al. (1967) [28]	Descriptive	Low
Stereotyped, repetitive and compulsive behavior	Rumsey et al. (1985) [30]	–	Low
Bizarre behaviors	Szatmari et al. (1989) [32]	n.s.	High
Challenging behaviors	Ruble and Dalrymple (1996) [34]	Descriptive	Low
Behavioral difficulties	Ballaban-Gil et al. (1996) [4]	Descriptive	Low
Autistic-like stereotyped and repetitive behavior patterns	Howlin et al. (2000) [35]	–	Low
	Whitehouse et al. (2009) [39]	–	Low
Autistic-type behaviors	Howlin et al. (2004) [7]	–	High
Maladaptive behaviors	Taylor and Seltzer (2010) [40]	Sig	Low
Adaptive behavior	Farley et al. (2009) [38]	–	Low
<b>Social deficits/impairment</b>			
Social deficits/impairment	Rumsey et al. (1985) [30]	–	Low
	Ballaban-Gil et al. (1996) [4]	Descriptive	Low
	Whitehouse et al. (2009) [39]	–	Low
Impairments in social behavior (speech and nonverbal communication)	Rumsey et al. (1985) [30]	–	Low
	Szatmari et al. (1989) [32]	n.s.	High
Social functioning	Howlin et al. (2004) [7]	–	High
Underactivity/lack of drive/lack of initiative	Rutter et al. (1967) [28]	–	Low
Functional independence (ADL)	Taylor and Seltzer (2010) [40]	Sig	Low
<b>External factors</b>			
Parents	Rumsey et al. (1985) [30]	–	Low
Family income	Taylor and Seltzer (2010) [40]	n.s.	Low
History mental illness parent	Rutter et al. (1967) [28]	n.s.	Low
Family situation (not living at home)	Rutter et al. (1967) [28]	n.s.	Low
Age sent away from home	Lotter (1974) [29]	–	Low
Institutionalization	Wolf and Goldberg (1986) [31]	Descriptive	Low
Treatment	Rutter et al. (1967) [28]	n.s.	Low
Use of medication/pharmacotherapy	Fombonne et al. (1989) [33]	n.s.	Low
	Larsen and Mouridsen (1997) [5]	–	High
Schooling	Rutter et al. (1967) [28]	–	Low
Amount of schooling	Lotter (1974) [29]	–	Low
Age excluded from school	Lotter (1974) [29]	n.s.	Low

*n.s.* Not significant, *Sig* significant

latitude and minimal social interaction [13, 30, 35]. As our economy becomes more knowledge-based, and globalization transforms and eliminates unskilled jobs, those with limited cognitive function may become increasingly marginalized [51]. Also periods of employment are alternated by periods of unemployment or temporary jobs [7]. Data of the Dutch Social Security Institute suggest that about 11% ( $n = 1,618$  per year) of the young disabled applying for a social security benefit has ASD [52].

If employed, the majority is working part-time, sometimes less than 10 h a week [37]. Fulltime work is not always feasible for this group. For successful sustainable work participation a fit between the individual, the job and the work environment is essential [51]. This person-environment fit—or Person-Job fit when focussed on work [53]—concerns the balance between knowledge, skills, abilities, attitude and motivation of the person at the one hand and work and its context at the other hand. A situation of balance contributes to the health, well-being and work-functioning of the employee. A disbalance leads to stress and disfunctioning. We can distinguish two kinds of PE-fit: the demands-abilities fit and the needs-supply fit [54]. In people with autism both their abilities and their needs can be influenced by the disorder. From a theoretical point of view tailor-made adjustment in demands and supplies (support) may be necessary to ensure a good fit. The practice of part time work might be a reflexion of this.

Considering the severe consequences of autism and the consequential need for special attention for a tailor-made fit between individual and work characteristics, it is important that effective assessments and interventions with respect to work participation of the ASD population are available. Over the last years, special vocational re-integration services and supported employment services have been set up for individuals with ASD, because existing services are not always accessible to them as services sometimes require a basic set of skills of applicants, like interpersonal communication skills, to increase employability [11, 55]. Part of the supported employment strategy is to adapt the environment and workplace to the needs of disabled individuals who have the skills to do a certain job [56]. According to Garcia-Villamizar [8, 16] supported employment produces favorable results for people with ASD as compared to sheltered employment services with regard to severity of impairments and quality of life. Ridley and Hunter [11] reviewed the practice of supported employment in Scotland and found that the principles of supported employment are not widely and consistently applied, while adherence to these principles is related to improved employment outcomes [57]. Moreover, people with ASD have limited access to these services and unpaid and part-time jobs were more frequently achieved than paid jobs. Leadership by local authorities is needed to improve implementation of supported employment and

accessibility. This supports Howlin's [6] claim that the area where an individual lives and the available services is a major influence in outcome with regard to employment.

Autism spectrum disorders are studied extensively since the 70's and more attention is given to social functioning. Unfortunately, only one study focussed on employment as primary outcome. Most of the studies we reviewed were descriptive in nature and thus the quality of the data is variable and often limited. Few studies were able to report significant findings. Moreover, numbers of participants in the studies were often limited. Also quite a few studies in our review consisted of clinical samples, that by the nature of their population have limited generalizing capacity, because of problems with representativeness of these samples. Due to the diverse reporting of outcome it is not possible to compare the studies or to statistically pool the data. For that same reason we did not use the quality assessment for determining levels of evidence for the factors, but to inform the reader about the quality of the studies included. If the results of high quality studies differ from the results of low quality studies, this can be an indication of bias. In our review we found conflicting results for maladaptive behavior between one high and one low quality study [32, 40].

Two early studies [28, 29] were conducted in a very different climate with regard to the employment of individuals with disability. Their results seem to indicate that work outcomes did not improve in recent years.

## Recommendations

This review gives an overview of factors facilitating or hindering work participation of people with autism. Factors, identified in high quality studies, can help to provide an evidence-based ground for the development of instruments and intervention programs to increase work participation of individuals with ASD. The availability of adequate services for these individuals during their education, their transition from school to work and to independent living might influence employment outcome considerably [6, 12, 28]. The findings of this review emphasize the need for adequate intervention and services, geared to the needs of the individual with ASD, that help them to adjust to the psychosocial demands in society [39].

However, this review also painfully points to an important gap in the literature regarding predictors of work outcomes in individuals with ASD. High quality studies on predictors of work participation in individuals with ASD are lacking. Most of the included studies reported on outcome as an overall social outcome measure, including work; not on work as a primary outcome measure. In our study we assumed the seventeen factors we found are useful in predicting work outcome. However, further research should focus on work participation as the primary outcome measure in determining

whether the factors mentioned are indeed influencing work outcome in individuals with ASD. High quality longitudinal studies are needed to identify variables that are responsive to interventions and that take the person-environment fit into account. Only then there is enough base for developing and implementing evidence based strategies to enhance optimal work participation for this group, that could benefit considerably from it in terms of quality of life.

**Open Access** This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

## Appendix

See Table 6.

**Table 6** Operationalization of criteria list for quality assessment

Study population	A Inception cohort
	One point if participants are identified at an early uniform point in the course of their disability Zero point if it is not clear if an inception cohort was used.
	B Description of source population
	One point if the source population is described in terms of place of recruitment (for example: Groningen, the Netherlands), time-period of recruitment and sampling frame of source population (for example: health service provider, special education services). Zero point if $\leq 2$ features of source population are given.
Follow-up	C Description of relevant inclusion and exclusion criteria
	One point if $> 2$ criteria are formulated. Zero point if $\leq 2$ criteria are formulated.
	D Follow-up at least 12 months
Treatment	One point if the follow-up period is at least 12 month and data are provided for this moment in time.
	E Drop-outs/loss to follow-up $< 20\%$
	One point if total number of drop-outs/loss to follow up $< 20\%$
	F Information completers versus loss to follow-up/drop-outs
Prognostic factors	One point if sociodemographic information is presented for completers and those lost to follow-up/drop outs at baseline, or no loss to follow-up/drop outs. Reasons for loss to follow-up/drop outs have to be unrelated to the outcome. Loss to follow-up/drop outs: all participants of the assembled cohort minus the number of participants at the main moment of measurement for the main outcome measure, divided by the total number of participants of the assembled cohort.
	G Prospective data collection
	One point if a prospective design is used, or a historical cohort when the prognostic factors are measured before the outcome is determined. Zero point if a historical cohort is used, considering prognostic factors at time zero which are not related to the primary research question for which the cohort is created, or in case of an ambispective design.
Prognostic factors	H Treatment in cohort is fully described/standardized
	One point if treatment subsequent to inclusion into cohort, is fully described and standardized, or in case of no treatment is given, or if multi-variate correction for treatment is performed in analysis. Zero point if different treatment is given and if it is not clear how outcome is influenced by it, or if it is not clear whether any treatment is given.
Prognostic factors	I Relevant potential prognostic factors
	One point if besides socio-demographic factors (age, gender) at least one other factor of the following is described at baseline: <i>health related factors</i> <i>personal factors</i> <i>external factors</i>
	J Standardized or valid measurements
Prognostic factors	One point if at least one of the factors of I, excluding age and gender, are reported in a standardized or valid way (for example: questionnaire, structured interview, register, patient-status of health service).
	K Data presentation of most important prognostic factors
Prognostic factors	One point if frequencies, or percentages, or mean (and standard deviation/confidence interval), or median (and Inter Quartile Range) are reported for the three most important factors of I, namely age, gender and at least one other factor, for the most important follow-up measurements.

**Table 6** continued

Outcome	L Relevant outcome measures One point if at least one of the following outcome criteria is reported: social functioning, independent living, employment, daily life activities.
	M Standardized or valid measurements One point if one or more of the main outcome measures of L are reported in a standardized or valid way (for example: questionnaire, structured interview, registration, patient-status of occupational/insurance physician).
	N Data presentation of most important outcome measures One point if frequencies, or percentages, or mean (and standard deviation/confidence interval), or median (and Inter Quartile Range) are reported for one or more of the main outcome for the most important follow-up measurements.
Analysis	O Appropriate univariate crude estimates One point if univariate crude estimates (RR, OR, HRR) between prognostic factors separately and outcome are presented. Zero point if only <i>P</i> values or wrong association values (Spearman, Pearson, sensitivity) are given, or if no tests are performed at all.
	P Appropriate multivariate analysis techniques One point if logistic regression analysis is used, or survival analysis for dichotomous outcomes, or linear regression analysis for continuous outcomes. Zero point if no multivariate techniques are performed at all.

## References

- WHO. International classification of functioning, disability and health (ICF). 2001; resolution WHA 54.21.
- Waddell G, Burton K, Aylward M. Work and common health problems. *J Insur Med*. 2007;39:109–20.
- Kobayashi R, Murata T, Yoshinaga K. A follow-up study of 201 children with autism in Kyushu and Yamaguchi areas, Japan. *J Autism Dev Disord*. 1992;22:395–411.
- Ballaban-Gil K, Rapin I, Tuchman R, Shinnar S. Longitudinal examination of the behavioral, language, and social changes in a population of adolescents and young adults with autistic disorder. *Pediatr Neurol*. 1996;15:217–23.
- Larsen FW, Mouridsen SE. The outcome in children with childhood autism and Asperger syndrome originally diagnosed as psychotic: a 30-year follow-up study of subjects hospitalized as children. *Eur Child Adolesc Psychiatry*. 1997;6:181–90.
- Howlin P. Outcome in adult life for more able individuals with autism or Asperger syndrome. *Autism*. 2000;4:63–83.
- Howlin P, Goode S, Hutton J, Rutter M. Adult outcome for children with autism. *J Child Psychol Psychiatry*. 2004;45:212–29.
- Garcia-Villamizar D, Ross D, Wehman P. Clinical differential analysis of persons with autism in a work setting: a follow-up study. *J Vocat Rehabil*. 2000;14:183–5.
- Hume K, Loftin R, Lantz J. Increasing independence in autism spectrum disorders: a review of three focused interventions. *J Autism Dev Disord*. 2009;39:1329–38.
- Kogan MD, Blumberg SJ, Schieve LA, Boyle CA, Perrin JM, Ghandour RM, et al. Prevalence of parent-reported diagnosis of autism spectrum disorder among children in the US, 2007. *Pediatrics*. 2009;124:1395–403.
- Ridley J, Hunter S. The development of supported employment in Scotland. *J Vocat Rehabil*. 2006;25:57–68.
- Gerhardt PF, Lainer I. Addressing the needs of adolescents and adults with autism: a crisis on the horizon. *J Contemp Psychother*. 2011;41:37–45.
- Jennes-Coussens M, Magill-Evans J, Koning C. The quality of life of young men with Asperger syndrome: a brief report. *Autism*. 2006;10:403–14.
- Magill-Evans J, Galambos N, Darrah J, Nickerson C. Predictors of employment for young adults with developmental motor disabilities. *Work*. 2008;31:433–42.
- Parmenter TR, Knox M. The post-school experiences of young people with a disability. *Int J Rehabil Res*. 1991;14:281–91.
- Garcia-Villamizar D, Wehman P, Navarro MD. Changes in the quality of autistic people's life that work in supported and sheltered employment. A 5-year follow-up study. *J Vocat Rehabil*. 2002;17:309–12.
- Eggleton I, Robertson S, Ryan J, Kober R. The impact of employment on the quality of life of people with an intellectual disability. *J Vocat Rehabil*. 1999;13:95–107.
- Rutter M. Autistic children: infancy to adulthood. *Semin Psychiatry*. 1970;2:435–50.
- Gillberg C. Outcome in autism and autistic-like conditions. *J Am Acad Child Adolesc Psychiatry*. 1991;30:375–82.
- Nordin V, Gillberg C. The long-term course of autistic disorders: update on follow-up studies. *Acta Psychiatr Scand*. 1998;97:99–108.
- Mawhood L, Howlin P. The outcome of a supported employment scheme for high-functioning adults with autism or Asperger syndrome. *Autism*. 1999;3:229–54.
- Gillberg C. Asperger syndrome and high-functioning autism. *Br J Psychiatry*. 1998;172:200–9.
- Achterberg TJ, Wind H, de Boer AG, Frings-Dresen MH. Factors that promote or hinder young disabled people in work participation: a systematic review. *J Occup Rehabil*. 2009;19:129–41.
- Altman DG. Systematic reviews of evaluations of prognostic variables. *BMJ*. 2001;323:224–8.
- Scholten-Peeters GG, Verhagen AP, Bekkering GE, van der Windt DA, Barnsley L, Oostendorp RA, et al. Prognostic factors of whiplash-associated disorders: a systematic review of prospective cohort studies. *Pain*. 2003;104:303–22.
- Cornelius LR, van der Klink JJ, Groothoff JW, Brouwer S. Prognostic factors of long term disability due to mental disorders: a systematic review. *J Occup Rehabil*. 2011;21:259–74.
- Nonkin Avchen R, Wiggins LD, Devine O, Van Naarden Braun K, Rice C, Hobson NC, et al. Evaluation of a records-review surveillance system used to determine the prevalence of autism spectrum disorders. *J Autism Dev Disord*. 2011;41:227–36.

28. Rutter M, Greenfield D, Lockyer L. A five to fifteen year follow-up study of infantile psychosis. II. Social and behavioural outcome. *Br J Psychiatry*. 1967;113:1183–99.
29. Lotter V. Social adjustment and placement of autistic children in Middlesex: a follow-up study. *J Autism Child Schiz*. 1974;4:11–32.
30. Rumsey JM, Rapoport JL, Sceery WR. Autistic children as adults: psychiatric, social, and behavioral outcomes. *J Am Acad Child Psychiatry*. 1985;24:465–73.
31. Wolf L, Goldberg B. Autistic children grow up: an eight to twenty-four year follow-up study. *Can J Psychiat*. 1986;31:550–6.
32. Szatmari P, Bartolucci G, Bremner R, Bond S. A follow-up study of high-functioning autistic children. *J Autism Dev Disord*. 1989;19:213–25.
33. Fombonne E, Talan I, Bouchard F, Lucas G. A follow-up study of childhood psychosis. *Acta Paedopsychiatr*. 1989;52:12–25.
34. Ruble LA, Dalrymple NJ. An alternative view of outcome in autism. *Focus Autism Other Dev Disabil*. 1996;11:3–14.
35. Howlin P, Mawhood L, Rutter M. Autism and developmental receptive language disorder—a follow-up comparison in early adult life. II: social, behavioural, and psychiatric outcomes. *J Child Psychol Psychiatry*. 2000;41:561–78.
36. Cederlund M, Hagberg B, Billstedt E, Gillberg C, Gillberg IC. Asperger syndrome and autism: a comparative longitudinal follow-up study more than 5 years after original diagnosis. *J Autism Dev Disord*. 2008;38:72–85.
37. Eaves LC, Ho HH. Young adult outcome of autism spectrum disorders. *J Autism Dev Disord*. 2008;38:739–47.
38. Farley MA, McMahon WM, Fombonne E, Jenson WR, Miller J, Gardner M, et al. Twenty-year outcome for individuals with autism and average or near-average cognitive abilities. *Autism Res*. 2009;2:109–18.
39. Whitehouse AJO, Watt HJ, Line EA, Bishop DVM. Adult psychosocial outcomes of children with specific language impairment, pragmatic language impairment and autism. *Int J Lang Commun Disord*. 2009;44:511–28.
40. Taylor JL, Seltzer MM. Employment and post-secondary educational activities for young adults with autism spectrum disorders during the transition to adulthood. *J Autism Dev Disord*. 2011;41:566–74.
41. Billstedt E, Gillberg IC, Gillberg C. Aspects of quality of life in adults diagnosed with autism in childhood: a population-based study. *Autism*. 2011;15:7–20.
42. Lagerveld SE, Bultmann U, Franche RL, van Dijk FJ, Vlasveld MC, van der Feltz-Cornelis CM, et al. Factors associated with work participation and work functioning in depressed workers: a systematic review. *J Occup Rehabil*. 2010;20:275–92.
43. Ustun TB, Chatterji S, Bickenbach J, Kostanjsek N, Schneider M. The international classification of functioning, disability and health: a new tool for understanding disability and health. *Disabil Rehabil*. 2003;25:565–71.
44. Gillberg C, Steffenburg S, Schaumann H. Is autism more common now than ten years ago? *Br J Psychiatry*. 1991;158:403–9.
45. Beadle-Brown J, Murphy G, Wing L. Long-term outcome for people with severe intellectual disabilities: impact of social impairment. *Am J Ment Retard*. 2005;110:1–12.
46. Howlin P. Outcome in high-functioning adults with autism with and without early language delays: implications for the differentiation between autism and Asperger syndrome. *J Autism Dev Disord*. 2003;33:3–13.
47. Volkmar FR, State M, Klin A. Autism and autism spectrum disorders: diagnostic issues for the coming decade. *J Child Psychol Psychiatry*. 2009;50:108–15.
48. Verdonschot MM, de Witte LP, Reichrath E, Buntinx WH, Curfs LM. Community participation of people with an intellectual disability: a review of empirical findings. *J Intellect Disabil Res*. 2009;53:303–18.
49. Dusseljee JC, Rijken PM, Cardol M, Curfs LM, Groenewegen PP. Participation in daytime activities among people with mild or moderate intellectual disability. *J Intellect Disabil Res*. 2011;55:4–18.
50. Vila M, Pallisera M, Fullana J. Work integration of people with disabilities in the regular labour market: what can we do to improve these processes? *J Intellect Dev Disabil*. 2007;32:10–8.
51. Kirsh B, Stergiou-Kita M, Gewurtz R, Dawson D, Krupa T, Lysaght R, et al. From margins to mainstream: what do we know about work integration for persons with brain injury, mental illness and intellectual disability? *Work*. 2009;32:391–405.
52. UWV. UWV Kwartaalverkenning 2009-III. 2009.
53. Edwards J. Person-Job fit: a conceptual integration, literature review and methodological critique. In: Cooper CL, Robinson IT, editors. *International review of industrial and organizational psychology*. New York: Wiley; 1991. p. 283–357.
54. Edwards J. The relationship between person-environment fit and outcomes: an integrative theoretical framework. In: Ostroff C, Judge TA, editors. *Perspectives on organizational fit*. San Francisco: Jossey-Bass; 2007. p. 209–58.
55. Lawer L, Brusilovskiy E, Salzer MS, Mandell DS. Use of vocational rehabilitative services among adults with autism. *J Autism Dev Disord*. 2009;39:487–94.
56. Schneider J. Supported-employment practice in the UK: evidence about an emerging occupational group. *Disabil Rehabil*. 2008;30:1819–28.
57. McGrew JH, Griss ME. Concurrent and predictive validity of two scales to assess the fidelity of implementation of supported employment. *Psychiatr Rehabil J*. 2005;29:41–7.