



Assistive Technology and Employment Opportunities for People with Disabilities: A Systematic Review and Meta-analysis

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ABSTRACT

Assistive technology (AT) can support the employment of people with disabilities (PwDs). This study aimed to investigate the impact of AT on the employability of PwDs and determine the barriers hindering its effective use in the job market in Saudi Arabia. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed. A total of 20 sources were incorporated, inclusive of 7259 participants. To identify articles for this meta-analysis, database search results were screened by considering article titles and abstracts. Statistical analyses, including effect size calculation, weighting, subgroup analysis, and heterogeneity assessment, were conducted using RevMan software (version 5.3). A significant relationship between AT use and the employability of PwDs was found. The meta-analysis indicated that individuals using AT had higher odds of being employed than their counterparts without the devices (odds ratio = 2.41, 95% confidence interval: 1.89-2.93, $P < 0.013$). Subgroup analysis indicated that PwDs using AT for communication, ergonomic accommodations, and mobility had higher job retention and employability rates than their counterparts without AT. Limited awareness concerning AT, high acquisition costs, and skill insufficiency were found to be major hindrances to the use of AT among PwDs. AT use associates positively with the employability and overall well-being of PwDs. Fiscal aid, targeted education, and awareness campaigns can help disabled Saudi workers utilize AT more effectively.

KEYWORDS

people with disability, assistive technology, employment, workforce diversity, Saudi Arabia

INTRODUCTION

Equity in employment opportunities has been a subject of concern for decades. Heightened recognition of diversity and inclusiveness in the modern workplace has shifted focus to employment opportunities, especially for people with disabilities (PwDs) (Alqahtani et al., 2023). Accordingly, the Kingdom of Saudi Arabia (KSA) has been attempting to foster labor market equity for PwDs through policy re-design (Almalki, 2022). The KSA government has emphasized the need to augment the utilization of assistive technology (AT) in efforts aimed at improving the employability and well-being of PwDs. Researchers have noted, however, that despite AT adoption measures, societal restrictions have continued to impede inclusion and it remains difficult for PwDs to acquire employment (Almalki, 2022; Kumari and Lenka, 2023). The employability of PwDs in the KSA has remained low despite attempts to improve the situation with AT use. Recent statistics have indicated only a slight increase

in the employability of PwDs (Kumari and Lenka, 2023). Sulaimani and Bagadood (2023) noted that comprehensive policies are needed to foster the inclusion and employability of PwDs across different economic sectors.

Global trends emphasizing the inclusion of PwDs align with changing environments in the Saudi labor market (Almalki, 2022). The present systematic literature review and meta-analysis aims to bridge this gap by providing a comprehensive investigation of the impacts of AT usage on employment opportunities among PwDs in the KSA. Furthermore, the influences of AT on employment possibilities, job satisfaction, and the well-being of PwDs were determined with an emphasis on identifying obstacles impeding effective AT adoption. The following two research questions guided this systematic review and meta-analysis: (i) How does AT impact PwDs, and how can its strategic adoption make them more employable? (ii) What barriers can be alleviated for

PwDs in the Saudi job market through AT adoption, and how can greater AT access influence the overall well-being and employability of PwDs?

The results of this study are anticipated to have a major impact on KSA policies targeting increasing the employability prospects for the nation's disabled citizens. Implications of the study pertaining to the potential for enhancing the employability of PwDs may have a positive impact on diversity and inclusivity in contemporary businesses. This study offers insightful information that can be used to encourage AT usage by PwDs.

Contribution of this study

Although numerous studies have explored the role of AT in enhancing employment opportunities for PwDs globally, there is a scarcity of research specifically focusing on the Saudi context. This study differentiates itself in the following five ways:

1. Regional focus: concentration on the KSA, where cultural, social, and policy environments differ from previously examined Western contexts.
2. Policy implications: providing insights that can inform and shape national policies aimed at improving employment prospects for PwDs in the KSA directly.
3. Comprehensive analysis: utilizing a systematic review and meta-analysis methodology allows for the synthesis of available data, resulting in a rigorous assessment of the effects of AT on employment results.
4. Identifying barriers and solutions: highlighting of specific barriers to AT adoption in the workplace and suggesting targeted interventions to overcome these challenges.
5. Longitudinal perspective: considering recent trends and changes in policy and practice, this study offers a contemporary view of the employment landscape for PwDs in the KSA.

The results of this study are anticipated to have a major impact on KSA government policies intended to increase the employability prospects for the nation's disabled citizens. Implications of the study may support efforts to enhance the employability of PwDs in the KSA and have a positive impact on diversity and inclusivity, especially as it relates to hiring PwDs in contemporary businesses. This study offers insightful information that can be used to encourage occupational AT usage by PwDs.

Employment opportunities for PwDs have been studied previously, including examinations of the potential for AT to enhance employability. Morash-Macneil et al.'s (2018) systematic review of occupational AT for intellectually disabled (ID) people found that various technologies improve job performance and satisfaction. Their conclusions were supported by Marinaci et al.'s (2023) thematic analysis exploring inclusive workplace approaches to disability through AT.

Damianidou et al.'s (2019) meta-analysis of using technology to assist work outcomes for adults with intellectual and developmental impairments found that AT improves job acquisition and retention. Furthermore, Brandt et al.'s (2020) review of the ability of information and communication

technology-based AT to compensate for impaired cognition in activities of daily life indicated that AT has the potential to enhance both the daily functioning and employment prospects of PwDs. In their review of AT utility for the educational inclusion of students with disabilities, Fernández-Batanero et al. (2022) discuss the potential transferability of AT utility in the educational setting to employment contexts. Similarly, McNicholl et al. (2021) related positive impacts of AT use for students with disabilities in higher education to long-term employment outcomes. For an overview of the effective educational interventions, readers are referred to Thapliyal and Ahuja's (2023) recent meta-synthesis review of the implications of instructional strategies on AT for individuals with learning disabilities.

There remains a gap in occupational AT research in the KSA context. This study aims to fill this gap by providing a comprehensive analysis of AT impacts on employment opportunities for PwDs in the KSA. Cultural and policy-related barriers specific to the KSA are identified, and targeted interventions to improve the employability and well-being of PwDs are suggested.

METHODS

Justification for PRISMA guidelines

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were chosen owing to their comprehensive framework, which enhances the transparency and the efficacy of systematic reviews and meta-analyses. PRISMA's structured approach ensures that all critical aspects of the review process are addressed, providing clarity and reproducibility for readers. Given the complexity and scope of synthesizing data on AT and employment opportunities for PwDs, PRISMA guidelines are well suited to ensure methodological rigor and consistency.

PRISMA process

The PRISMA process that was followed involved the following five key steps:

1. Identification: a comprehensive approach was taken in this study, with systematic searches conducted across multiple databases to identify relevant studies. The databases searched were Education Resources Information Center (ERIC), PubMed, ScienceDirect, Saudi Digital Library, Google Scholar, Elsevier, Emerald, Medline, and SpringerLink. The search strategy incorporated specific keywords and Boolean operators (NOT, AND, OR) to refine the search results.
2. Screening: titles and abstracts of retrieved articles were meticulously screened to exclude irrelevant studies. Potentially relevant articles were then subjected to full-text review to determine their eligibility based on predefined criteria.
3. Eligibility: articles meeting the inclusion criteria were assessed for methodological quality and relevance.

4. Inclusion: the final systematic review and meta-analysis articles passed the screening and eligibility stages. Data extraction was performed using standardized forms to ensure consistency.
5. Data extraction and synthesis: to minimize bias, data from the included studies were extracted independently by multiple reviewers. The extracted data were synthesized qualitatively and quantitatively with meta-analysis techniques.

Search strategy

Systematic searches were conducted with a focus on the following databases: ERIC, PubMed, ScienceDirect, Saudi Digital Library, Google Scholar, Elsevier, Emerald, Medline, and SpringerLink. The search strategy involved using a combination of terms/keywords such as “disability,” “inclusion,” “assistive technology,” “Saudi Arabia,” “employment,” and “workforce diversity.” Boolean operators (NOT, AND, OR) were used to improve the scope and accuracy of the search.

A total of 172 articles were retrieved from the databases: ERIC (41), PubMed (54), ScienceDirect (32), Google Scholar (11), and SpringerLink (34). After removing

duplicates, reviews, case reports, and other studies marked as ineligible by automation tools, 100 sources remained for further analysis. After removing 31 sources that did not specifically address how AT may improve the employability of PwDs, this systematic review and meta-analysis included 20 studies. The results of the methodical searches are condensed in the PRISMA flow diagram (Fig. 1).

Inclusion and exclusion criteria

The criteria for inclusion were peer review, publication between 2014 and 2024, a focus on AT for improving the employability of PwDs, and the use of observational study methodologies. The exclusion criteria were publication before 2014, insufficient data relevant to the topic, not being focused on occupational AT for PwDs, and the absence of peer review.

Article screening and data extraction

The screening process involved two stages. First, titles and abstracts of retrieved articles were screened to exclude

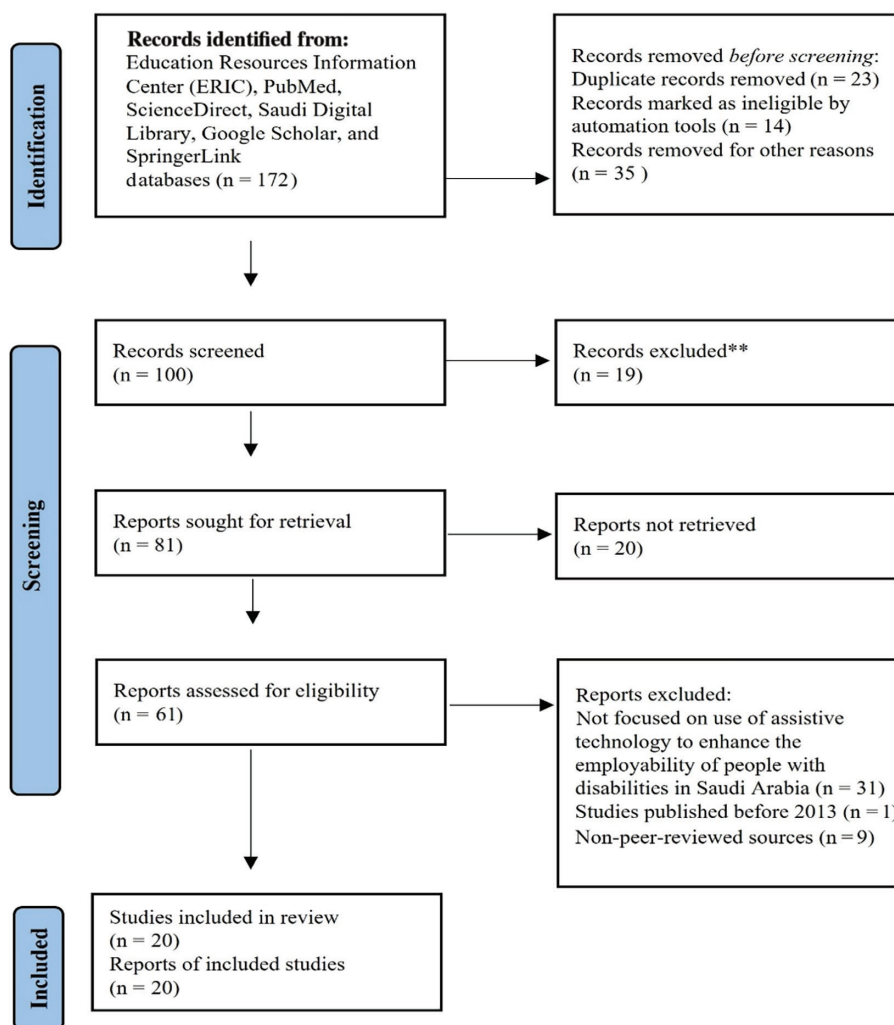


Figure 1: PRISMA flow diagram representing the work process carried out in the study. Abbreviation: PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

irrelevant studies. Second, the full texts of potentially relevant articles were reviewed to determine their eligibility based on the inclusion and exclusion criteria. This rigorous screening process ensured that only the high-quality clearly relevant studies were included.

To ensure accuracy and consistency, independent reviewers used standardized forms to extract data from each included article. A pilot study was conducted using a small subset of articles to refine the data extraction process. Extracted data were organized to facilitate data analysis.

Risk of bias analysis

While undertaking a systematic review with meta-analysis in mind, it is critical to consider biased risk. Considerations of the risk of biased risk as analysis are critical in studies that embody meta-analysis to ensure that researchers can evaluate articles' quality and reliability; these measures minimize biases and foster confidence in the findings (Lundh and Gøtzsche, 2008). Consequently, the articles selected for this study were analyzed using the Cochrane Collaboration's risk of bias tool, and several key aspects were noted and utilized for this meta-analysis. These aspects constituted bias associated with randomization, deviation bias linked to AT interventions, bias linked to missing data, measurement outcome bias, and bias related to reported results.

Meta-analysis

Statistical analysis is best carried out with the help of modern software. In this study, the researcher used the RevMan program (version 5.3) provided by the Cochrane Collaboration, based in London, United Kingdom. Mean and standard deviations were calculated to compute the required weighted mean differences with 95% confidence intervals. The chi-square (χ^2) test shall be used to test the statistical heterogeneity across the articles included in this meta-analysis. Heterogeneity is statistically significant when the measure of heterogeneity (I^2) is $>50\%$ and $P < 0.05$ based on the test statistics (Baker et al., 2009). In that case, the random-effects model will be employed. When the heterogeneity is considered low ($I^2 \leq 50\%$), a fixed-effects model is used in data analysis.

RESULTS

Study selection

A total of 172 articles were initially researched from six databases, including ERIC (41), PubMed (54), ScienceDirect (32), Google Scholar (11), and SpringerLink (34). A total of 100 sources were left for further analysis after reviews, duplications, case reports, and other studies marked as ineligible by automation tools were removed. After excluding, a total of 31 sources not focused on how AT is adopted to enhance the employability of PwDs were removed from the meta-analysis. A total of 20 studies were retrieved and

included in this study. Figure 1 is the PRISMA flow diagram representing the article selection process.

Study characteristics

Table 1 lists the main characteristics of the studies included in this review, including the author's name, year of publication, population/sample size, research design, study location, intervention adopted by the researchers, and main findings. This meta-analysis included a total of 20 studies published between 2013 and 2023. A total of 7259 participants, including employees living with disabilities, human resources managers, policymakers, and disability employment service providers, were considered and included in this meta-analysis. The main forms of disability considered included intellectual, physical (paralysis), sensory, developmental (autism spectrum and attention-deficit/hyperactivity disorders), and communication disabilities. The mean age of the population in this meta-analysis ranged from 29.3 to 55.6 years. The geographic location of the included articles was multicentric, comprising Saudi Arabia, the United States, Canada, the United Kingdom, India, and Australia. All the cases included in this study had either used AT, formulated policies on AT, or supervised people living with disabilities using technology to help them at work.

Risk of bias analysis

The risk of bias for all studies included in this meta-analysis was thoroughly evaluated using the Cochrane Collaboration tool. The domains that were taken into account were as follows: (D1) bias resulting from the randomization procedure; (D2) bias caused by variations from planned interventions; (D3) bias resulting from missing outcome data; (D4) bias in the assessment of outcomes; and (D5) bias in the selection of the reported findings. Each domain was assessed and categorized as low risk, some worries, or high risk. The total risk of bias for each research was then graphically represented in a risk of bias plot (Fig. 2), where green represents low risk, yellow represents some concerns, and red represents high risk. This visual representation makes the evaluation more accessible and increases our trust in the accuracy and credibility of the results. This thorough evaluation instills confidence in the strength and reliability of the results derived from the analyzed research.

Outcomes of the meta-analysis

Employment and retention rates of PwDs were the primary outcome measures in this meta-analysis. Since no statistical heterogeneity was present ($I^2 = 0\%$, as shown in Tables 2 and 3), the fixed-effects model was used for data analysis. This uniformity in the adoption and utilization of AT can be attributed to various factors inherent in the technological devices being used and the study population. For instance, the nature of physical disabilities usually presents similar hurdles to employment, including challenges related to

Table 1: Characteristics of the studies included in the meta-analysis.

Author (year)	Study type	Country: study population	Intervention/technology	Findings
Beneveau et al. (2023)	Qualitative	USA: seven disabled employees	Comparing pre-disability vs. post-disability performance	AT plays a key role in enhancing the employability of PwDs
Bonaccio et al. (2020)	Systematic review and meta-analysis	USA, Europe, and Asia: disabled employees using supportive technologies	Determining barriers to inclusion of PwDs in the workplace	Eliminable barriers include awareness about technology use and costs of AT
Carver et al. (2016)	Mixed	USA: 34 disabled employees	Mobility assistive technology devices (MATDs)	Quantitative findings indicated that MATDs enhanced mobility and employability of PwDs
Chan et al. (2021)	Cross-sectional survey design	USA: 466 human resources managers	Disability Inclusion Profiler tool	Large- and mid-sized companies, Fortune 500 companies, and federal contractors were more likely to have ATs that enable inclusion of PwDs
Collins et al. (2014)	A cross-sectional survey design	USA: three young adults with intellectual disability (ID)	Portable electronic AT	AT-enhanced participants' ability to complete office-related tasks
Darcy et al. (2017)	Qualitative and interpretive research design	USA: 15 disabled employees using AT work	Use of a mobile technology platform	Adoption of mobile technology-enhanced participants' communication and social participation at work
Gentry et al. (2015)	Quantitative	USA: 50 employees with ASD	Personal digital assistants (PDAs)	Employees who received PDA training needed less coaching support ($P = 0.013$)
Graser et al. (2013)	Quantitative: experimental	Saudi Arabia: disabled persons performing librarian tasks	Functional Robot with Dexterous Arm and User-Friendly Interface for Disabled People (FRIEND)	FRIEND system supported PwDs effectively at work
Grills et al. (2017)	Cross-sectional population-based survey	Uttarakhand, India: 2431 disabled persons	Interviewer-administered household survey and measures of disability, well-being, and participation	Barriers to employer inclusion of PwDs include lack of information, transport, and physical inaccessibility
Hagner et al. (2015)	Quantitative descriptive study	UK: 53 employment specialists	Workplace culture survey	Lack of access to shared equipment emerged as main work inclusion barrier for PwDs
Helena et al. (2023)	Qualitative descriptive study	Sweden: 15 persons with ID and 10 employers	Interviewing	Wage subsidy attenuated barriers to employability of PwDs
Jetha et al. (2023)	Qualitative (grounded theory)	Canada: 40 policymakers and disability employment service providers	Interviews on implications of digital technology advancements for PwDs	Barriers to AT adoption in the workplace included disparities in digital technology access, personal resources, and job skills
Heman et al. (2022)	Mixed-methods exploratory study	Midwest USA: 213 employment service providers	Surveys on barriers to and use of electronic AT	Identified barriers to AT adoption included access, expense, and complexity
Kumari and Lenka (2023)	Mixed-methods exploratory	USA: 321 people with visual, hearing, physical, and cognitive disability	Surveys on how AT can enhance recruitment and retention of PwDs at the workplace	Adoption of AT hindered by lack of hard and soft skills
Kwan (2021)	Case study	Hong Kong: eight employees working in two companies	Comparative study on factors influencing the employment outcomes of PwDs using AT	Skills, knowledge, and attitudes predict the success of disabled employees using AT
Lancioni et al. (2014)	True experimental study	USA: Study 1: two blind people with severe ID and minimal object interaction. Study 2: three deaf people with severe visual impairment and profound ID	Music boxes and optic sensors	In both studies, AT enabled participants to complete object manipulation exercises

Table 1: Continued.

Author (year)	Study type	Country: study population	Intervention/technology	Findings
Rasouli et al. (2023)	Quantitative	USA: 11 informants in home-based services and 176 healthcare staff	Five-point scale evaluation of factors determining success of AT implementation for people with ID	Availability of resources, staff attitudes, and personal interests influence AT implementation for individuals with ID
Sundar et al. (2018)	Quantitative	USA: 3013 working adults with disabilities	Survey on workplace experiences and job search activities among PwDs	52.4% of respondents cited AT as a key employment enabler
Wahidin et al. (2018)	Qualitative descriptive	Australia: five professional workers with visual impairments	Interviews focusing on barriers to successful adoption of AT in the workplace	Challenges to AT integration and making shared documents accessible were identified as main barriers
Walsh et al. (2019)	Qualitative descriptive	USA: three adults with ASD and ID	Interviews focused on effects of a technology-based prework assessment on job performance	ATs were more effective in supporting low-skill-match jobs and low-preference tasks than high-skill-match jobs and high-preference tasks

Abbreviations: ASD, autism spectrum disorder; AT, assistive technology; PwDs, people with disabilities.

access to information, mobility, communication, and discrimination. Bonaccio et al. (2020) noted that PwDs seeking employment commonly face comparable employment-related hurdles. Furthermore, individuals also have a shared objective of adopting AT to enhance their chances of being employed (Carver et al., 2016). These factors contribute to there being minimal variability within a study population.

The meta-analysis revealed a significant relationship between adopting AT and improved employment outcomes (employment and retention rates) among PwDs (Fig. 3). As shown in Figure 4, the pooled odds ratio (OR) for employment status was 2.41 [95% confidence interval (CI): 1.89-2.93, $P < 0.013$], indicating that individuals using AT were 2.41 times more likely to secure employment compared to their disabled counterparts not utilizing these aids. The subgroup analysis by the type of AT indicated consistent findings across the various intervention categories. For instance, the employees with communication devices (OR = 2.51, 95% CI: 1.73-3.29, $P < 0.001$), mobility aids (OR = 2.18, 95% CI: 1.69-2.89, $P < 0.001$), and ergonomic accommodations (OR = 2.64, 95% CI: 1.92-3.52, $P < 0.006$) had significantly higher odds of job retention compared to those not using the assistive devices (Table 3).

A regression analysis conducted to evaluate the impact of the moderator on effect size (Table 4) revealed that the slope was 0 and not statistically significant, indicating that there was no meaningful impact. That is, the slope ($\beta = -0.02$, $P = 0.909$) suggested that the moderator variable did not influence effect size significantly. Although the overall model was significant ($F_{1,10} = 12.00$, $P = 0.006$), the insignificance of the slope indicates that other factors may have contributed to the model's overall significance.

The meta-analysis revealed several barriers hindering optimal AT utilization among employees with disabilities. Limited awareness about disabled workers and their technology use emerged as a significant barrier (OR = 0.43, 95% CI: 0.33-0.52, $P < 0.001$). High costs associated with AT acquisition were also found to impact adoption and workplace integration negatively (OR = 0.39, 95% CI: 0.25-0.52, $P < 0.006$). Furthermore, skill insufficiency was identified as a barrier, with participants showing significant gaps in both hard and soft skills necessary for effective technology use (OR = 0.52, 95% CI: 0.32-0.72, $P < 0.001$). These findings highlight the need for targeted interventions to address AT awareness, cost, and skill-related barriers to improve employment prospects and workplace integration for PwDs.

DISCUSSION

Impact of AT use among PwDs

The present meta-analysis revealed a direct correlation between AT adoption and the employability of PwDs, suggesting that AT adoption leads to more favorable employment outcomes together with enhanced competencies and employment-related skills, such as problem-solving and communication skills. The study's findings indicate that AT usage, particularly communication aids, improves

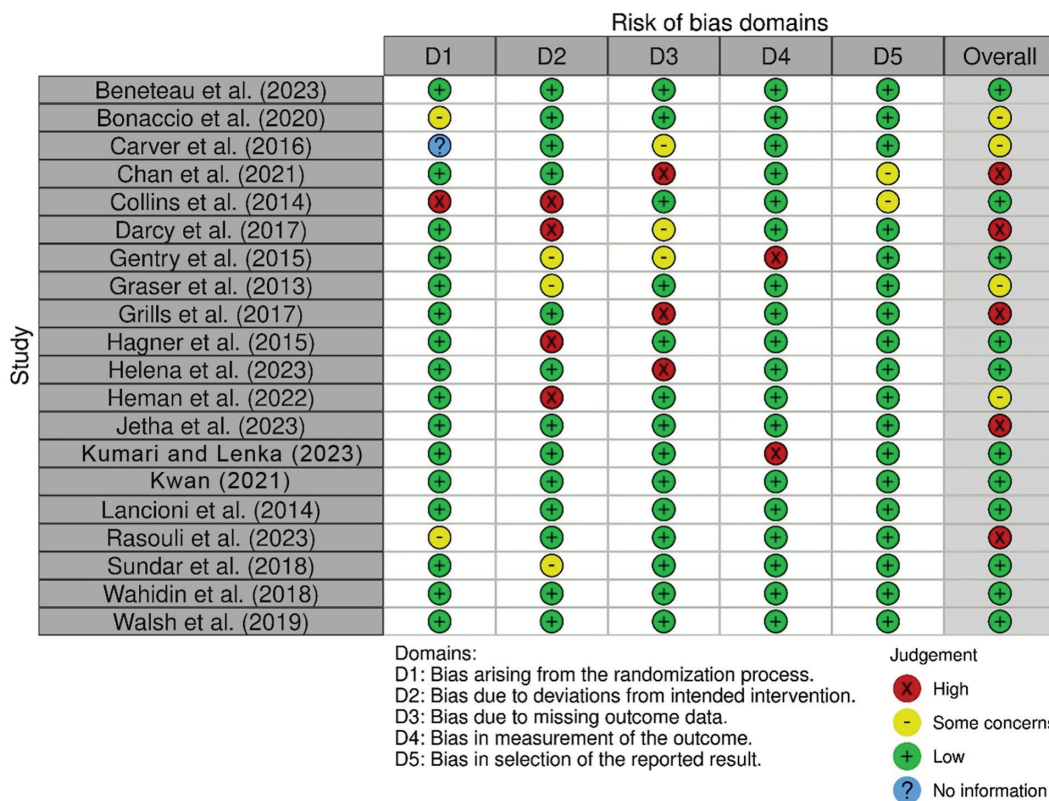


Figure 2: Summary of the risk of bias analysis.

Table 2: Subgroup analysis.

No.	Study	Effect size	CI lower limit	CI upper limit	Weight (%)
1	Beneteau et al. (2023)	0.34	-0.14	0.60	4.98
2	Bonaccio et al. (2020)	0.25	0.09	0.61	6.63
3	Carver et al. (2016)	0.41	0.12	0.44	17.50
4	Chan et al. (2021)	0.34	-0.35	0.95	4.98
5	Collins et al. (2014)	0.52	-0.22	0.76	2.12
6	Darcy et al. (2017)	0.26	0.08	0.68	4.98
7	Gentry et al. (2015)	0.24	-0.12	0.60	3.46
8	Graser et al. (2013)	0.43	-0.12	0.70	2.54
9	Grills et al. (2017)	0.39	-0.04	0.88	2.12
10	Hagner et al. (2015)	0.25	-0.07	0.57	4.98
11	Helena et al. (2023)	0.43	0.18	0.72	7.78
12	Heman et al. (2022)	0.49	0.21	0.81	4.98
13	Jetha et al. (2023)	0.31	0.07	0.77	3.46
14	Kumari and Lenka (2023)	0.30	-0.19	0.79	1.79
15	Kwan (2021)	0.29	0.07	0.51	9.26
16	Lancioni et al. (2014)	0.25	-0.03	0.53	5.71
17	Rasouli et al. (2023)	0.44	0.08	0.80	3.46
18	Sundar et al. (2018)	0.42	0.05	0.79	3.10
19	Wahidin et al. (2018)	0.38	0.04	0.72	3.88
20	Walsh et al. (2019)	0.40	-0.05	0.85	2.31

Abbreviation: CI, confidence interval.

employability prospects for PwDs. These findings are consistent with those of Walsh et al. (2019) who found that emergent supportive technologies enhance employability and retention. Similarly, Alsamiri et al.'s (2022) work suggests that strategic AT use can augment task completion and workplace skills for PwDs. The present findings add to

and align with former work advocating for AT adoption to improve PwD employability.

In KSA, AT has been linked previously to better accommodation and improved employability and workplace performance (Al Shehri et al., 2022; Alqahtani et al., 2023). AT was reported to improve employability and retention

Table 3: Combined analysis.

No.	Study/subgroup	Effect size	CI limits	Weight (%)	Q	PQ	I ²	T ²	T	PI limits
1	Beneteau et al. (2023)	0.23	-0.14, 0.60	11.05						
2	Bonaccio et al. (2020)	0.35	0.09, 0.61	14.71						
3	Carver et al. (2016)	0.28	0.12, 0.44	38.84						
4	Chan et al. (2021)	0.30	-0.35, 0.95	11.05						
5	Gentry et al. (2015)	0.24	-0.12, 0.60	7.67						
6	Graser et al. (2013)	0.29	-0.12, 0.70	5.64						
7	Hagner et al. (2015)	0.25	-0.07, 0.57	11.05						
8	AA	0.28	-0.25, 0.32	52.21	0.51	0.998	0.00	0.00	0.00	0.25, 0.32
9	Collins et al. (2014)	0.27	-0.22, 0.76	9.64						
10	Darcy et al. (2017)	0.38	0.08, 0.68	22.66						
11	Grills et al. (2017)	0.42	-0.04, 0.88	9.64						
12	Helena et al. (2023)	0.45	0.18, 0.72	35.41						
13	Heman et al. (2022)	0.51	0.21, 0.81	22.66						
14	BB	0.43	0.33, 0.52	47.79	0.91	0.923	0.00	0.00	0.00	0.33, 0.52
15	Combined effect size	0.35	0.19, 0.51	—	4.24	0.962	0.00	0.00	0.00	0.08, 0.62

Abbreviations: AA, analysis algorithm; BB, bias assessment; CI, confidence interval; I², percentage of variation across studies due to heterogeneity rather than chance; PI, prediction interval; PQ, P-value for the Q statistic; T, t-value measure of difference size relative to variation in sample data.

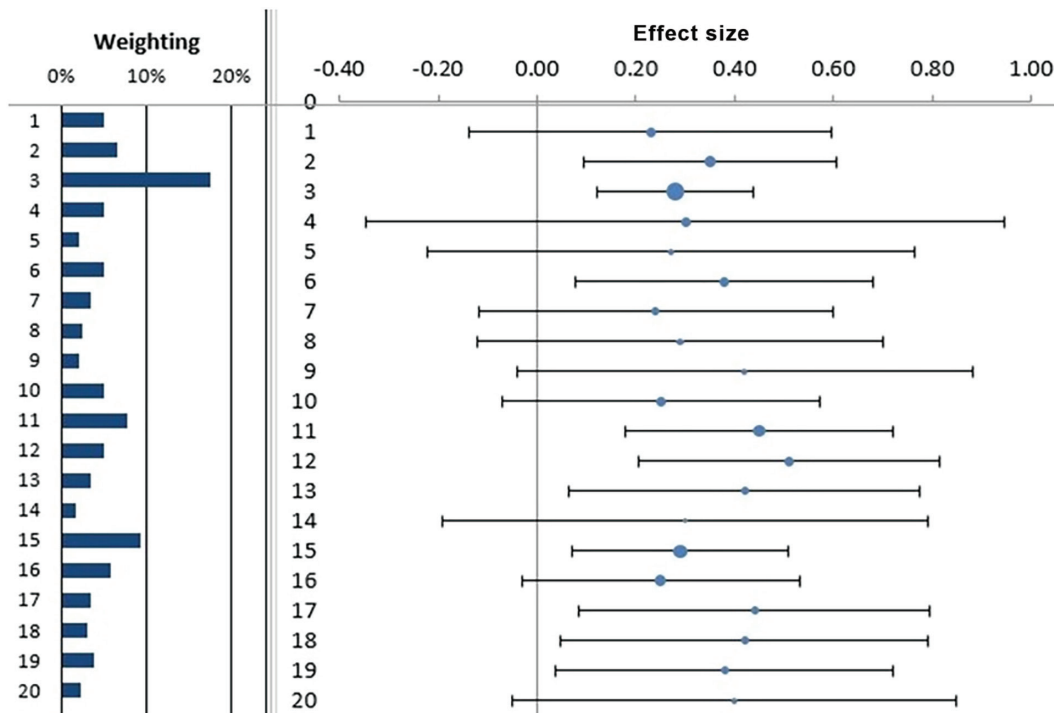


Figure 3: Forecast plot of the included studies. Note: Numbers 1 to 20 represent the studies included in the meta-analysis.

by enhancing performance within organizational policies (Al-Dawaideh, 2013; Alqahtani et al., 2023). However, AT adoption and utilization in KSA are influenced by factors such as resource accessibility and organizational policies (Bonaccio et al., 2020).

The meta-analysis results suggest that strategic AT has the potential to overcome workplace performance challenges for PwDs. Hagner et al. (2015) noted that well-implemented AT use improved productivity and influenced employment and retention decisions. Additionally, strategic use of emerging AT has been described as essential for achieving efficiency (Gentry et al., 2015; Darcy et al., 2017). Researchers have emphasized the need for training PwDs in AT use to enhance

their competitiveness in the labor market (Collins et al., 2014; Chan et al., 2021). The findings of the present meta-analysis are consistent with Morash-Macneil et al.'s (2018) demonstration of positive impacts of AT in the workplace for individuals with an ID, Marinaci et al.'s (2023) demonstration of broad benefits of AT in enhancing employability and fostering inclusive work environments, and Damianidou et al.'s (2019) reporting that AT supports employment-related outcomes for individuals with ID and developmental disability.

Additionally, it is worthwhile to consider how occupational AT relates to broader AT use for PwDs, including the potential for AT in the information and communication domains to compensate for cognitive deficits in daily life (Brandt et al.,

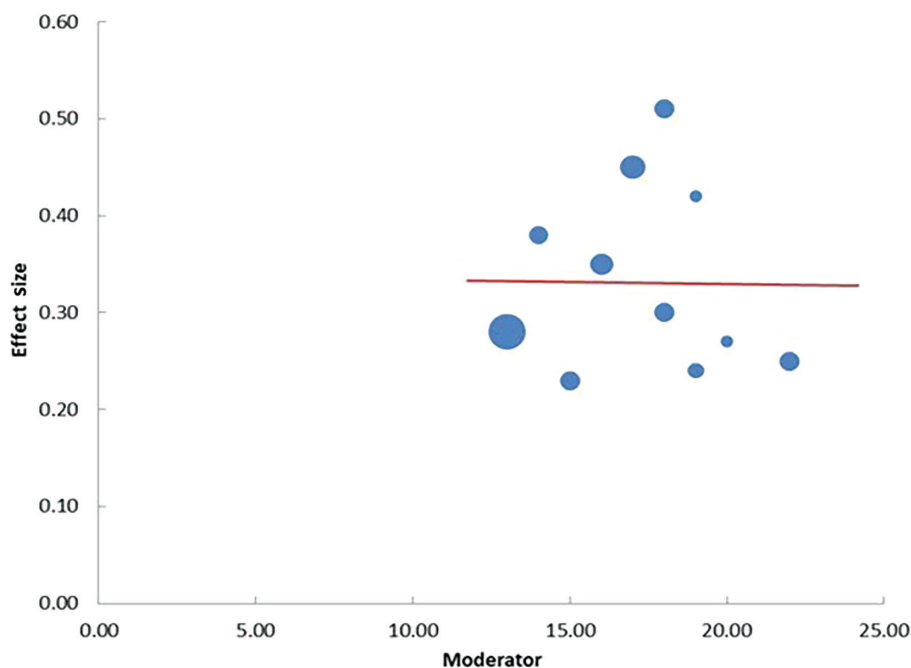


Figure 4: Regression of moderator on effect size.

Table 4: Regression analysis of the study group.

Parameter	β	SE	CI limits	β	Z-value	P
Intercept	0.34	0.06	0.21, 0.46	—	5.99	>0.001
Slope	0.00	0.00	-0.01, 0.01	-0.02	-0.11	0.909
ANOVA	Q	df	P	MS	F-value	
Model	6.16	1	0.013	6.16	12.00	0.006
Residual	5.13	10	0.882	0.51	—	—
Total	11.29	11	0.419	—	—	—
Combined effect size	0.22	—	—	—	—	—
T^2	0.00	—	—	—	—	—
R^2	54.55%	—	—	—	—	—

Abbreviations: ANOVA, analysis of variance; CI, confidence interval; df, degrees of freedom; MS, mean square; Q, sum of squares; R^2 , coefficient of determination; SE, standard error; T^2 , differences between the mean values of two groups.

2020) and generalization of AT across educational and occupational environments (McNicholl et al., 2021; Fernández-Batanero et al., 2022; Thapliyal and Ahuja, 2023).

Overall, the present work supports the supposition that effective AT adoption can have positive impacts on the employment outcomes of PwDs. More specifically, this meta-analysis supports Alqahtani et al.’s (2023) findings, indicating that AT can extend and enhance the functional capabilities of PwDs. Notwithstanding, more research, including research with within-subject experimental designs, is needed to explore the factors influencing AT effectiveness in improving employment outcomes for PwDs.

Barriers to effective adoption of AT in the workplace

The employability of PwDs is influenced by their ability to adapt to and utilize AT (Kwan, 2021). The results of

the present meta-analysis indicated that there is a positive relationship between AT awareness and its adoption to enhance PwD employability. Conversely, low awareness of AT functionality and availability hinders AT adoption and usage, affecting employment prospects for PwDs negatively (Rasouli et al., 2023). Moreover, lack of managerial support for AT usage and awareness impedes disabled employees’ retention (Heman et al., 2022; Kumari and Lenka, 2023). Educating PwDs on AT usage can improve communication abilities and enhance employability and retention (Kwan, 2021; Jetha et al., 2023).

The present meta-analysis also identified high acquisition costs of supportive technology devices as a significant barrier to effective AT adoption. PwDs often lack the financial resources to acquire supportive devices despite being keen to pursue employment opportunities. This finding aligns with the literature highlighting financial challenges in accessing AT in the KSA labor market (Qureshi et al., 2021; Al Shehri et al., 2022). Limited financial resources, high AT costs, and

inadequate insurance coverage exacerbate employment disparities for PwDs in the KSA (Alqahtani et al., 2023).

The lack of soft and hard skills among PwDs also emerged as a notable barrier to AT adoption and utilization. The meta-analysis revealed a strong correlation between targeted employment skills and effective AT use. Sundar et al. (2018) emphasized the importance of training and skill development to optimize AT effectiveness. A lack of skills in AT use makes it difficult for PwDs to secure and sustain employment opportunities (Al Shehri et al., 2022). Addressing this employability challenge requires targeted training programs to help PwDs master AT use (Sulaimani and Bagadood, 2023).

CONCLUSION

This present examination of potential AT augmentation of the employability of PwDs in the KSA job market demonstrated a strong positive association between AT adoption and improvements in employment outcomes for PwDs in the KSA, including benefits for employability and retention prospects. Barriers such as lack of awareness, lack of skills, and high costs of AT devices hinder the effective adoption and use of ATs in the workplace. Targeted interventions, including fiscal assistance programs, specific education and

awareness campaigns, initiatives to foster skill development, and potential policy changes, are necessary to address these challenges. Implementation of such targeted interventions may enable the creation of a more inclusive job market that supports the employment and retention of PwDs. The findings from this study can be used as guidance in policy-related decisions, inform resource allocation adjustments, and aid in designing strategies to improve employment outcomes and the overall well-being of PwDs in the KSA.

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