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Title: Oral health characteristics of intellectual disability patients at transition phase from paediatric dental service to adult dental service: A systematic search review

Short title: Dentistry and intellectual disability

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Abstract

Aim: A systematic review was conducted to evaluate the available literature to ascertain the oral health characteristics of patients with intellectual disability (ID) when they transfer from pediatric to adult health and social care services.

Material and Methods: The electronic search was performed between June 2020 and July 2020 using the following databases: MEDLINE and EMBASE. Grey literature and Google Scholar was also searched. References of articles obtained from the electronic searches were scanned through. Journals and regulation agency websites were also hand searched. This systematic review used a defined search strategy keywords for all the electronic databases. The strength of evidence in these studies was evaluated using the BMJ AXIS tool.

Results: The search process identified 45 eligible articles. Of these, 35 studies were excluded. At the end, 10 observational were included.

Conclusion: it seems that a considerable percentage of subjects with ID in their transition phase, aged between 18 and 25 years have a high prevalence of dental caries, gingivitis and periodontal disease when compared to general population.

Keywords: intellectual disability, transition phase, dental caries, gingivitis.

Introduction

Intellectual disability (ID) is defined as “*an impairment in cognitive and adaptive function*” (1). The prevalence of ID was reported to be roughly between 1% and 3% of the population, with considerable regional difference, with a 2:1 male to female ratio (1). Several reasons are reported for the development of ID, such as genetic disorders, chromosomal abnormalities, congenital brain deformities, neurodegenerative illnesses, congenital central nervous system infections, inborn metabolic errors, maternal sickness during pregnancy, in utero toxicity exposure, and birth injuries (2).

Individuals with ID have a higher frequency and severity of periodontal disease than the rest of the population (3). In terms of caries, the frequency of dental caries in children with ID is comparable to that of the general population (4). However, their dental health deteriorates faster when children reach adulthood, with more decaying and removed teeth, but fewer fillings than their non-ID peers (4). This indicates some sort of insufficiency in their dental visits, which could be attributed to many factors.

Indeed, one of these factors is the challenging of the transition phase of people with ID in health service from youth to adulthood, parental care to community or institutional care, and transitions from schools or educational institutions (5). For example, shortages of available primary and specialist adult facilities, lack of reimbursement and resources for transfer care, and insufficient awareness of, or access to, community support programmes are among the most commonly quoted “significant” barriers to a smooth transition (6). Additionally, the transition care process for a young adult with ID is complicated by a fractured healthcare system (7,8).

This article is intended to assist healthcare workers who engage with patients on a daily basis and can routinely highlight, promote, and support improvements in health behaviours in order to minimise disease risk in the community. While it makes good public health sense to consider how GPs can screen for learning disabilities oral health and then recommend the best intervention to the public, this strategy has largely overlooked the important role that other key primary care health professionals, such as dentists and dental teams, can contribute to reducing levels of dental diseases. Unfortunately, there is a scarcity of oral health patient data for ID individuals at their

transition phase from the paediatric dental service to adult dental service. Accordingly, this systematic review aimed to evaluate the available literature to ascertain the oral health characteristics of patients with ID in this challenging transition phase of their lives, where they transfer from paediatric to adult health and social care services. This may help determine how this patient group and their carers and service providers may be supported, including demonstrating the need for a more robust transition system and guidelines during this difficult phase.

Materials and methods

Study eligibility

This systematic review was structured based on the PEO structure (i.e., *participants*: patients with an ID, regardless of the cause or associated condition, in the age group 18 to 25 years old; *exposure*: this investigation reviewed all studies examining patients with an ID who attended dental services for dental examination or treatment; and *outcome*: oral health characteristics).

Inclusion and exclusion criteria

Studies that included people with an ID, participants whose ages ranged from 18 to 25 years old. This systematic review also considered a two-year margin of error below and above the age range, studies that were conducted using an original observational study type, studies that measured oral health using validated and reliable tools, and studies that were limited to English language were also included. Studies that did not assess ID, studies where participants' ages were less than 16 and more than 27 years. Finally, study types including randomised controlled trials (RCTs), case reports, case series or conference papers, or secondary analysis (i.e., review, systematic reviews, and meta-analyses) were excluded.

Search strategy

The electronic search was performed between June 2020 and July 2020 using the following databases: MEDLINE and EMBASE. Grey literature and Google Scholar was also searched.

References of articles obtained from the electronic searches were scanned through. Journals and regulation agency websites were also hand searched. This systematic review used a defined search strategy of keywords for all the electronic databases – see **Table 1**. The search was performed by the main reviewer and a second search was conducted independently by a second reviewer.

Data collection process

As part of the data collection process, a data extraction sheet was developed to help the reviewers during data extraction. The first reviewer (AO) completed the data extraction sheet for each included paper. The second reviewer (SA) conducted independent extraction of data from a sample of the included articles. Information on demographic details of participants' age, learning disability, attendance at dental services, and oral characteristics were extracted from each paper where available. The variables that the investigators sought to extract from each study included participant age, ID status, dental status, periodontal status and oral hygiene status. Measurement indices of these variables included Decayed, Missing and Filled Teeth Index (DMFT), Decayed, Missing and Filled Surfaces Index (DMFS), Debris Index (DI-S), Calculus Index (CI-S), Oral Hygiene Index (OHI-S), Plaque Index (PI) and Gingival Index (GI). Presence of bleeding, calculus, shallow pockets and frequency of brushing were also recorded.

Quality assessment tool

Data from the studies included in a systematic review influence the validity of the review. It is, therefore, imperative to assess the quality of this data to ensure a high-quality review. Types of bias introduced to this review include sampling, selection, detection, performance, response, and reporting bias. This review used the appraisal tool (AXIS) for cross-sectional studies developed by the British Medical Journal (BMJ). The main investigators (AA and SA) independently evaluated the risk of bias of the studies included in the review to determine their validity at both study and outcome level.

Results

Figure 1 presents the PRISMA diagram of the selection process. The search process identified 45 eligible articles. Of these, 35 studies were excluded. In the end, 10 observational studies met the inclusion criteria. Of the 10 included studies (9, 10, 11, 12, 13, 14, 15, 16, 17, 18), eight were cross-sectional studies (9, 10, 12, 13, 14, 15, 16, 17), and two were cohort studies (11, 18).

Sample characteristics

Table 2 presents the sample characteristics of the included studies. All selected studies used either medical records or clinical examinations to obtain the oral health characteristics of patients with ID at the transitional phase from paediatric dental service to adult dental service. The common aim of these studies was to identify oral health characteristics of patients with ID at the transitional phase such as dental health status, periodontal health status, and oral hygiene level.

Table 1: Search strategy keywords.

The search terms were composed of three items: learning disability, oral condition, and age. The initial search terms relating to learning disability included “learning disability” OR “learning disabilities” OR “intellectual disability” OR “intellectual disabilities” OR “developmental disabilities” OR “learning difficulty” OR “learning difficulties” OR “mental illness” OR “mentally retarded” OR “mentally ill” OR “mental retardation”. The initial search terms relating to the oral condition included “oral health” OR “oral characteristics” OR “oral status” OR “oral hygiene” OR “dental care” OR “dental status” OR “dental health” OR “caries” OR “periodontitis” OR “periodontal health” OR “gingivitis” OR “gingival health”. In the initial search relating to age, the search terms included “transition phase group” OR “transition age” OR “young adult” OR “teenagers” OR “teen” OR “adolescent” OR “16 to 24” OR “16 to 24 years old” OR “16 to 24 group” OR “16 to 24 age group” OR “18 to 25” OR “18 to 25 years old” OR “18 to 25 group” OR “18 to 25 age group.”

Table 2: Sample characteristics of the included studies (n=10).

Author	Country	Type of study	Subjects	Measurement
Shapira et al., 1989	Israel	Cross-sectional	One group of 17 patients aged 17–26 years old were institutionalised for various lengths of time in a separate department within a psychiatric hospital	DMFS, DMFT, Periodontal Treatment Need System
Agholme et al., 1999	Sweden	Cross-sectional	34 individuals with Down's syndrome, during a seven-year timeline. The baseline mean age was 16.6 years and 23.5 years at follow-up time	Periodontal condition determined by clinical examination, bitewing and periapical radiographs and microbial analysis tools
Vazquez et al., 2002	Spain	Cross-sectional	46 participants were in the age range 20–24 years old	DMFT + tooth brushing frequency
Bagic et al., 2003	Croatia	Case control	A total of 71 patients with Down's syndrome were selected and sub-grouped in this study. 32 of these were aged 16–25 years old	Community Periodontal Index of Treatment Needs (CPITN) system
Oredugba and Akindayomi, 2008	Nigeria	Cross-sectional	16 patients were in the age range 16–26 years old	DMFT, Oral Hygiene Index
Turner et al., 2008	United Kingdom	Cross-sectional	349 patients aged 16–25 years old were grouped in this study	Presence of missing teeth, caries, fillings, trauma, fluorosis, gingivitis, and soft tissue condition
Jain et al., 2009	India	Cross-sectional	87 persons with an LD aged between 16 and 25 years old	DMFT, DMFS, DI-S, CI-S, OHI-S, bleeding, calculus and shallow pockets
Schulte et al., 2013	Germany	Cross-sectional	95 patients were in the age range 18–24 years old	DMFT, plaque index

<p>Marks et al., 2015</p>	<p>Europe and Eurasia</p>	<p>Retrospective longitudinal study</p>	<p>Athletic patients with LD participating in the annual Special Olympics Special Smile event. The number of participants for our target age group was not clear</p>	<p>Frequency of tooth brushing, presence of gingival signs</p>
<p>Amira, Fauziah and Suharsini, 2019</p>	<p>Indonesia</p>	<p>Cross-sectional</p>	<p>112 patients were in the age range 16–26 years old</p>	<p>Gingival index and OHIS</p>

Dental caries, gingivitis and periodontal diseases

The included studies discussed three main subheadings (i.e., dental caries, gingival and periodontal diseases) – see **Table 3**. The following is the discussion of each subheading theme.

Dental caries

Vázquez *et al.* (2002) analysed the prevalence of dental caries in 166 adult patients between the ages of 20 and 40 years with ID attending public health services. Of these, 46 adult patients with ID were selected with ages ranging from 20 to 24 years. The DMFT scoring of these 46 participants was 4.41 (+0.7), DT: 1.43 (+ 0.34), MT: 0.98 (+ 0.34), FT: 1.72 (+ 0.44). Vázquez *et al.* (2002) reported the reason behind the high prevalence of dental caries was poor oral hygiene. For example, most of the participants (60%) brushed their teeth once or twice a day. They used the DMFT system to assess caries prevalence.

Similarly, Oredugba and Akindayomi (2008) evaluated the oral health condition of 54 young patients with ID. Of these, 18 patients were aged between 16 and 26 years. They used the DMFT system to analyse caries prevalence. They found that the mean DMFT of the 18 patients was 2.29 (SD = 0.94). The high caries level was justified by the poor oral hygiene of the majority of the patients. For example, the oral hygiene status of these 18 patients with ID was good for 27.78% (five participants), fair for 33.33% (six participants) while 38.89% (seven participants) had poor oral hygiene.

Additionally, Schulte, Freyer and Bissar (2013) determined the caries prevalence and oral hygiene status of 428 adults with ID. Of these, 95 were 18 to 24 years old. Schulte, Freyer and Bissar (2013) found that the mean DMFT of this age group was 6.78 (SD = 5.45). This high index of dental caries was justified by the poor oral hygiene of the participants, as they found that the plaque index was high as well (score = 1.33 (SD = 0.70)).

Besides, Jain *et al.* (2009) conducted a study to examine the oral health status of 225 adults with ID aged between 12 and 30 years included in this study (38.7%), of whom 87 participants were

aged between 16 and 25 years according to their IQ level and their parents' education level. They found that individuals aged 16 to 25 years had a higher oral hygiene index as well as DMFT index compared to younger individuals (rates of DMFT, DMFS, DI-S, CI-S, OHI-S, bleeding, calculus, and shallow pockets for the age group 16–20 years were 2.61, 3.19, 1.85, 1.30, 3.15, 5.38, 3.33 and 3.33, respectively, whereas for those in the 21-25 year age group, they were 2.63, 4.75, 1.62, 1.24, 2.87, 5, 3.75 and 3.75, respectively).

Shapira *et al.* (1989) assessed the oral hygiene and dental treatment of 22 patients with ID. Of these, 17 patients aged 17 to 26 years were institutionalised for various lengths of time in a separate department within a psychiatric hospital. Shapira *et al.* (1989) reported that ID patients who were institutionalised had DMFS scores of 16.12. The “D” component was prevalent 45.2% of the time in DMFS scores; the “M” component 37.2%; and the “F” component 17.6%.

Gingival diseases

Marks *et al.* (2015) evaluated the presence of gingivitis and the oral hygiene of athletic individuals with ID participating in the annual Special Olympics Special Smile event in Europe and Eurasia between 2007 and 2012. There were three age groups, one of which was the 18–25-year-old age group. They checked gingivitis by assessing the presence of any signs of gingival inflammation under clinical examination. Data on oral hygiene practice was collected using questionnaires. The results showed that the majority of participants had gingivitis and 98% brushed their teeth once or more daily.

Similarly, Amira, Fauziah and Suharsini (2019) in Indonesia measured the presence of gingivitis and oral hygiene in patients with ID representative by patients with Down's syndrome. The sample size was 112 patients with ages ranging from 16 to 26 years. They used the gingival index and oral hygiene index as measurement tools. They found that six of the participants had mild gingivitis (5.4%), 100 had moderate gingivitis (89.2%), and six had severe gingivitis (5.4%). Again, poor oral hygiene of the participants was the reported reason for the developed gingivitis. For example, good oral hygiene was found in two patients (1.7%), 86 had fair oral hygiene (76.7%), and in the rest of this selected age the oral hygiene was poor (21.6%).

Periodontal diseases

Agholme, Dahlföf and Modéer (1999) investigated the development of periodontal disease of 34 patients with ID representative by Down's syndrome over seven years. The baseline mean age was 16.6 years, and 23.5 years at follow-up time. The investigator checked the periodontal condition by clinical examination, bitewing and periapical radiographs, and microbial analysis tools. These tools were used to record surface gingivitis percentages, pocket depth, alveolar bone loss, distance from alveolar bone crest to the cemento-enamel junction, and the presence of periodontal pathological bacteria. They found that the percentage of surface gingivitis was significantly decreased at follow-up (67% to 44%). The pocket depth was significantly increased from 41% to 65%. Alveolar bone loss also showed a significant increase from 35% to 74%, while the presence of pathological periodontal bacteria had shown no significant difference between the baseline and follow-up.

Furthermore, Bagić *et al.* (2003) assessed the periodontal condition of 32 patients with ID in Croatia. The age of the participants was 16 to 25 years. The control group consisted of 32 age-matched healthy subjects. They used a periodontal probe as a tool to assess gingival health conditions. The recorded data was obtained by a coding system where 0 represents healthy periodontal tissue, 1 represents bleeding on probing, 2 represents presence of calculus, 3 represents presence of shallow pockets and 4 represents deep pockets. The results showed that the means of code 0 was 0.9, code 1 was 5.7, code 2 was 2.8, code 3 was 1.4, and code 4 was 0.2.

Similarly, Turner *et al.* (2008) evaluated the oral health condition of athletes with ID at the seventh UK Special Olympics (SO) National Games and related it to the UK Adult Dental Health Survey (1998). For instance, 349 patients aged from 16 to 25 years old were included in this study. They recorded the presence of missing teeth, caries, fillings, trauma, fluorosis, gingivitis, and soft tissue condition. They found that 98% of this group had a stable dental health condition compared to the participants in the older age groups; there was no edentulism among this age group and 53% of them had no fillings. Also, they recorded that there was no age association with soft tissue conditions.

Lastly, using the Periodontal Treatment Need System, Shapira *et al.* (1989), in their study discussed above which aimed to assess the oral hygiene and dental treatment need of 17 patients with ID, noticed that 53% of participants (n=9) were grouped under class 2 with sub- and supragingival calculus; eight patients (47%) with class 3 (deep periodontal pockets), and almost half of them (n=9) (53%) required periodontal surgery.

Table 3: Summary of the outcomes for all included studies.

Authors	Dental status	Periodontal status	Oral hygiene	Conclusions
Shapira et al., 1989	Institutionalised patients with autism had lower decayed, missing and filled teeth. The DMFS score was 16.12. The “D” component was prevalent 45.2% of the time in the DMFS scores; the “M” component 37.2%; and the “F” component 17.6%.	53 % of the participants had sub- and supragingival calculus. 8 patients (47%) had deep periodontal pockets.	12 toothbrushes (71 %) were rated too big, and 12 had bristles that were in poor condition.	Institutionalised patients with autism had lower rates of caries and more severe periodontal problems than the general population, therefore the help of highly motivated medical teams may improve their dental status significantly.
Agholme, Dahllof and Modeer, 1999	-	Surface gingivitis decreased at follow up (67% to 44%), pocket depth increased from 41% to 65%, alveolar bone loss increased from 35% to 74%, the presence of pathological periodontal bacteria had shown no significant difference between baseline and follow up.	-	Prevention treatment may decrease the frequency of periodontitis.
Vazquez et al., 2002	DMFT scoring was 4.41(±0.7), DT: 1.43 (+ 0.34), MT: 0.98 (+ 0.34), FT: 1.72 (+ 0.44)	-	60% of the participants brushed their teeth once or twice a day.	Young adult participants with LD may have a high caries prevalence.

Bagic et al., 2003	-	The results showed that the mean of code 0 was 0.9, code 1 was 5.7, code 2 was 2.8, code 3 was 1.4 and code 4 was 0.2.	-	DS patients may need periodontal treatment due to a high prevalence of periodontitis.
Oredugba and Akindayomi, 2008	The mean DMFT was 2.29 ±0.94	-	Good for 27.78% (5 participants), fair for 33.33% (6 participants), 38.89% (7 participants) have poor oral hygiene	Patients with LD may have a high caries prevalence due to lack of parent's education on diet and oral hygiene and irregular dental visits.
Turner et al., 2008	98% of this group had an unstable dental health condition. There was no edentulism among this age group. 53% had no fillings. There was no age association with soft tissue conditions.	-	-	They concluded that many of the younger participants (those under the age of 35) had not undergone extractions and were free of caries, suggesting that only maintenance of the current level of oral health was needed for most of the younger athletes.
Jain et al., 2009	In the 16–20 years age group, the DMFT was 2.61, DMFS was 3.19. In the 21–25 years age group, the DMFT was 2.63 and DMFS was 4.75.	DI-S, CI-S, OHI-S, bleeding, calculus, and shallow pockets for the age group 16-20 years were 1.85, 1.30, 3.15, 5.38, 3.33 and 3.33, respectively. For the 21-25 years age group, they were 1.62, 1.24, 2.87, 5, 3.75 and 3.75, respectively	-	Lower IQ level, poorer education level of parents and the aetiology of the disability had a negative effect on the oral health status of theLD population.

Schulte, Freyer and Bissar, 2013	The mean DMFT of this age group was 6.78 with 5.45 standard deviation.	-	The mean PI index was 1.33 (sd 0.70).	The improvement of dental care of LD patients may decrease the prevalence of dental caries and periodontal disease.
Marks et al., 2015	-	98% of the participants had gingivitis.	The participants brushed their teeth once or more daily.	The oral health education of participants' parents may decrease the high prevalence of gingivitis.
Amira et al., 2019	-	6 of the participants had mild gingivitis, 100 had moderate gingivitis and 6 had severe gingivitis.	2 patients had good (1.7%), 86 had fair (76.7%) and 24 had poor (21.6%) oral hygiene.	The majority of DS patients had mild to moderate gingivitis and fair oral hygiene.

Quality assessment of the included studies

Table 4 presents the quality assessment of the included studies. All the included studies had clear aims, appropriate measures which had been used previously, appropriate study design methodology and clear target populations. However, none of them had a justifiable study sample size calculation. With regard to whether the sample frame represented the target population, all the articles met the required criteria, but only five studies investigated the selected target (Shapira *et al.*, 1989; Turner *et al.*, 2008; Oredugba and Akindayomi, 2008; Amira *et al.*, 2019; Marks *et al.*, 2015). All included studies, except Turner *et al.* (2008) used descriptive statistics. Data in all included studies were internally consistent except in three studies (Vazquez *et al.*, 2002; Oredugba and Akindayomi, 2008; Marks *et al.*, 2015). Ethical approval was confirmed in all the included studies, except in three studies (Shapira *et al.*, 1989; Vazquez *et al.*, 2002; Bagić *et al.*, 2003). Three studies showed bias in response rate (Oredugba and Akindayomi, 2008; Turner *et al.*, 2008;

Schulte, Freyer and Bissar, 2013). Only three studies recorded non-responsive or dropout rates (Agholme *et al.*, 1999; Oredugba and Akindayomi, 2008; Jain *et al.*, 2009). No other conflict of interest was found or recorded in all the included studies. Three studies did not discuss or mention any study limitation (Amira *et al.*, 2019; Bagić *et al.*, 2003; Jain *et al.*, 2009; Amira *et al.*, 2019).

	Shapira et al. (1989)	Agholme, Dahllof & Modeer (1999)	Vazquez et al. (2002)	Bagić et al. (2003)	Oredugba & Akindayomi (2008)	Turner et al. (2008)	Jain et al. (2009)	Schulte, Freyer & Bissar (2013)	Marks et al. (2015)	Amira, Fauziah and Suharsini (2019)
Proper introduction and rationale	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clear aim	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Appropriate study design	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Justified sample size	No	No	No	No	No	No	No	No	No	No
Clearly defined target population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample frame represented target	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Investigated selected target	Yes	No	No	No	Yes	Yes	No	No	Yes	Yes

Measuring non-responders?	No drop out reported	Yes	No drop out reported	No drop out reported	Yes	No	Yes	No	No drop out reported	No drop out reported
Appropriate measurements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Measurement used previously?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Validated measurement for statistical significance	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Reliable statistical method	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Results Descriptive basic data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Response rate bias	No dropout	No	No drop out reported	No drop out reported	Yes	Yes	No	Yes	No drop out reported	No
Descriptive cause of non-response	No drop out reported	Yes	No drop out reported	No	Yes	No	Yes	No	No drop out reported	No drop out reported

Internally consistent results	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes
Results analysis description	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Discussion justified results	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Discussed study limitations	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Other conflict of interest	No	No	No	Not reported	No	Not reported	No	No	No	No
Ethical approval or consent	No	Yes	No	Not reported	Yes	Yes	Yes	Yes	Yes	Yes

Discussion

It was found that there are many complex circumstances surrounding the oral health of people with ID at their transitional phase from pediatric dental service to adult dental service, such as high caries rate, gingivitis and periodontal diseases. In this review, we have systematically selected a number of studies with interesting and significant findings. However, for the purpose of accuracy, the shortcomings of the included studies must be discussed.

High caries prevalence in people with ID

Vazquez *et al.* (2002) reported that young adult individuals with ID have a high caries prevalence compared to the general population. However, there were a few flaws in their study. For example, Vazquez *et al.* (2002) did not justify the sample size calculation nor did not investigate the selected target. Also, they did not mention whether or not ethical approval or consent was obtained for the selected sample, and the results of that study were not consistent.

Another study arrived at the same conclusion, reporting that people with ID have high caries prevalence and they needed a high restorative treatment due to lack of parental education on diet and oral hygiene practice, and irregular dental visits (Oredugba and Akindayomi, 2008). However, in Oredugba and Akindayomi (2008), the authors did not justify the sample size calculation or adequately explain how it was determined. Moreover, a lack of adequate information about dropouts means that there is a chance of bias with the non-respondents, which can lead to a shift in the baseline data. However, these two studies were in agreement with Schulte, Freyer and Bissar (2013), who concluded that individuals with ID have poorer oral health and more dental extraction needs when compared to the general population, and that the improvement of oral hygiene of this patient group might decrease the prevalence of dental caries. Further to the quality assessment phase, Schulte, Freyer and Bissar's (2013) study was affected by many biases. For example, the sample size was not appropriate for the purpose of the study and did not represent the selected target. Besides, the selected target was not investigated. In addition to that, Schulte, Freyer and Bissar (2013) did not provide information about non-responders, including their reasons for not responding, which introduces participation bias to the study.

Gingivitis in people with ID

The presence of gingivitis in the general population is well-documented, while literature on gingivitis in young adult patients with ID is scarce (Zweers *et al.*, 2014). It seems to have found that there is a sense of agreement about the presence of gingivitis in young adults with ID (Marks *et al.*, 2015; Amira, Fauziah and Suharsini, 2019). Amira, Fauziah and Suharsini (2019) found that most of the selected patients with ID had moderate gingivitis; however, their study did not justify the sample size calculation and therefore, the researcher did not make a valid inference, besides not addressing their study limitations. It is possible that the higher prevalence of gingivitis in individuals with ID is because of poor motor skills when compared to the general population. This is because of physical features that people with ID have, such as low muscle tone, loose ligaments that require greater joint flexibility, and decreased joint strength which would make it challenging to maintain dental hygiene or reduce access to dental treatments for this population group (19). These findings were in accordance with past works that evaluated gingivitis in ID patients (19, 20). However, different findings contradict Amira *et al.* (2019), who reported that patients with ID have lower moderate gingivitis (21). This might be explained by different demographic characteristics and divergent socioeconomic status (Amira, Fauziah and Suharsini, 2019). Moreover, high prevalence of gingivitis is not only associated with ID; it is also present in other ID patients whose ID is caused by or associated with conditions other than Down's syndrome, who are in a transition age (Marks *et al.*, 2015). Similarly, Marks *et al.* (2015) did not justify the sample size, which leads to the same type of bias that Amira, Fauziah and Suharsini (2019) faced; therefore, they did not reach a solid, reasonable conclusion. In addition to these shortcomings, the results of Marks *et al.* (2015) were not internally consistent.

Periodontitis in people with ID

One of the main oral characteristics found in this review was a high periodontitis prevalence in ID individuals (Agholme, Dahlföf and Modér, 1999; Bagić *et al.*, 2003). Alveolar bone loss in adolescents with ID increased over a seven-year follow-up period from 35% to 74%. However, in both studies there were some limitations. For example, neither study justified the sample size or investigate the selected target. On the other hand, there was no response bias as dropouts and the reasons for them were mentioned sufficiently. All of these findings show that periodontal disease increases considerably with age in persons with ID.

Dental treatment / oral healthcare in people with ID

Turner *et al.* (2008) evaluated the oral health condition of athletic patients with ID at the Special Olympics Special Smile event (UK, Glasgow). They found that 98% of this group had a stable dental health condition when compared to the general population. The study by Turner *et al.* (2008) was relatively weak when undergoing quality assessment of potential biases. The sample size was not justified, and there was inadequate information about the non-responders. Also, the statistical measurement used to assess the significant difference is not validated (Turner *et al.*, 2008).

Additionally, Jain *et al.* (2009) concluded that lower IQ level, poorer education level of parents and the aetiology of the ID had negatively affected the oral status. However, Jain *et al.*'s (2009) study has some limitations. For example, there is no justified sample size nor investigated selected target. Moreover, Jain *et al.* (2009) did not give a clear explanation of the aetiology that has an influence on the oral health. On the other hand, Turner *et al.* (2008) were in agreement with Shapira *et al.* (1989), who concluded that institutionalised patients with ID had lower rates of caries and severe periodontal problems than non-ID persons. However, Shapira *et al.* (1989) did not justify the sample size, use validated tools, or obtain ethical approval or informed consent, which introduces authorisation bias, jeopardising the integrity of the study (Shapira *et al.*, 1989).

Limitations and strengths

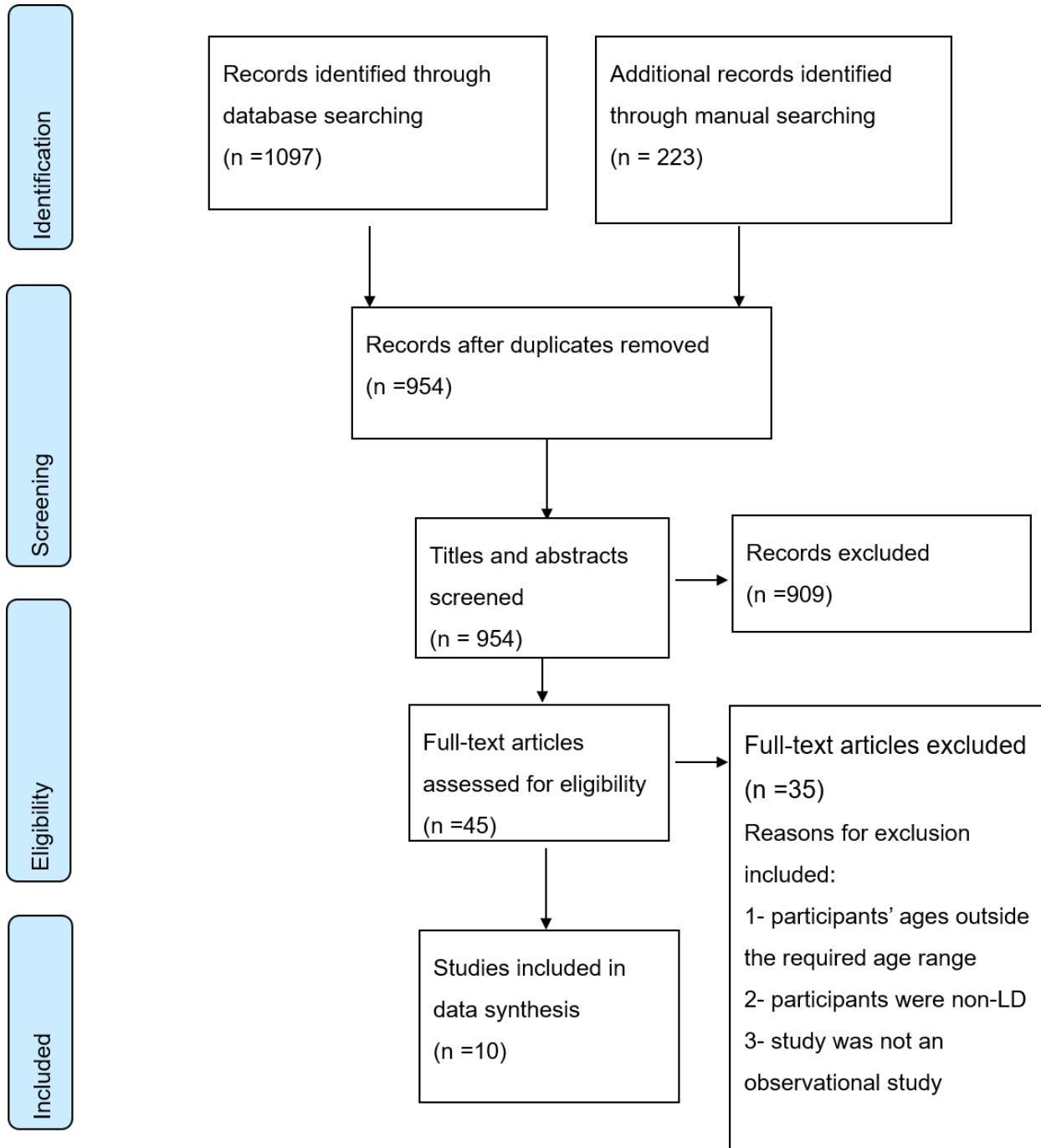
The present systematic search review has some important limitations. First, most of the included studies did not focus on the target age group (18–25 years), and in most available studies, the age range was older than our initial target, which made it difficult to extract the data. Second, due to a lack of homogeneity of the studies, the statistics could not be used for meta-analysis. Third, the researchers had no discretion of exposure or result evaluation of the included studies, so they had to rely on others to perform accurate analyses and maintain reliable records. Fourth, several studies included unjustified and/or small sample sizes, so it was impossible to tell whether a specific finding was accurate; hence type II errors may have occurred in certain situations. Fifth, the sampling technique was not clear in most of the included studies. Despite those limitations, we can discern the strengths of the following; two evaluators have evaluated the included studies in

this review, broad keywords had been used to extract the available studies, this review focused on a neglected age of people who live with ID, and finally, this review could represent a solid base for further longitudinal prospective studies, including an adequate and justifiable sample size of the intended target group.

Conclusions

This systematic search review set out to discover the oral health characteristics of ID individuals in the transitional age group. In conclusion, it seems that a considerable percentage of subjects with ID in their transition phase, aged between 18 and 25 years, have a high prevalence of dental caries, gingivitis and periodontal disease when compared to the general population. Oral health education of these individuals, their parents and carers is crucial, as are preventive programmes specifically designed to address their needs and meet their intellectual and other challenges while they are in the transition phase of their lives. Easier access to dental healthcare services must be provided to promote oral healthcare in this population. This will improve not only their oral health but also their overall quality of life.

Figure 1: The PRISMA diagram of the selection process.



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