[1] **Pratima Lukesh Bhuyar**

[2] **Rajashree Shedge**

[3] **Shilpa Shinde**

[4] **Lukeshkumar Bhuyar**

Parents' Mental Health Detection Having Children with Disabilities Using Machine Learning Technique

JES
Journal of Electrical Systems

Abstract: - The journey of parents raising children with disabilities is fraught with unique challenges, underscoring the critical need for comprehensive research to illuminate statistical insights that can drive informed policy, bolster support systems, and inspire community initiatives. This study leverages a diverse array of sources, including national surveys, government databases, and peer-reviewed studies, to provide a nuanced understanding of the multifaceted experiences of these parents. Through meticulous data analysis spanning various dimensions, such as the prevalence of different disability types, socioeconomic disparities, geographic distribution, and access to essential services like healthcare and education, this research aims to offer a holistic perspective. Recognizing the pivotal role of machine learning, particularly in addressing mental health challenges, this study presents an innovative approach. Utilizing advanced techniques such as Qualitative Analysis, Regression Analysis, and logistic regression, the research lays the groundwork for a proposed system designed to predict and detect parental mental health issues within families raising disabled children. This proposed system integrates classification algorithms, leveraging both structured and unstructured data. For structured data, a combination of sophisticated algorithms including Random Forest, XGboost, KNN, SVM, and decision trees is employed. Meanwhile, Natural Language Processing (NLP) techniques are applied to unstructured data, enhancing the assessment of parental mental health.

Keywords: Disability, Machine Learning, Parents' Mental Health, Statistical Analysis.

I. INTRODUCTION

Parents of children with disabilities is marked by unique challenges, and critical statistical insights that can inform policy, support systems, and community initiatives. The disability refers cerebral palsy, autism spectrum disorder, sensory impairments, down syndrome, and many others. The study of parents in this context seeks to shed light on various aspects of their lives, including their emotional well-being, coping mechanisms, social support networks, healthcare access, educational experiences, and advocacy efforts. It is a field that recognizes the resilience and strength of parents who are often faced with extraordinary demands, and it strives to provide insights that can inform policy, services, and support systems to enhance the quality of life for these families. By fostering a deeper understanding of the unique demands placed upon these families, society can move towards creating a more inclusive and compassionate world for all children, regardless of their abilities [1]. In this research we will study the daily realities, emotional landscapes, and societal implications of parenting children with disabilities. This exploration is not only an academic endeavor but also a testament to the strength and determination of these parents, who inspire us with their unwavering commitment to their children's well-being and the pursuit of a more equitable world [2].

Machine learning is a methodology that uses sophisticated statistical and probabilistic methods to build systems that can get better with use. It is thought to be a very helpful technique for helping to predict mental health. In general, research into various machine learning approaches and methods is still being conducted in order to produce the best outcomes. Finding the class of algorithms that perform best in a given task context is still important, even if it is important to remember that there isn't a single learning algorithm that works best everywhere [3].

II. COMPARATIVE ANALYSIS OF DIFFERENT STUDIES ON MENTAL HEALTH OF PARENTS OF DISABLED

Comparative analysis for research paper provides the methodology and details about the work related to parent mental health detection. Following Table 1 presents the comparative study of related targeted population, research work and different methods.

[1] Student, Ramarao Adik Institute of Technology, D Y Patil deemed to be University, Nerul, Navi Mumbai, India. kharangkar.pratima@gmail.com
[2, 3] Assistant Professor, Ramarao Adik Institute of Technology, D Y Patil deemed to be University, Nerul, Navi Mumbai, India. rajashree.shedge@rait.ac.in, shilpa.shinde@rait.ac.in
[4] Lecturer, Department of Prosthetics & Orthotics, AIIPMR, Mumbai, India. brlukeshmpo@gmail.com

III. METHODOLOGY

3.1   Logistic Regression

Logistic regression is used to model the relationship between categorical response variable and predictor factors [2][9]. logistic regression serves to classify whether individuals seek treatment for disabilities, based on various input features. The predictive model within the code is powered by logistic regression, which determines whether or not choose to receive treatment for their mental health. Finding correlations between input feature (children disability, type of disability, gender, age, family history and more) and the binary outcome ('treatment') is

Table 1: Comparative analysis of different studies on Mental Health of Parents of Disabled Children

Pub-Year	Scope	Observations	Method	Advantages	Limitation
[3]-2011	Developmental Disabilities	youngsters with developmental impairments	Meta-analysis	Effective parenting strategies is shown by the moderate correlation found between positive parental attributes and child outcomes, especially for young children with disabilities.	Generalizability to other populations is limited by the high percentage of children with Down syndrome and the disregard for father-child relations.
[4]-2012	Developmental Disabilities	youngsters with developmental impairments	Meta analysis	Positive parenting correlates moderately with child outcomes, emphasizing its importance for young children, especially those with impairments.	Limited generalizability due to lack of fathers' interactions and the high proportion of children with Down syndrome
[5]-2017	Mothers of children who suffer from autism spectrum disorder	Utilizing simple surveys like the CHIP PSI-SF and FNQ is crucial for identifying individual family needs accurately.	Linear Regression	User-friendly and reasonably priced surveys such as the FNQ, PSI-SF, and CHIP are important resources for accurately evaluating changing family requirements.	The findings' applicability to caregivers with kids with ASD is constrained by the limited sample size and the low rate of participant involvement.
[6]-2019	Mothers of autistic children who are not intellectually disabled	The study looks at the relationships between coping mechanisms, social support, symptom intensity, and parenting stress in moms of autistic children who do not have intellectual disabilities.	Pearson correlations and multiple regression analysis	negative impacts of stress is to support moms in adopting behavioural approaches and coping mechanisms with their kids.	Parent-report questionnaires, which may introduce bias and limit the ecological validity of the measures.
[12]-2021	Literature Review	During the pandemic, families with children with disabilities will have to pay more for caregiving.	Multiple regression analysis	Parents of children with developmental problems are compared to parents without impairments in a cross-sectional study.	The quality of life of parents of children with impairments is not thoroughly examined in this study.
[13]-2022	Mothers of children with dis- abilities.	The mothers who participated in the program reported feeling less stressed, anxious, and depressed.	Data analysis	The program proved successful in lowering the moms who participated's levels of stress, anxiety, and depression symptoms.	tracking going forward to determine whether the changed habit lasted
[14]-2023	caregiver of disabled kids	parents of children with impairments have greater rates	Logistic regression	Examine the connection between having a kid with a disability and the expenses	doesn't make it possible to determine the connection between the child's handicap diagnosis and

		of mental health problems than parents of children who are typically developing across all age groups.		and utilization of mental health care, allowing statistical comparisons to pinpoint significant variations.	the timing of the parents' mental health issues

the aim of the dataset analysis. Based on these insights, it makes predictions about the probability that a certain person would seek therapy. The effectiveness of logistic regression in classification is measured by means of assessment measures like accuracy and precision, which provide important information about the predictive power and performance of the model. Logistic regression is the least best performing algorithm in the series. It gives an accuracy of **71.03%** with a precision of **72%**.

3.2 K-Neighbors Classifier

KNN is based on feature similarity which means it will check the similarity between the sample features of the training set, and this similarity will help determine the data point. KNN was used in multiple researches of mental health. In [10] it was used to predict whether the person needed treatment or not. The preprocessed data is used to train the KNN classifier, which identifies patterns between the target variable which indicates whether parents seek treatment and a variety of factors, including age, gender, and family history, child disability. For both the training and testing datasets, the model forecasts the probability of seeking treatment after training. After that, evaluation metrics like precision and accuracy are computed to evaluate the model's performance. High precision denotes the model's capacity to precisely identify parents who actually need treatment, while high accuracy reflects the model's efficacy in correctly classifying occurrences. Consequently, positive accuracy and precision scores would imply that the KNN model successfully recognizes and helps parents who require mental health support, guaranteeing prompt intervention and care for this susceptible group.
KNN is the least best performing algorithm in the series. It gives an accuracy of **71.42%** with a precision of **75**%.

3.3 Extreme Gradient Boosting (XGBoost)

XGBoost, known as Extreme Gradient Boosting, represents a powerful and scalable framework for distributed gradient-boosted decision trees in the realm of machine learning. It stands out as a premier library for addressing regression, classification, and ranking challenges, boasting

efficient parallel tree boosting capabilities [14]. In the above code, the XGBoost algorithm is in charge of forecasting whether parents of disabled children would seek mental health care. Based on characteristics including age, gender, employment position, type of disability, and family history, XGBoost successfully predicts whether parents would seek treatment for mental health concerns in this work, as evidenced by its high accuracy score. An accurate model that correctly identifies parents in need of support can enable prompt intervention and assistance, as shown by a high accuracy score. In a practical demonstration, XGBoost showcases its prowess by achieving an impressive **73.54%** accuracy and **75.40%** precision for the current sample dataset.

3.4 Support Vector Machine (Svm)

An important factor in determining whether parents of disabled children would seek mental health therapy is the Support Vector Machine (SVM) algorithm [15]. The main classifier, SVM, is charged with identifying patterns in the dataset in order to differentiate between parents who will seek therapy ('Yes') and those who won't ('No'). SVM creates a decision boundary in the feature space by using a linear kernel, which effectively divides the two classes. In order to provide precise predictions, the SVM model modifies its parameters during training in order to reduce classification errors and increase the margin between classes. After training, SVM classifies new cases using the learnt decision boundary, which allows it to anticipate whether parents will seek therapy based on those features. The SVM model's performance gives a accuracy of **69.04%** for current sample dataset and precision **68.0%.**

3.5 Decision tree

Decision tree can be used for both classification and regression It is a flowchart like structure consisting of nodes where the nodes represent an attribute [15]. The Decison Tree classifier uses an advanced algorithmic technique to examine a number of characteristics, such as age, gender, child disability, type of disability and family history, in order to forecast whether or not parents of disabled children will seek mental health therapy. By means of a hierarchical partitioning procedure, the model formulates decision rules that efficiently divide parents into discrete

groups according to their inclination to request help. Decision tree is the least performing algorithm which provide accuracy of **71.43%** and precision **68.57%**.

3.6   *Random Forest*

During training, the Random Forest ensemble learning technique creates several decision trees. Using random feature subsets for node splitting and a random subset of the dataset for training, this method generates a set of one hundred decision trees. The Random Forest method combines the predictions made by each individual decision tree after training. It generates a final forecast by averaging (regression) or classifying the guesses through voting. One well-known application of Random Forests is their capacity to reduce overfitting, a prevalent problem in machine learning models [15]. The following steps are involved in the prediction of parents' mental health.

Preprocessing of the data: The dataset is painstakingly assembled by filling in the missing values using imputation strategies designed for both numerical and categorical attributes.

Training the Model: The preprocessed dataset is used to train a Random Forest classifier, which consists of a group of 100 decision trees.

Evaluation measures: Known measures like accuracy and precision are used to thoroughly assess the trained model.

Graphical representation: A bar graph is used to show the computed accuracy for training and testing and precision.

In the proposed solution, Random Forest algorithm provides highest level of accuracy **80.16%** with **82.02%** precision.

IV. PROPOSED SOLUTION

The below Fig 1 shows the proposed flow diagram for the proposed system and show the complete flow of integrated approach. In the proposed solution the all the six algorithms

Knn, Svm, Logistic Regression, Decision Tree, XGboost, and Random Forest apply on data. The model or algorithm which give the highest accuracy that will be consider. The unpredicted values highest model is considered as data from next model which is second highest model or algorithm and predict the improve accuracy.
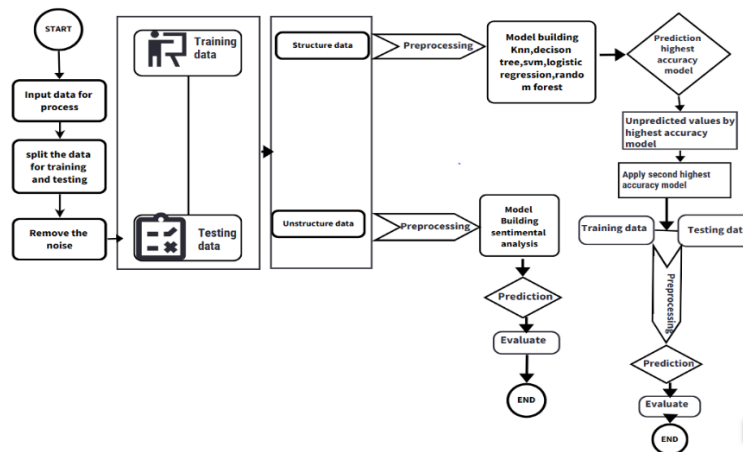

Fig. 1. Proposed System Flowchart

Part 1:

The proposed system is an integrated approach of multiple classification algorithm for structure data Random Forest algorithm provides highest level of accuracy (**80.15%**) and XGBoost provides the second highest level of accuracy (**73.54%**). To improve the accuracy of overall model the second highest model is applied to unpredicted values of random forest and improve the accuracy up to **96.43%**.

Following Steps are involved in proposed system.

1.   Preprocessing data: Preprocessing the data involves encoding categorical categories, standardizing numerical features, and handling missing values.

2.   Trains the Model: After dividing the data into testing and training sets, the logistic regression model is trained using the training set.

3.   Makes Predictions: For both training and testing sets, it makes predictions about the target variable.

4.   Assesses Performance: determines the precision score for the testing set and the accuracy scores for the training and testing sets.

5.   Displays Outcomes Visually: displays in a bar graph the model's performance parameters (precision, testing accuracy, and training accuracy) for simple comparison.

Part 2:

Above same steps are followed for the unpredicted values to improve the accuracy in second model.

Part 3:

NLP model (Sentimental analysis) where we used sentimental analysis for unstructured data (comments) which provides the predicted result in the form of positive, negative and neutral comments.

Part 4:

At the end we are combining the predicted common result for structure data (age, type of disability, child disability, family history and more) and unstructured data(comments) for same dataset.

V.   RESULT ANALYSIS:

Part 1: Result Analysis by Using Classification Algorithm

To predict parents' mental health condition, the current study used logistic regression and descriptive analysis [1][7]. The algorithm's training, testing, and precision accuracy and precision are displayed in the graph below, which predicts the mental health of parents of disabled children which shown in fig 4.

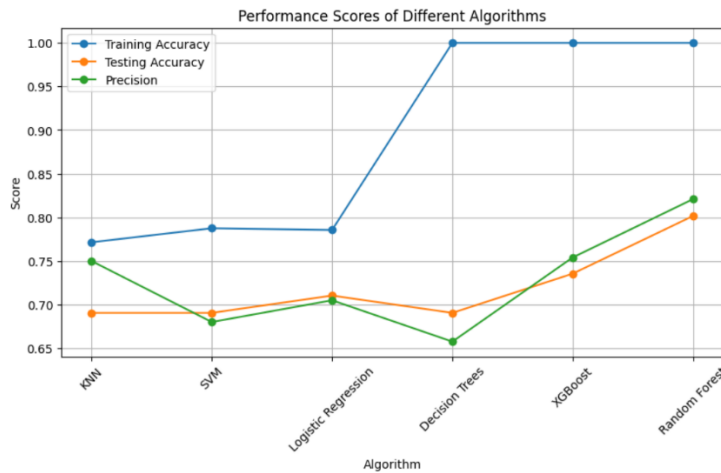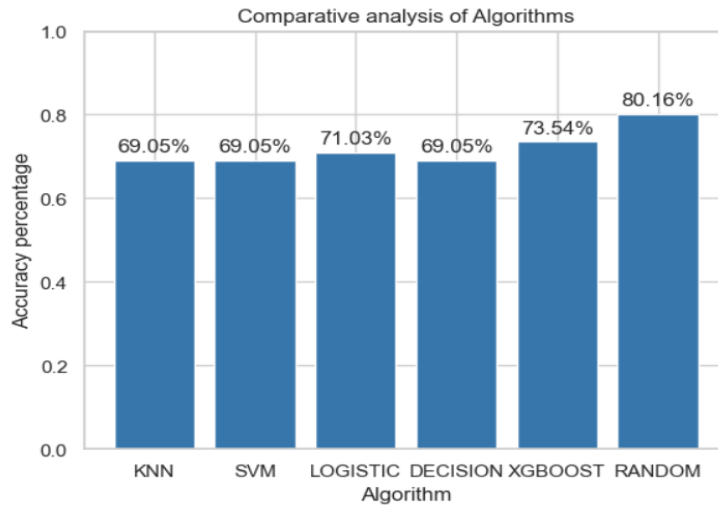**Comparative Analysis of Algorithm**

Fig. 2. Performance score for different algorithm

The comparison of knn, svm, logistic regression, decision tree, XGboost, and random forest is displayed in the graph below.

Fig. 3. Comparative analysis of Algorithm

In below table the accuracy of various classification algorithm is given to predict the mental health of the parents.

Table 2: Accuracy of various classification Algorithm

Algorithm	Accuracy %
KNN	69.05
SVM	69.05
Logistic Regression	71.03
Decision Tree	69.05
XGboost	73.54
Random Forest	80.16

Part 2: Integrated Approach to Improve the Accuracy Over the Random Forest

The below graph shows the improve accuracy XGboost over the random forest for those values which are not predicted by the Random Forest algorithm.
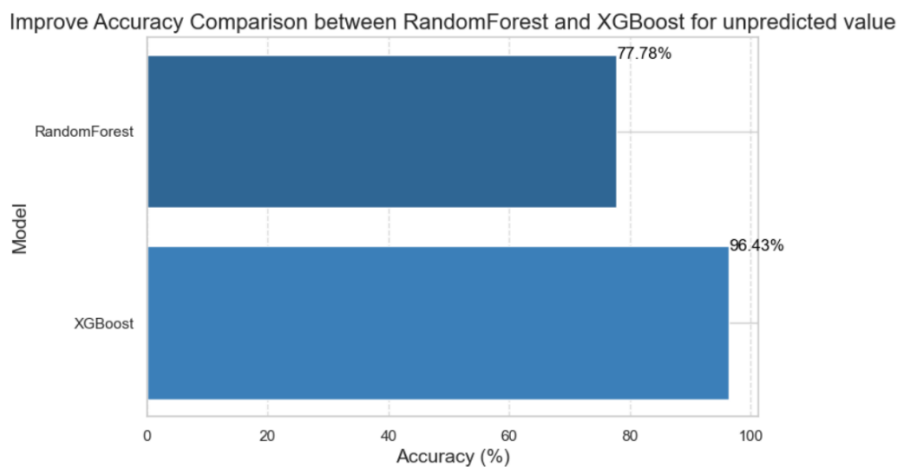

Fig. 4. Improve accuracy between Rando Forest and Xgboost for unpredicted values

Part 3: Prediction By Using Unstructured Data

The below graph figure 5 shows the positive and negative sentiments for the Unstructured data (Comments) for distribution of positive, negative and neutral sentiments.
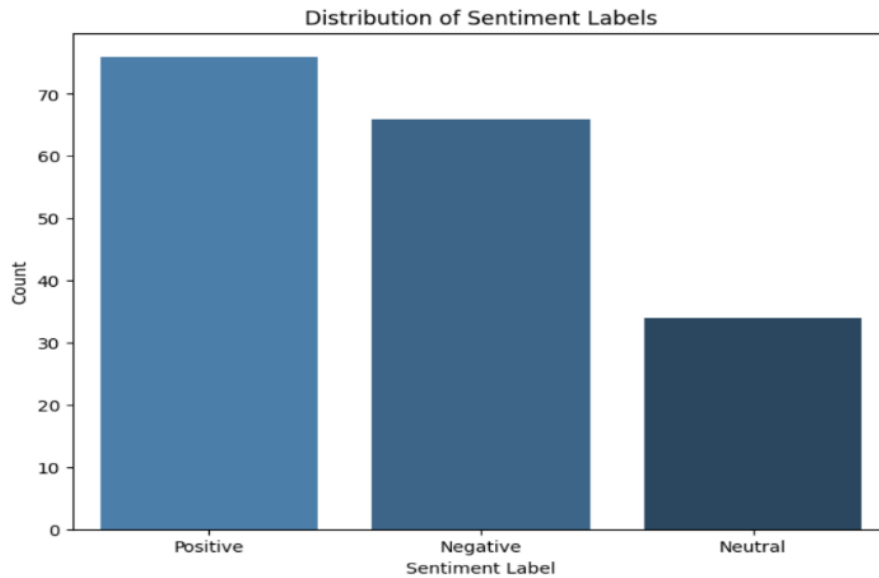

Fig. 5. Distribution of sentimental label.

Part 4: Common Result for Machine Learning Algorithm for Structure Data and Natural Language Processing for Unstructured Data.

The below graph figure 6 shows the common result for the same dataset by using machine learning for structure data and Sentimental analysis for unstructured data.
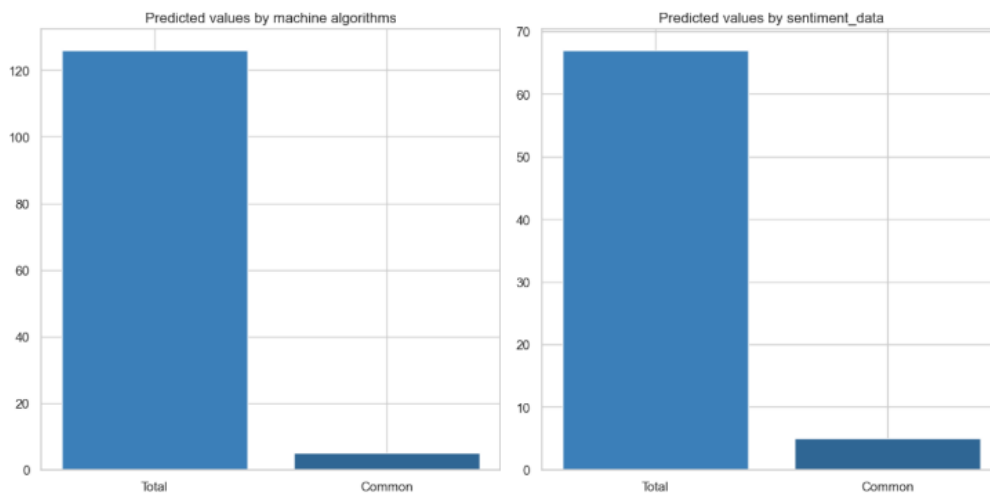

Fig. 6. Common Results for Machine algorithm and Sentimental analysis

VI. CONCLUSION

Regression models predict the level or magnitude of the outcome variable, but they do not directly classify individuals into distinct categories. So, the classification algorithm is used to predict the mental health problem. Our system combines advanced algorithms like Random Forest for structured data and NLP for unstructured data to assess parental mental health in families with disabled children. By integrating these approaches, we offer tailored support, interventions, and resources to improve parental well-being and caregiving resilience.

REFERENCES

[1] Chung, J., Teo, J. Single classifier vs. ensemble machine learning approaches for mental health prediction. Brain Inf. 10, 1 ,2023.

[2] S. Chen, B. Mulgrew, and P. M. Grant, "A clustering technique for digital communications channel equalization using radial basis function networks," IEEE Trans. on Neural Networks, vol. 4, pp. 570-578, July 1993.

[3] C. Y. Lin, M. Wu, J. A. Bloom, I. J. Cox, and M. Miller, "Rotation, scale, and translation resilient public watermarking for images," IEEE Trans. Image Process., vol. 10, no. 5, pp. 767-782, May 200 Chu Chen, MPH a, Cate Bailey, PhD b, Gordon Baikie, MD c, Kim Dalziel, PhD b, Xinyang Hua, PhD b, "Parents of children with disability: Mental health outcomes and utilization of mental health services", Disability and Health Journal, Disability and Health Journal 16 2023.

[4] Ana Miranda1 *, Alvaro Mira1, Carmen Berenguer1, Belen Rosello1 and In- maculada Baixauli2, "Parenting Stress in Mothers of Children with Autism Without Intellectual Disability. Mediation of Behavioural Problems and Cop- ing Strategies", 2019.

[5] Hilliard ME, et al. "The Experiences and Needs of Parents of Young Children with Type 1 Diabetes: A Literature Review". Health Psychology. 2011.

[6] Dyches TT, Smith TB, Korth BB, Roper SO, Mandleco B, et al. "Positive parenting of children with developmental disabilities: A meta-analysis". July 2012.

[7] Helen M. Bourke Taylor1 Kahli S. Joyce1 · Sarah Grzegorczyn2 · Loredana Tirlea3, "Mental Health and Health Behaviour Changes for Mothers of Chil- dren with a Disability: Effectiveness of a Health and Wellbeing Workshop" Journal of Autism and Developmental Disorders ,2022.52:508"521.

[8] Sheri R. Kiami 1 and Shelley Goodgold, "Support Needs and Coping Strate- gies as Predictors of Stress Level among Mothers of Children with Autism Spectrum Disorder", Published 25 December 2017.

[9] Usman Ali, Vardah Bharuchi, Nasreen Gulzar Ali and Sidra K. Jafri*," As- sessing the Quality of Life of Parents of Children With Disabilities Using WHOQoL BREF During COVID-19 Pandemic",13 Aug2021.

[10] Betz CL, et al, "Parental Resilience and Families of Children with Disabili- ties: A Review of the Literature". Research Practice for Persons with Severe Disabilities. 2011.

[11] Hilliard ME, et al, "The Experiences and Needs of Parents of Young Children with Type 1 Diabetes: A Literature Review". Health Psychology. 2011.

[12] Brown, I., Anand, S., Fung, W. L., Isaacs, B., Baum, N. "Family Quality of Life when There is a Child with a Developmental Disability", 2003.

[13] Aldridge J, Becker K,"Caring for Children wit Disabilities: An Exploratory Study of Parental Stress and Coping". Health Social Work. 1999.

[14] Pitchford EA, Leung W, Webster EK. "Fundamental Motor Skill Delays in Preschool Children with Disabilities: 2012 National Youth Fitness Survey". Front Public Health. Dec 2021.

[15] Jetli Chung, Jason Teo, "Mental Health Prediction Using Machine Learning: Taxonomy, Applications, and Challenges", Applied Computational Intelligence and Soft Computing, vol. 2022, Article ID 9970363, 19 pages, 2022. https://doi.org/ 10.1155/2022/9970363.

[16] Ku B, Stinson JD, MacDonald M, McIntyre LL. "Parental Behavior Influ- ences on Motor Skill Development in Young Children with Developmental Disabilities: A Two-Year Longitudinal Study". Child Psychiatry Hum Dev. Apr, 2023.

[17] Tate AE, McCabe RC, Larsson H, Lundstrm S, Lichtenstein P, Kuja- Halkola R. Predicting mental health problems in adolescence using machine learning techniques. PLoS One. 2020 Apr 6;15(4):e0230389. doi: 10.1371/jour- nal.pone.0230389. PMID: 32251439; PMCID: PMC7135284.

[18] Rodocanachi Roidi ML, Isaias IU, Cozzi F, Grange F, Scotti FM, Gestra VF, Gandini A, Ripamonti E," Motor function in Rett syndrome: comparing clinical and parental assessments". Dev Med Child Neurol. Aug 2019.

[19] Czupryna K, Nowotny-Czupryna O, Nowotny J,"Back pain in mothers of cerebral palsied children". Ortop Traumatol Rehabil. Sep-Oct ,2014.

[20] Kenyon LK, Mortenson WB, Miller WC." ™Power in Mobility™: parent and therapist perspectives of the experiences of children learning to use powered mobility". Dev Med Child Neurol. Oct ,2018.

[21] Polovina-ProloscicT, VidovicV, Polovina S, Polovina ,"A Family and child with central nervous system lesion". Coll Antropol. Jun 2009.

[22] Akemoglu Y, Laroue D, Kudesey C, Stahlman M." A Module-Based Teleprac- tice Intervention for Parents of Children with Developmental Disabilities". J Autism Dev Disord. Dec ,2022.