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Systematic Review

Mental Health Biobanks—A Systematic Review on the Prevalence, Creation, and Implementation of Mental Health Biobanks Globally

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Abstract: Biobanks are collections of human biological materials (biospecimens) alongside personal health information that are stored for scientific research. There is a wide range of evidence to show that biomarkers can be linked to psychiatric illnesses. Identification of such biomarkers facilitates clinical diagnosis, early intervention, and compressive treatment. The aim of this systematic review was to analyze the methodology of global biobanks focusing on mental illnesses. Six databases were systematically searched. A total of 1363 abstracts were screened, and 21 full texts were assessed for eligibility. The quality of the literature was appraised. Of the six papers included, there were few mental health-specific biobanks globally, with the majority being in European and American countries. Most research was conducted examining depression with scant research on self-harm, personality disorders, and post-traumatic stress disorder (PTSD). Blood was the most common biological sample collected, and less common samples were hair and saliva. Mental health-specific biobanks support the understanding of biological etiologies of psychiatric diseases. There are gaps in research on certain mental illnesses such as personality disorders and PTSD. More research is required in lower–middle income countries. Despite scientific progress to identify biochemical markers of mental disorders, further research is needed to aid diagnosis and management within this discipline.

Keywords: biobank; biological markers; psychiatry; mental illness; biological specimens

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1. Background

Mental illnesses are highly prevalent globally and affect individuals in all biological, psychological, and social dimensions of health [1]. Mood disorders, anxiety disorders, and psychotic disorders are amongst many debilitating psychiatric illnesses seen in over one billion of the world's population [2]. Anxiety disorders can affect up to 33.7% of the population during their lifetime [3]. Psychotic disorders such as schizophrenia affect approximately one in three hundred people globally and individuals affected by this illness are two to three times more likely to die than the general population [4]. For example, up to 75% of individuals with schizophrenia die of coronary heart disease when compared to 33% of the general population [5]. The remaining deaths in individuals with schizophrenia are due to causes such as suicide, homicide, and accidents [5]. According to the World Health Organisation, depression is currently the leading cause of disability worldwide and contributes significantly to the global burden of disease [4]. Other mental illnesses can include personality disorders, post-traumatic stress disorder, self-harm, and substance abuse, however, they are less likely to be addressed.

Understanding the biological etiologies of psychiatric illness is congruent with the biopsychosocial model proposed by George Engel [1]. Biological advances in psychiatry have allowed for an objective and evidence-based approach in causation, diagnosis, and

treatment [1]. Additionally, this can be then used to tailor pharmacology more effectively to the patient.

2. Psychiatric Illness and Biochemical Markers

There is a wide range of evidence to show that biomarkers can be linked to various psychiatric illnesses [6]. Through identifying these biomarkers, it is possible to explain the pathophysiology of a particular illness and target pharmacotherapy more efficiently [7]. Biomarkers can include extracellular mechanisms, such as the hypothalamic–pituitary axis, or they can also be intracellular such as various metabolic processes [8]. For example, proinflammatory biomarkers such as interleukin-6 and C-reactive protein have been shown to be elevated in depressed patients [9]. Although the etiology of these diseases may remain unclear, biomarkers can eventually become an essential tool to aid diagnosis, predict risk factors, and allow effective treatment.

3. Biobank

To collect the necessary biomarkers, appropriate biobanks are needed to further our understanding. A biobank is a collection of human biological materials (biospecimens) alongside personal health information that can aid scientific research [10]. Biological specimens can include but are not limited to blood, saliva, hair, feces, cerebrospinal fluid (CSF), and tissue. These samples are then linked to an individuals' personal medical record such as history, lifestyle, and genetic markers [11]. Biobanks are particularly vital to understand the biological processes of complex diseases. Summarizing international biobanks informs the creation of future mental health biobanks. This can provide a better understanding of the process of collection, storage, and analysis of biospecimens so that it can be implemented in future practice.

4. Materials and Methods

4.1. Aims

This systematic review summarizes how global biobanks specifically investigating mental illnesses are created and implemented. This includes (1) the protocols that were followed, (2) the ethical considerations that were addressed, (3) the recruitment process, (4) samples collected, (5) clinical outcomes analyzed, and (6) barriers to implementation. This review was registered on 6th November 2021 on the International Prospective Register of Systematic Reviews (PROSPERO) prior to commencement: CRD42021283102. (https://www.crd.york.ac.uk/prospero/).

4.2. Study Design

The 24-step framework for systematic review and meta-analysis was used to guide the research process [12]. The methodological approach included identification of the literature through various databases, data extrapolation, data analysis, and data synthesis. Collation of the findings were presented in a matrix table, allowing for visualization and selection of recurrent themes and patterns. The simplification of the themes within this table enabled conclusions to be drawn.

4.3. Search Strategy

The hospital librarian was consulted to support the generation of the search strategy. The following databases were searched by 2 November 2021: PubMed/MEDLINE (OVID), Cochrane Database, Embase, Web of Science, PsycINFO, and CINAHL (please see Supplementary Table S1 for full search criteria). Boolean operators were used to identify search terms around (1) biological specimen banks, e.g., blood, saliva, CSF, and (2) mental health, e.g., ((mental* or psych*) adj2 (health or disorder* or ill*)) ti,ab. Additional filters such as publications from 1990 and only ones published in English were applied. Hand searching through Google was performed for relevant research methodology.

4.4. Inclusion and Exclusion

Articles were included if (1) any mental health/psychiatric condition was examined, (2) a specific biobank was mentioned, (3) biospecimens such as but not limited to blood, feces, and CSF were collected, (4) live people were recruited and samples were collected, and (5) the biobank was implemented anywhere internationally. Literature that included protocols, commentary, cohort, and cross-sectional studies were included to ensure the research question was addressed. Other methodologies such as randomized-control trials, systematic reviews, and meta-analyses were excluded. Only articles published from 1990 onwards and primarily in English were selected. Any literature that included (1) children under 18 and (2) neurological or neurodegenerative conditions (e.g., autism-spectrum disorder, attention-deficit hyperactive disorder, Alzheimer's dementia, Parkinson's disease) were excluded.

4.5. Search Procedure and Outcomes

Results were exported from all databases to EndNote version 20. Duplicates were removed and the remaining titles and abstracts were independently screened by an author (NG) based on the eligibility criteria. There was subsequent consultation with the other author (GB) to decide on papers to include in the full review.

4.6. Strength of Evidence

Due to the various methodological designs, several critical appraisal tools were utilised to assess the quality of the research. The methodological quality of cohort studies was evaluated using the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) Statement [13]. The tool included 22 items that were scored and reviewed by the authors (N.G and G.B). In the tool, 0 = item not reported, 1 = item reported inadequately, 2 = item reported adequately, and N/A = not applicable. The Joanna Briggs Institute was used for text and opinion papers. This included analysing the source of the article, the analytical processes, and references to existing literature. The options included "yes", "no", "unclear", or "not applicable" [14]. The Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) 2013 checklist was used to assess the methodological quality of the protocol studies [15]. This was a 33-item checklist that was scored by stating the page number it was addressed on. All papers reviewed were included regardless of the final score as there were a limited number of papers that were eligible.

4.7. Data Extraction and Synthesis

As per Muka et al. [12], the data were grouped into various categories to analyse common themes and identify patterns. Data were extracted into four main tables to highlight key aspects of the papers reviewed, psychiatric diagnoses studies, biological samples used, and constructs evaluated in clinical measure outcomes. Final themes were verified amongst both authors NG and GB.

5. Results

5.1. Search Results

A Prisma Flow Chart [16] is shown in Figure 1. The search yielded 1834 articles across six databases. Three articles were extracted from a manual hand search of the literature. After 471 duplicates were removed, 1363 articles were screened via their titles and abstracts. A total of 1342 were excluded as they did not meet the inclusion criteria. The full text of the remaining 21 studies were reviewed, of which 15 were excluded as seven articles did not have any mention of a specific biobank, and eight articles did not measure mental health outcomes.

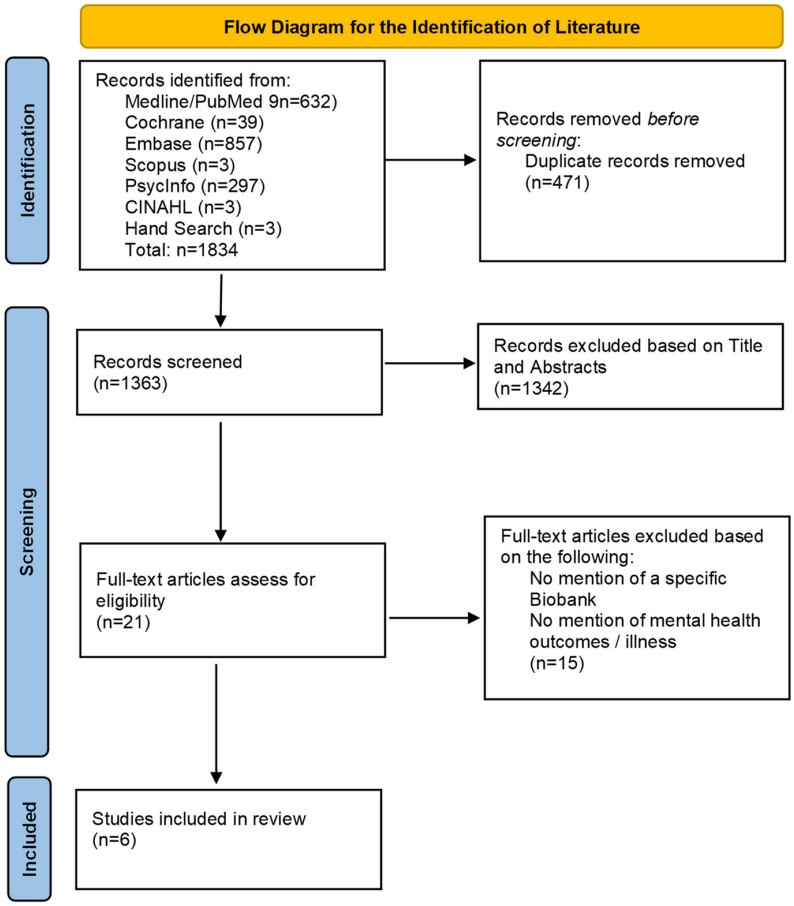

Figure 1. PRISMA 2020 flow diagram for new systematic reviews [16].

Finally, six articles were selected for inclusion and data extraction. For each study, information was summarized about the author(s), year of publication, type of paper, country, setting/hospital/clinic, sample size, recruitment process, biospecimens, psychometric tests used, psychiatric diagnosis, analysis, ethical considerations, and barriers in creation and implementation. The data are extracted and presented in Table 1.

Table 1. Key aspects of papers included in review (N = 6).

Author (Year)	Type of Paper	Country	Setting/Clinic/ Hospital	Recruitment	Sample Size	Limitations
Molnar and Bencsik (2006) [17]	Study Protocol	Hungary	four sites—Department of Neurology and Psychiatry from four Medical Universities (Budapest, Debrecen, Pecs, Szeged)	-	-	-
Frye et al. (2015) [18]	Cohort Study	United States of America	two sites—(1) Mayo Clinic, Rochester, Minnesota, (2) Linder centre for HOPE, Cincinnati, Ohio.	Clinical population	1363 [a]	Little racial variation-90% Caucasian, unable to measure severity of illness
Witt et al. (2016) [19]	Study Protocol	Germany	three sites—(1) Department of Genetic Epidemiology in Psychiatry, (2) Molecular Genetic Laboratory, (3) Central Institute of Mental Health (CIMH)	Clinical population	78,000 [b]	-
Davis and Hotopf (2019) [6]	Commentary Paper	United Kingdom	four sites—(1) UK Biobank, (2) Hospital Episodes Statistics for England (3) Scottish Morbidity Record (4) Patient Episode Database for Wales	Voluntary participation of general population	150,000 [c]	Large sample size to conduct interview, mental disorders under-reported in routine health care, self-report bias

Table 1. *Cont.*

Author (Year)	Type of Paper	Country	Setting/Clinic/ Hospital	Recruitment	Sample Size	Limitations
Jeppesen et al. (2021) [20]	Study Protocol	Denmark	Mental Health Centre, Copenhagen	Clinical population	200 [d]	Selection bias, Confounders such as smoking, alcohol use and eating habits, possible adverse effects following collection of biospecimens
Tigchelaar et al. (2021) [21]	Cohort Study	The Netherlands	University Medical Centre Groningen	Clinical population	450 [e]	Selective sample of patients, nil healthy controls. CSF was collected at only one time point subjected to biochemical changes in circadian rhythm, Self-report questionnaires bias

[a] Number of people enrolled in the biobank; [b] number of people specimens have already been collected from; [c] number of people who completed questionnaires and gave biospecimens; [d] number of people proposed as the sample size; [e] number of people enrolled in the study and gave biospecimens.

5.2. Quality Assessment

Three protocol studies were assessed using SPIRIT checklist as shown in Table 2. Jeppesen et al. [20] clearly stated the majority of the items reported, including the study objective, study protocol, and methodology. Of the 31-item checklist, 5 items or 16.1% were not reported. Both Molnar and Bencsik [17] and Witt et al. [19] did not report aspects of the methodology adequately, with 11 items or 35.4% not reported. There were also no statistical methods recorded in these two studies.

Two cohort studies were assessed using the STROBE checklist as shown in Table 3. Tigchelaar et al. [21] scored 77.3% in the quality assessment compared to Frye et al. [18] which scored 72.8%. Both studies were above 70%, which means they are both adequate in their quality assessment [22]. In the results and discussion, Tigchelaar et al. [21] scored majority "2" which indicated that the item was reported adequately. Frye et al. [18] scored majority "2" in the discussion section.

A text and opinion paper were assessed using the JBI checklist as shown in Table 4. Davis and Hotopf [6] clearly identified the authors and their field of expertise. The interests of the population were unclear; however, existing literature was referred to in support of the findings and some limitations were noted.

Table 2. Quality assessment results based on the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) checklist for research protocols [15].

	Molnar and Bencsik (2006) [17]	Jeppesen et al. (2021) [20]	Witt et al. (2016) [19]
Administrative Information			
Title	1	1	1
Title registration	1	1	4
Protocol Version	1	2	5
Funding	NR	10	1
Introduction			
Background and Rationale	1	2	1
Objectives	2	3	1
Trial Design	NR	3	NR
Methods: Participants, Interventions, Outcomes			
Study Setting	2	3	4
Eligibility Criteria	NR	3	NR
Interventions	2	4	NR
Outcomes	NR	4	NR
Participant timeline	NR	5	3
Sample size	NR	5	4
Recruitment	2	3	NR

Table 2. *Cont.*

	Molnar and Bencsik (2006) [17]	Jeppesen et al. (2021) [20]	Witt et al. (2016) [19]
Methods: Data collection, management, and analysis			
Data collection methods	2	4	2
Data management	2	4	3
Statistical methods	NR	5	NR
Methods: Monitoring			
Data monitoring	3	NR	NR
Harms	3	6–7	3
Auditing	NR	NR	NR
Ethics and Dissemination			
Research ethics approval	3	3	3
Protocol Amendments	NR	NR	NR
Consent or assent	3	3	3
Confidentiality	3	4	3
Declaration of interests	NR	10	5
Access to data	3	10	5
Ancillary and post-trial care	NR	NR	NR
Dissemination policy	3	10	5
Appendices			
Informed consent materials	3	NR	NR
Biological specimens	2	7	3

Note. Number indicates page number that it was addressed on; NR = not reported.

Table 3. Quality assessment results based on Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) criteria for cohort studies [22].

		Tigchelaar et al. (2021) [21]	Frye et al. (2015) [18]
Title and Abstract		1	1
Introduction			
	Background/rationale	2	2
	Objectives	2	2
	Methods		
	Study Design	2	1
	Setting	2	2
	Participants	1	2
	Variables	2	1
	Data sources/measurement	2	2
	Bias	0	0
	Study size	2	1
	Quantitative variables	2	2
	Statistical methods	1	1
Results			
	Participants	2	1
	Descriptive Data	2	1
	Outcome Data	2	2
	Main Results	1	1
	Other analyses	0	0
Discussion			
	Key results	2	2
	Limitations	2	2
	Interpretation	2	2
	Generalisability	0	2
Other information			
	Funding	2	2
	Total:	34/44	32/44
	Total percentage score:	77.3%	72.8%

Note. The STROBE is scored using 0 = item not reported, 1 = item reported inadequately, 2 = item reported adequately and N/A = not applicable.

Table 4. Quality assessment results based on the Joanna Briggs Institute checklist for text and opinion papers [14].

Author (Year)	1. Is the Source Completed Identified?	2. Does the Source of the Opinion Have Standing Field of Expertise?	3. Are the Interests of the Population in the Central Focus of This Opinion?	4. Is the Stated Position the Result of an Analytic Process, and Is There Logic in the Opinion Expressed?	5. Is There Reference to Existing Literature?	6. Is Any Incongruence with Literature/ Sources Logically Defended?
Davis and Hotopf (2019) [5]	Yes	Yes	Unsure	Yes	Yes	Yes

Note. The JBI checklist is scored using Yes, No, Unsure, and N/A.

6. Summary of Evidence

6.1. Type of Paper

Three papers included were study protocols [17,19,20], two papers were cohort research studies [18,21], and one was a commentary paper [6].

6.2. Country

Four of the six papers selected were conducted in Europe including Denmark, Germany, Hungary, and Netherlands [17–19,21]. One paper was conducted in the United Kingdom (UK) [6]. The other paper was based in the United States of America [18].

6.3. Setting

Two studies were across single sites [20,21]. Four studies were across multiple sites [6,17–19]. Only one study was across three different countries [6].

6.4. Recruitment

Four studies recruited a clinical population identified from various hospitals, clinics, and centres in the area [18–21]. One study relied on the voluntary participation of the general population [6]. One study did not report their methods of recruitment, although did report that recruitment was conducted across medical universities [17]. Out of approximately half a million people who signed up for the UK Biobank, those who had an email address were sent a mental health questionnaire. This self-completed questionnaire allowed researchers to compare the data provided with their biological samples [6]. Another method of recruitment was in the University Medical Centre in Groningen, Netherlands, where all medical patients over 18 years undergoing an elective spinal anesthesia were screened via a questionnaire and invited to participate in the collection of CSF [21].

6.5. Sample Size

Jeppesen et al. [20] proposed a sample size of 200 participants but no empirical data have been collected yet. Tigchelaar [21] and Frye et al. [18] had a sample size between 450–1363 participants, respectively. Witt et al. [19] collected biospecimens from approximately 78,000 participants, making this the second largest sample size analysed in this review. Davis and Hotopf [6] had the largest sample size, which included data from 157,000 participants in their biobank.

6.6. Ethical Considerations

All biobanks adhered to their respective ethical and legal laws governed by the relevant organizations. For example, the BioPsy Biobank was approved under the European Network of Research Ethics Committees (UREC), OECD Guidelines on Human Biobanks and Genetic Research Guidelines and the Permanent Working Party of Research Ethics Committees in Germany [19]. All participants gave informed consent, all data were deidentified, and confidentiality was maintained with restricted access to the biobank in all studies included. Data protection was ensured by only allowing selected access to the biospecimens by those who were approved prior to collection. No papers reported

on whether patients were included or excluded based on their involuntary or voluntary treatment status. No papers reported on whether acutely psychotic patients were included.

6.7. Psychiatric Illness

Depression was addressed by four papers [6] (see Table A1). Schizophrenia, bipolar disorder, and substance abuse were studied by three papers. Two papers identified anxiety [6,20]. Personality disorders and post-traumatic stress disorder (PTSD), as well as self-harm, were each addressed by one paper.

6.8. Biological Samples

The most common biological sample collected was blood, with five of the six papers using this as a part of their analysis [17–21]. Three studies included CSF [17,20,21] and two studies included tissue in their reservoir of samples [17,21]. Less common samples included hair, feces, saliva, and body fluids with only one study documenting this in their collection (See Table A2).

6.9. Constructs Evaluated in Clinical Outcome Measures

To assess clinical outcome measures in anxiety, the two main tools used were the Hamilton Anxiety Rating Scale [20] and Generalised Anxiety Disorder 7-item scale [6,21]. Bipolar disorder was assessed using the Structured Clinical Interview for DSM-IV [18] and Young Mania Rating Scale [20]. Cognition was assessed using the Montreal Cognitive Assessment [20,21] and Mini-Mental State Examination [20]. Depression was assessed using the Hamilton Depression Rating Scale and Montgomery–Asberg Depression Rating Scale [20] as well as the Patient Health Questionnaire for depression and 16-item Quick Inventory of Depressive Symptomatology–Self-report [21]. Diagnostic assessment was done using the Composite International Diagnostic Interview Short Form [6]. Personality was assessed using the Eysenck Personality Inventory [6]. PTSD was evaluated using the Childhood Trauma Screen and Post-Traumatic Stress Disorder Checklist-5 questionnaires [6]. Schizophrenia outcomes were measured using the Scale for Assessment of Positive/Negative Symptoms questionnaire [20]. Other clinical measures included in the analysis were the Cumulative Illness Rating Scale [18], the Alcohol Use Disorder Identification Tool [5], and the Patient Health Questionnaire for Somatisation survey [21] (see Table A3).

7. Discussion

This systematic review aimed to summarize the key features of mental health-specific biobanks globally in relation to their design and implementation, with six articles included in the review. Details of the participants' characteristics, clinical factors, and the biospecimens are outlined below.

7.1. Country

While there were some European and USA studies, there was a lack of global representation in this review. In particular, there were no Oceanic, African, or Asian countries which had mental health-specific biobanks. It is plausible that the reason for this is the limited acceptance and understanding of mental illness in low to middle income countries (LMIC) [23]. In such countries, less than 1% of the total health budget is spent on mental health [23]. Although three-quarters of the global burden of mental illness comes from LMICs, it still remains a stigmatized area of health [24]. There is limited funding to generate further evidence for the understanding and treatment of mental illnesses [24].

7.2. Recruitment

The majority of the recruitment process was voluntary such as in the UK Biobank [6] or in controlled clinical trials such as The Anesthetic Biobank of Cerebrospinal Fluid [21]. There was a lack of report of whether participants in the acute phase of their illness were

included or excluded from the biobanks. Difficulty can arise when recruiting participants to include in a biobank as some psychiatric patients in the acute setting of their illness may not have capacity to provide informed consent. This can have implications on the process of collection of biological samples and the analysis of results. As the patient must have the ability to understand risks and outcomes, most patients are recruited when they are in a less severe spectrum of their disease course [25].

7.3. Sample Size

While there were two large biobanks [6,19], most of the biobanks were small to medium-sized [17,18,20,21]. To ensure power is efficient, the sample size needs to be adequate as a very small sample size can prevent findings from being generalized [26]. Although there are mental health-specific biobanks, research is limited by the number of participants in each study. This can be due to the difficulty in collection, storage, and processing of biological specimens in such large sample groups. On the other hand, in a large sample size such as that of the UK Biobank, it would be costly to do gold-standard clinical interviews. Hence, self-reported answers from questionnaires are the basis of the analysis, which could lead to self-reporting bias [6]. Additionally, there can be difficulty in selecting participants to include in a biobank as there may be reluctancy to provide biological samples for storage. However, through de-identification of data, informed consent, and appropriate collection techniques this can be addressed.

7.4. Psychiatric Illness

Depression was the most studied psychiatric illness which may be due to its high prevalence in society. According to the World Health Organisation [27], around 280 million people in the world have depression. Five of the six articles examined depression, however, illnesses such as self-harm, personality disorders, and PTSD were less commonly studied, with only one biobank addressing each. This could be due to the less prevalent nature of these illnesses and thus, the difficulty in gathering participants [28].

7.5. Biomarker

Most of the studies collected blood while few studies collected hair, feces, and saliva. When studying large samples, the best specimens are those that can be collected at a lower cost and efficiently [29]. Biological samples must be stored for long periods of time, using liquid nitrogen and frozen to temperatures of −80 °C [17]. The quality of the specimen is integral to the analysis, for example, in the Hungarian Biobank, storage freezers are placed in special generator powered rooms and linked to an alarm system. Therefore, the collection, storage, and maintenance of each biological specimen is an integral aspect to ensuring success of a biobank.

Genetic markers which are taken from blood samples in Biobanks are compared to each individual with the same diagnosis. For example, Frye et al. [18] state that bipolar disorder is highly heritable, and genetics can account for 85% of increased risk for this illness. There are certain genes that have been identified to contribute to this such as Ankyrin-G or ANK3 (encoding anky-rin3), NCAN (encoding neurocan) and DGKH (encoding diacylglycerol kinase) [24]. This can potentially aid diagnosis in the future, allowing for genetic testing to assess disease risk and targeting pharmacological therapy.

According to Jeppesen et al. [20], inflammatory pathways have been identified in some patients with psychotic disorders. For example, in acutely psychotic patients, there have been higher levels of pro-inflammatory cytokines in the blood. Additionally, in schizophrenia, associations with HLA-genes, which are responsible for the body's inflammatory process, have been found [20]. A recent meta-analysis showed that anti-inflammatory drugs as an add-on treatment to antipsychotics had an improvement on the negative symptoms of schizophrenia [30].

8. Limitations

There were a number of limitations identified through the review of these studies. A limitation to creating a location-specific biobank is the lack of diversity within the sample. There was little racial variation within the studies as the majority of the participants were Caucasian. It does allow to analyze epidemiological representations of the illness within that society; however, generalizability may be an issue [18]. Additionally, there may be adverse effects following the collection of the biological specimens and this may limit the sample collection and thus, subsequent storage [29], for example, if the collection process is traumatic or contaminated.

There was no report as to whether the collection time was standardized amongst participants, as most biological specimens are collected at a specific point in time, it may be affected by the individuals' circadian changes. There was no report if multiple samples were taken over a period to track changes in one's disease course. However, this may not be feasible with limited resources in a larger sample size or with patients lost to follow-up.

Another limitation is self-report bias which occurred when the participants themselves completed a subjective questionnaire. Group questionnaires were used in the UK Biobank due to the difficulty in conducting clinical interviews in large sample sizes. It can also limit the validity of the results and confounders can have a greater influence on the dataset.

9. Clinical Implications

These studies aid in the understanding of the biological etiologies of psychiatric disease. By collecting, storing, and identifying biomarkers, it is possible to improve misdiagnosis and/or overdiagnosis of mental illnesses. Currently, it is dependent on a subjective clinician interpretation of the signs and symptoms of these diseases [31]. Mental disorders are classified using the two major diagnostic manuals—International Classification of Disease (ICD) and the Diagnostic and Statistical Manual of Mental disorders [32]. The addition of biomarkers to the diagnostic criteria will assist in targeting pharmacotherapy to aid efficacy of treatment. These tools aid in identifying etiology, classifying signs and symptoms, and assessing severity. Despite scientific progress to identify biological markers of mental disorders, further research is required in order to add this as a part of the diagnosis.

10. Future Recommendations

There are many recommendations for the implementation, creation, and development of biobanks. Primarily, more biobank collections are required. A wider range of biological data (including, but not limited to, hair, placenta, feces, CSF, blood, and tissues) should be collected from a broader range of psychiatric diagnoses (eating disorders, dementia, schizophrenia, and neurodevelopmental disorders), with more socio-economic and ethnic diversity. Mental health biobanks could also include biological samples from patients without any morbidities to allow for baseline comparison to individuals burdened with mental illness. Including patient characteristics would be recommended to study the effect of epidemiological factors on adverse mental health outcomes [21]. Longitudinal data are also needed to explore progression and risk factors relating to psychiatric illness. Evidence of the influence of environmental factors, such as pollution on mental illness [33], with possible generational effects, highlights the importance of gathering a wide array of biological and clinical outcome data for epigenetic studies. Multigenerational collections would permit the exploration of heritability or intergenerational transmission of psychiatric illness.

Government funding and engagement is required to successfully create biobanks. Rigorous guidelines need to be created on the ethical, legal, and methodological approaches to establishing biobanks. Patient recruitment can best be done with voluntary participation of the target population, as seen in the UK Biobank. However, self-report and sampling bias needs to be carefully addressed. Both clinician-rated and patient-rated scales should be used to evaluate outcomes. This can help to avoid self-report bias and strengthen the analysis. More comprehensive collections would allow more thorough etiological investigations to

improve diagnostic clarity for early intervention, reduce risk of misdiagnosis, and provide superior, tailored medications and treatments.

11. Conclusions

In conclusion, six studies were analyzed in terms of location, recruitment process, sample size, psychiatric illness, biological samples, and barriers to conducting the study. Clinical outcome measures were also identified as well as ethical considerations. There are very few mental health specific biobanks globally. The lack of literature prevents greater understanding of mental illnesses and thus, can affect the diagnosis and management within this discipline [24].

By establishing the need for psychiatric research and requesting government funding accordingly, various underrepresented countries could also engage in the creation of biobanks. Through biobanks, it is possible to understand the combination of environmental and genetic factors, leading to a vast improvement in the prevention, diagnosis, and management of mental illnesses [34]. Overall, the creation and implementation of mental health specific biobanks globally is a significant step towards understanding the biological etiologies of psychiatric diseases.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/psychiatryint5010001/s1, Table S1: Literature search strategy used for the PubMed/Medline (OVID) database.

Author Contributions: The study was conceptualized, and the methodology designed, by G.B. and N.S.G. Supervision was provided by G.B. Literature searches were conducted by N.S.G. Screening and analyses were conducted by G.B and N.S.G. N.S.G. wrote the initial draft. K.M.G. and G.B. reviewed and edited the final manuscript. All authors have read and agreed to the published version of the manuscript.

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Appendix A

Table A1. Psychiatric diagnoses studied in biobank, (N = 6).

Author (Year)	Anxiety	Bipolar Disorder	Depression	Personality Disorders	Post-Traumatic Stress Disorder	Schizophrenia	Self-Harm	Substance Abuse
Molnar and Bencsik (2006) [17]						√		√
Frye et al. (2015) [18]		√						
Witt et al. (2016) [19]		√	√	√		√		√
Davis and Hotopf, (2019) [6]	√		√		√		√	√
Jeppesen et al. (2021) [20]	√	√	√			√		
Tigchelaar et al. (2021) [21]			√					

Table A2. Biological samples collected and stored in biobank, (N = 6).

Study	Blood	Body Fluids (Amniotic Fluid, Cells, and Urine)	Cerebral Spinal Fluid	Faecal Sample	Hair	Saliva	Tissue (Placenta, Muscle/Nerve/ Kidney Biopsy)
Molnar and Bencsik, 2006 [17]	√		√				√
Frye et al., 2015 [18]	√						
Witt et al., 2016 [19]	√	√			√	√	√
Davis and Hotopf, 2019 [6]							
Jeppesen et al., 2021 [20]	√		√	√			
Tigchelaar et al., 2021 [21]	√		√				

Table A3. Summary of the constructs evaluated in clinical outcome measures (N = 6).

Author (Year)	Anxiety	Bipolar	Cognition	Depression	Diagnostic	Personality	Post-Traumatic Stress Disorder	Schizophrenia	Other
Molnar and Becsik (2006) [17]	-	-	-	-	-	-	-	-	-
Frye et al. (2015) [18]	-	Structured Clinical Interview for DSM-IV	-	-	-	-	-	-	Cumulative Illness Rating Scale
Witt et al. (2016) [19]	-	-	-	-	-	-	-	-	-
Davis and Hotopf (2019) [6]	Generalised Anxiety Disorder 7-item scale	-	-	-	Composite International Diagnostic Interview Short Form	Eysenck Personality Inventory	Childhood trauma screen, post-traumatic stress disorder checklist-5	-	Addiction (Self-report), Alcohol Use Disorder Identification Tool
Jeppesen et al. (2021) [20]	Hamilton Anxiety Rating Scale	Young Mania Rating Scale	Montreal Cognitive Assessment, Mini-mental state examination	Hamilton Depression Rating Scale, Montgomery-Asberg Depression Rating Scale	-	-	-	Positive and Negative Symptom Scale, Scale for Assessment of Positive/ Negative Symptoms	Trail Making Test
Tigchelaar et al. (2021) [21]	Generalised Anxiety Disorder 7-item scale	-	Montreal Cognitive Assessment	Patient Health Questionnaire for depression, 16-item Quick Inventory of Depressive Symptomatology–Self-report	-	-	-	-	Patient Health Questionnaire for somatisation

References

1. Tripathi, A.; Das, A.; Kar, S.K. Biopsychosocial Model in Contemporary Psychiatry: Current Validity and Future Prospects. *Indian. J. Psychol. Med.* **2019**, *41*, 582–585. [CrossRef]
2. Jurgen Rehm, K.D.S. Global Burden of Disease and the Impact if Mental and Addictive Disorders. *Curr. Psychiatry Rep.* **2019**, *21*, 10. [CrossRef]
3. Bandelow, B.; Michaelis, S. Epidemiology of anxiety disorders in the 21st century. *Dialogues Clin. Neurosci.* **2015**, *17*, 327–335. [CrossRef]
4. Evans-Lacko, S.; Aguilar-Gaxiola, S.; Al-Hamzawi, A.; Alonso, J.; Benjet, C.; Bruffaerts, R.; Chiu, W.T.; Florescu, S.; de Girolamo, G.; Gureje, O.; et al. Socio-economic variations in the mental health treatment gap for people with anxiety, mood, and substance use disorders: Results from the WHO World Mental Health (WMH) surveys. *Psychol. Med.* **2018**, *48*, 1560–1571. [CrossRef]
5. Liu, N.H.; Daumit, G.L.; Dua, T.; Aquila, R.; Charlson, F.; Cuijpers, P.; Druss, B.; Dudek, K.; Freeman, M.; Fujii, C.; et al. Excess mortality in persons with severe mental disorders: A multilevel intervention framework and priorities for clinical practice, policy and research agendas. *World Psychiatry.* **2017**, *16*, 30–40. [CrossRef]
6. Davis, K.; Hotopf, M. Mental health phenotyping in UK Biobank. *Prog. Neurol. Psychiatry* **2019**, *23*, 4–7. [CrossRef]

7. Brand, S.J.; Moller, M.; Harvey, B.H. A Review of Biomarkers in Mood and Psychotic Disorders: A Dissection of Clinical vs. Preclinical Correlates. *Curr. Neuropharmacol.* **2015**, *13*, 324–368. [CrossRef]
8. Boksa, P. A way forward for research on biomarkers for psychiatric disorders. *J. Psychiatry Neurosci.* **2013**, *38*, 75–77. [CrossRef]
9. Strawbridge, R.; Young, A.H.; Cleare, A.J. Biomarkers for depression: Recent insights, current challenges and future prospects. *Neuropsychiatr. Dis. Treat.* **2017**, *13*, 1245–1262. [CrossRef]
10. Otlowski, M.; Nicol, D.; Stranger, M. Biobanks information paper 2010. *J. Law Inf. Sci.* **2010**, *20*, 87.
11. Akervall, J.; Pruetz, B.L.; Geddes, T.J.; Larson, D.; Felten, D.J.; Wilson, G.D. Beaumont health system biobank: A multidisciplinary biorepository and translational research facility. *Biopreserv. Biobank* **2013**, *11*, 221–228. [CrossRef] [PubMed]
12. Muka, T.; Glisic, M.; Milic, J.; Verhoog, S.; Bohlius, J.; Bramer, W.; Chowdhury, R.; Franco, O.H. A 24-step guide on how to design, conduct, and successfully publish a systematic review and meta-analysis in medical research. *Eur. J. Epidemiol.* **2020**, *35*, 49–60. [CrossRef] [PubMed]
13. da Costa, B.R.; Cevallos, M.; Altman, D.G.; Rutjes, A.W.; Egger, M. Uses and misuses of the STROBE statement: Bibliographic study. *BMJ Open* **2011**, *1*, e000048. [CrossRef]
14. McArthur, A.; Klugárová, J.; Yan, H.; Florescu, S. Innovations in the systematic review of text and opinion. *JBI Evid. Imp.* **2015**, *13*, 188–195. [CrossRef] [PubMed]
15. Chan, A.-W.; Tetzlaff, J.M.; Altman, D.G.; Laupacis, A.; Gøtzsche, P.C.; Krleža-Jerić, K.; Hróbjartsson, A.; Mann, H.; Dickersin, K.; Berlin, J.A.; et al. SPIRIT 2013 statement: Defining standard protocol items for clinical trials. *Ann. Intern. Med.* **2013**, *158*, 200–207. [CrossRef]
16. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; A Akl, E.; E Brennan, S.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* **2021**, *372*, n71. [CrossRef]
17. Molnar, M.J.; Bencsik, P. Establishing a Neurological-Psychiatric Biobank: Banking, informatics, ethics. *Cell Immunol.* **2006**, *244*, 101–104. [CrossRef]
18. Frye, M.A.; McElroy, S.L.; Fuentes, M.; Sutor, B.; Schak, K.M.; Galardy, C.W.; A Palmer, B.; Prieto, M.L.; Kung, S.; Sola, C.L.; et al. Development of a bipolar disorder biobank: Differential phenotyping for subsequent biomarker analyses. *Int. J. Bipolar Disord.* **2015**, *3*, 14. [CrossRef]
19. Witt, S.; Dukal, H.; Hohmeyer, C.; Radosavljevic-Bjelic, S.; Schendel, D.; Frank, J.; Lang, M.; Streit, F.; Strohmaier, J.; Treutlein, J.; et al. Biobank of Psychiatric Diseases Mannheim. *BioPsy. Open J. Bioresour.* **2016**, *3*, e2.
20. Jeppesen, R.; Orlovska-Waast, S.; Sørensen, N.V.; Christensen, R.H.B.; Benros, M.E. Immunological investigations of the cerebrospinal fluid in patients with recent onset psychotic disorders: A study protocol. *PLoS ONE* **2021**, *16*, e0257946. [CrossRef]
21. Tigchelaar, C.; Atmosoerodjo, S.D.; van Faassen, M.; Wardenaar, K.J.; de Deyn, P.P.; Schoevers, R.A.; Kema, I.P.; Absalom, A.R. The Anaesthetic Biobank of Cerebrospinal fluid: A unique repository for neuroscientific biomarker research. *Ann. Trans. Med.* **2021**, *9*, 455. [CrossRef] [PubMed]
22. Cuschieri, S. The STROBE guidelines. *Saudi J. Anaesth.* **2019**, *13*, S31–S34. [CrossRef] [PubMed]
23. Patel, V. Mental health in low- and middle-income countries. *Br. Med. Bull.* **2007**, *81–82*, 81–96. [CrossRef] [PubMed]
24. Mascayano, F.; Armijo, J.E.; Yang, L.H. Addressing stigma relating to mental illness in low- and middle-income countries. *Front. Psychiatry* **2015**, *6*, 38. [CrossRef]
25. Amarasinghe, M.; Tan, H.; Larkin, S.; Ruggeri, B.; Lobo, S.; Brittain, P.; Broadbent, M.; Baggaley, M.; Schumann, G. Banking the brain. Addressing the ethical challenges of a mental-health biobank. *EMBO Rep.* **2013**, *14*, 400–404. [CrossRef]
26. Altman, D.G. *Practical Statistics for Medical Research*, 1st ed.; CRC Press: New York, NY, USA, 1990.
27. World Health Organisation. Depression. Available online: https://www.who.int/news-room/fact-sheets/detail/depression (accessed on 3 July 2023).
28. Davis, K.A.S.; Cullen, B.; Adams, M.; Brailean, A.; Breen, G.; Coleman, J.R.I.; Dregan, A.; Gaspar, H.A.; Hübel, C.; Lee, W.; et al. Indicators of mental disorders in UK Biobank-A comparison of approaches. *Int. J. Methods Psychiatr. Res.* **2019**, *28*, e1796. [CrossRef]
29. Vaught, J.B.; Henderson, M.K. Biological sample collection, processing, storage and information management. *IARC Sci. Publ.* **2011**, *163*, 23–42.
30. Jeppesen, R.; Christensen, R.H.B.; Pedersen, E.M.J.; Nordentoft, M.; Hjorthøj, C.; Köhler-Forsberg, O.; Benros, M.E. Efficacy and safety of anti-inflammatory agents in treatment of psychotic disorders—A comprehensive systematic review and meta-analysis. *Brain Behav. Immun.* **2020**, *90*, 364–380. [CrossRef]
31. Toben, C.; Arnet, V.K.; Lo, A.; Saunders, P.H.; Baune, B.T. Standardized biomarker and biobanking requirements for personalized psychiatry. In *Personalized Psychiatry*, 1st ed.; Baune, B.T., Ed.; Elsevier Academic Press: San Diego, CA, USA, 2019; pp. 537–547.
32. Clark, L.A.; Cuthbert, B.; Lewis-Fernández, R.; Narrow, W.E.; Reed, G.M. Three Approaches to Understanding and Classifying Mental Disorder: ICD-11, DSM-5, and the National Institute of Mental Health's Research Domain Criteria (RDoC). *Psychol. Sci. Public Interest* **2017**, *18*, 72–145. [CrossRef]

33. Stapelberg, N.J.C.; Branjerdporn, G.; Adhikary, S.; Johnson, S.; Ashton, K.; Headrick, J. Environmental Stressors and the PINE Network: Can Physical Environmental Stressors Drive Long-Term Physical and Mental Health Risks? *Int. J. Environ. Res. Public Health* **2022**, *19*, 13226. [CrossRef]
34. Sudlow, C.; Gallacher, J.; Allen, N.; Beral, V.; Burton, P.; Danesh, J.; Downey, P.; Elliott, P.; Green, J.; Landray, M.; et al. UK biobank: An open access resource for identifying the causes of a wide range of complex diseases of middle and old age. *PLoS Med.* **2015**, *12*, e1001779. [CrossRef] [PubMed]