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Developing and Evaluating the Integrated Addiction Recovery Model for the Persons' Engagement and Retention in the Recovery Process Among Clinical Populations from Rwanda

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Graduate Program in Nursing

A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy

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Abstract

Background

To date, research that has investigated psychosocial processes and mechanisms, which underpin addiction recovery outcomes is scarce. This study sought to develop and test the integrated addiction recovery model that accounts for individual's psychosocial context.

Methods

This predictive study enrolled 315 participants from tertiary addiction care settings in Rwanda. Data on the hypothesized model variables and individual's characteristics were collected with self-reported measures. Structural equation modelling techniques were used to test the model psychometric measures and associations between latent variables.

Results

Baseline data analyses showed a mean age at first substance use of 18.6 (SD=6.1). Early age at first substance use and individual's characteristics, such as post-traumatic stress disorder, had a significant effect on later addiction severity with $\beta = -.130$, $p = .013$ and $\beta = .363$; $p < .001$ respectively. Confirmatory factor analyses found a five latent-variable model with three or more indicators each and standardized factor loadings ranging between .307 and .997. Standardized factor covariances were positively and statistically significant for therapeutic relationships (TRE) versus basic psychological needs (BPN) (.522, $p \leq .001$); TRE versus retention in the addiction recovery process (RRP) (.353, $p \leq .001$), BPN vs RRP (.501, $p \leq .001$), and supportive social networks

(SSN) vs BPN (.347, $p \leq .001$). Autonomous motivation (AM) had no statistically significant correlations with any of the model variables. Analyses of mediation associations indicated that TRE had statistically significant total (.351, 95% CI= .237 - .460) and indirect (.183, 95% CI = .071 - .355) effect on RRP. Only the indirect effect of SSN on RRP was statistically significant (.124, 95% CI= .054 - .262, $p = .046$). The interaction of addiction severity with BPN nullified direct and indirect effects of TRE and SSN on RRP.

Discussion

These results establish psychometric properties of the integrated addiction recovery model. The results demonstrate that retention in the addiction recovery process is underpinned by interactions between therapeutic relationships and supportive social networks through the satisfaction of basic psychological needs. However, future research is needed to conduct the model measurement invariance in a different sample.

Keywords: Addiction; addiction recovery; autonomous motivation; confirmatory factor analysis, psychological needs; therapeutic relationships; structural equation modelling; supportive social network.

Summary for Lay Audience

Research that has examined the psychological and social processes that determine recovery from substance use issues is scarce. The present study sought to develop and test a unified model for engaging and retaining persons suffering from substance use issues in the recovery process in Rwanda.

Over nine months, 315 participants seeking treatment for substance use issues from tertiary mental healthcare services in Rwanda were recruited. Information from participants before discharge and one month later on different dimensions of recovery was collected. Statistics were computed to determine the contribution of each of the aspects of recovery to supporting people to engage and stay abstinent from substance use.

Analyses of information collected before discharge showed that the average age of starting substance use was 18.6 years old. People who start substance use earlier in life and those who suffered post-traumatic stress disorder developed more severe substance use issues.

The statistical analysis found a model with five dimensions of recovery from substance use issues. The dimensions, such as good interactions between healthcare providers and patients, support to fulfil basic psychological needs, and social support received from family, friends, and community were found to influence recovery for substance use issues. However, the researcher found that the person's motivation for treatment and level of substance use severity can nullify recovery outcomes.

This research provides valuable information about various psychosocial aspects to consider while conceiving addiction care programs for sustained substance use recovery. The present study also informs future research of aspects of treatment interventions to examine while investigating the recovery process among people with substance use issues.

Co-Authorship Statement

Boniface Harerimana conducted this research work under the supervision of Dr Cheryl Forchuk, Dr Michael Kerr and Dr Rick Csiernik, who are co-authors of publications related to chapters of the present dissertation.

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Chapter 1

Background and Significance

This chapter describes the research problem and provides the justification of the study and contextual situations that perpetuate the problem. The chapter also highlights the purpose of the study and the relevance of subsequent results to clinical practice, policy, and future research.

Background

Globally, substance use disorders (SUDs), such as alcohol and other substance misuse and addiction issues, have been identified as a public health concern. The 2017 report of United Nations Office for Drug and Crime (UNODC) indicated that 5% of the world adult population used an illicit drug, such as opioids, cocaine, amphetamines, at least once and 0.6% had clinically diagnosable drug addiction in 2015. The report also showed that SUDs contributed to a total annual global loss of 28 million lives, including 190,000 premature deaths solely attributable to opioid addiction worldwide (UNODC, 2017).

Additionally, the prevalence of opioid and cocaine use is rising among young women worldwide. For example, between 2005 and 2015, the rate of young women living with addiction problems increased by 25% for opioids and 40% for cocaine; whereas rates among their counterpart young men were 17 % and 26% respectively (UNODC, 2017). Besides the preceding rates, a global statistic compilation of addiction problems by Gowing et al. (2015) demonstrated that 4.9 % (about 240 million people)

and 22.5% (1 billion people) of the world populations suffered from alcohol use disorders and smoked tobacco respectively. The compilation of SUDs statistics also showed that alcohol use disorders contributed to 257 disability-adjusted life years per 100 000 population and tobacco smoking was associated with 11% of deaths in males and 6% of deaths in females each year (Gowing et al., 2015). Similarly, a recent analysis for global burden diseases demonstrated that SUDs are among the leading cause of years lived with disabilities, accounting for 28.5% global YLDs (Whiteford, Ferrari, Degenhardt, Feigin, & Vos, 2015).

Research has linked the ineffective stabilization of patients with addiction to increased risk of crimes (Staton-Tindall, Havens, Oser, & Burnett 2011). Wealthy and low resourced countries alike experience a high prevalence of addiction problems in criminal systems. For example, 45% of the inmate population worldwide had SUDs (UNODC, 2013). Crimes related to substance use in Rwanda, a low-resourced country, represented 23% of all cases in the criminal justice system (Bishuba, 2017); while in the emerging economy country, such as Brazil, 46.7%, 15.7%, and 10.9% individuals with SUDs were involved in the robbery, drug trafficking and homicide, respectively (Guimarães et al., 2017). In the last decade, in wealthy countries, including Canada, drug-related crimes have been on the rise, i.e. from 87,985 (in 2000) to 109,057 (in 2013) representing 5% of offences in the Canadian criminal system (Boyce, Cotter, & Perreault, 2014; Dauvergne, 2009).

Over the last three decades, there have been international commitments to improving addiction prevention and treatment outcomes, including the 1998 United Nations (UN) General Assembly Special Session on drugs. Subsequently, the United

Nations published 2000 political declaration and plan of action on international cooperation towards an integrated and balanced strategy to counter world drug problems (UN,2000). Through the political declaration, 132 heads of states agreed on a set of strategies, including pharmacological and psychosocial interventions aimed at improving rehabilitation, recovery, and social reintegration of patients with substance use disorders. Nonetheless, addiction care programs across the world experience higher rates of early attrition from treatment. Research has shown that up to 80% of patients enrolled for treatment are lost to follow-up in the first three months (Carroll et al., 2006; Hoseinie et al., 2017; Mutabazi, 2014; Szafranski et al., 2017). Additionally, evidence suggests that the median time for relapse is less than two months in addiction treatment (Cornelius et al., 2003). Low rates of patients engaging and remaining in the addiction recovery process until the completion of treatment programs may be among the contributing factors for the increasing rates of substance use-induced psychotic disorders (up to 24.1%) observed among patients with SUDs (Ng & Harerimana, 2016).

In view of the above evidence, the situation of substance use problems requires further attention, because of the potential burden on health and socio-economic sectors. For example, in 2015, a United States (US) health services evaluation indicated on average each person with SUDs had directly cost the health system up to \$2,783 per year for hospitalization only (Gryczynski et al., 2016).

This cost does not even account for substance use-related productivity loss, crimes and policing expenses.

Furthermore, evidence has demonstrated that successful addiction care saves up to 13 dollars (\$13) for every dollar (\$1) spent (Baldasare, 2011; Berlant, Trabin, & Anderson, 1994; Gerstein et al., 1994; Langenbucher, 1994).

One potential response to improved addiction care outcomes would be sustaining patients' behavior change through an enhanced patients' motivation for engaging and staying in the recovery process (Markland et al., 2005; Timko, Below, Schultz, Brief, & Cucciare, 2015). Evidence has also linked positive therapeutic relationships with healthcare providers (HCPs) to an improved motivation for engagement, retention in treatment, and improved addiction care outcomes (Cournoyer, Brochu, Landry, & Bergeron, 2007; Timko et al., 2015). Additionally, HCPs constitute a key extrinsic factor influencing addiction treatment outcomes; and their influence on changes in retention and patients' health outcomes is higher than that obtained from other different treatments approaches (Knuuttila, Kuusisto, Saarnio, & Nummi, 2012; Najavits, Crits-Christoph, & Dierberger, 2000; Najavits & Weiss, 1994). Building on HCPs influence, Markland et al., (2005) proposed that therapeutic relationships may enable patients to achieve and maintain addiction behaviour change by assisting them to develop realistic goals, providing positive feedback, and promoting autonomy via a demonstrated understanding of their problems. Similarly, supportive social networks such as satisfying social relationships, family, and peer networks influence patients' motivation for engagement and treatment completion (Fiorentine & Hillhouse, 2000; Knight, Joe, & Simpson, 2003). Cornelius, Earnshaw, Menino, Bogart, and Levy (2017), further, demonstrated that caregivers' attitudes expressing acceptance, autonomy support, and relatedness towards their relative suffering from substance use disorders facilitate treatment engagement.

Despite the preceding evidence that establishes interactions between addiction care outcomes and extrinsic factors, such as therapeutic relationships and supportive social network, little is known about patients' motivation for seeking and remaining in addiction care, especially when viewed in mechanisms for engaging patients in the addiction recovery process. Furthermore, little attention has been given to the investigation of mechanisms by which these extrinsic factors impact the patients' motivation for engagement and retention in the addiction recovery process. Thus, the present study sought to address this gap in the literature through developing and evaluating a model of patients' motivation for engagement and retention in the addiction recovery process. The developed addiction care model will be tested using a Rwandan sample of patients seeking addiction care from tertiary mental health care settings.

Addiction Problems in the Context of Rwanda

The proposed study was conducted in Rwanda; an East African nation often referred to as the Country of Thousand Hills with a population of nearly 13 million (Rwanda Population, 2020).

Rwanda is a landlocked country located on the far Western part of the Rift Valley, sharing the border with Tanzania in the East, Democratic Republic of Congo (DRC) in the West, Burundi in the South, and Uganda in the North. Kinyarwanda is the mother tongue for Rwandans and is also a language spoken widely across the African Great Lakes Region, mostly by cross borders' communities, in Burundi, Uganda, DRC, and Tanzania, which share a historical and cultural background with Rwandans (Mamdani, 2014). Rwanda has gone through intense sociocultural changes and historical events, which are inseparable to its current situation of mental health, and addiction in particular. Therefore, it is worthwhile

to contextualize addiction problems by briefly discussing the Rwandan sociocultural and support organization, repercussions of Rwandan history on addiction problems, and the structures of mental health care in Rwanda.

The Rwandan Sociocultural and Support Organization

Traditionally, the Rwandan culture is a family-based organization that strengthens kinship relationships and support to one another. A nuclear family, husband, wife and children, constitutes the first functional unit and layer of the social support fabric. The Rwandan family operates under patriarchal-oriented principals that assign husbands the role of leading both wife and children during daily production, economic advancement, and social well-being of the family (d' Hertefelt, Trouwborst, & Scherer, 2017).

According to d'Hertefelt, Trouwborst, and Scherer (2017), the second layer of the Rwandan sociocultural and support fabric comprises of the members of extended family, including grandparents, uncles, aunts, married offspring and their family-in-law; who have an obligation to contribute to social advancement and wellness under the guidance of the chief of the extended family. The third layer encompasses members of local residents and groups of friends, such as co-workers, church communities, and other social groups; wherein each member has a cultural responsibility of contributing to the social well-being of one another (d 'Hertefelt et al., 2017). Through the Rwandan sociocultural and support layers, women and children, as well other vulnerable groups benefit special protection and support from male family kinships and communities (Adekunle, 2007).

Furthermore, Rwandan cultural norms require all members of a nuclear and extended family, as well as communities to cease all activities and offer support to their

members experiencing life events, such as mourning for a member of family loss, illness, success and other occasions of both hardship and happiness (Bagilishya, 2000).

However, the Rwandan culture and norms also strictly expect a high level of discipline, which may pose problems for accommodating addiction behaviors. These cultural traditions are passed down from older to the young generation through both formal and pragmatic education; by which fathers ensure vocational training to their sons, while daughters are instructed by their mothers. The education of Rwandan culture and norms emphasized principals of dignity, assiduousness, discipline, mutual respect, and tolerance (Adekunle, 2007). In relation to the use of the psychoactive substance; for example, the Rwandan customs strictly prohibited to drink alcohol when you are performing valued activities, such as sculptures because of high sensitivity to any poor performance (Adekunle, 2007). Given the cognitive and decision-making impairment associated with addiction, in the Rwandan context, having addiction problems is not only considered as offensive behaviour (Adekunle, 2007), but it also carries social prejudice across all social structures, including mental health care services (Vedaste & Smith, 2016).

The Repercussions of Rwandan History on Addiction Problems

In 1994, Rwanda experienced the worse genocide of the twentieth century, which decimated sociocultural structures through mass killings. Estimates from several sources suggested that one-seventh of Rwandan citizens was killed and those left alive witnessed violent and other horrific traumatic and/or psychological experiences (Adekunle, 2007; Gishoma et al., 2015; Hintjens, 1999). In the aftermath of the genocide, sociocultural and support fabric was torn apart in a way that the country had an unprecedented number of

child orphans or widow headed families, wrecked economic resources and refugees (Adekunle, 2007; Hintjens, 1999; Thompson, 2007). This legacy of genocide has also negatively impacted the Rwandans' mental health status (Eytan, Munyandamutsa, Mahoro Nkubamugisha, & Gex-Fabry, 2015).

In the post-genocide, among Rwandans aged between 25 and 34 years, the prevalence of post-traumatic stress disorders (PTSD) was 26.1 % and comorbidity PTSD-depression and PTSD – substance dependence was 68.4 % and 7.6% respectively (Munyandamutsa, Nkubamugisha, Gex-Fabry, & Eytan, 2012). The last countrywide survey showed that 7.4% of persons aged 14 to 34 had alcohol dependence, 4.8% and 2.5% had nicotine and cannabis dependence respectively (Kanyoni, Gishoma, & Ndahindwa, 2015). Additionally, in 2016, crimes related to substance use represented 23% of all cases in the Rwandan criminal justice system (Bishuba, 2017). In Rwandan mental health care, including addiction care programs, the prevalence of patients who completed treatment programs remained low at 32.5% (Mutabazi, 2014). This low retention rate of the patients' retention in treatment may be associated with an increased prevalence of substance use-induced psychotic disorders, which was on the rise (24.1%) among patients seeking mental health care in Rwanda (Ng & Harerimana, 2016). Furthermore, Rwanda has an acute lack of qualified health care professionals, especially in the field of mental health and addiction (Umubyeyi, Mogren, Ntaganira, & Krantz, 2016).

Mental Health Care Structures in Rwanda

According to the Rwandan health sector strategic plan (HSS), 2012 – 2018 (Rwanda Ministry of Health, 2012) the mental health structures are comprised of a

mental health division that is housed in the Rwanda Biomedical Centre. This centre is responsible for developing and following the implementation of policies across health system institutions.

The HSS delivers mental health care services through a three-tiered system, which encompasses one national referral mental health hospital, Ndera Neuro-Psychiatric Hospital at tertiary level, and initiation of intermediate mental health referral services at provincial hospitals. These referral institutions offer mentorship to integrated health services, the second level of health care, which are mental health nurse-led units operating in most of the district hospitals (Rwandan Ministry of Health, 2014).

Additionally, the HSS 2012 -2018 recognized that primary level of mental health care interventions is ought to be conducted through networks of community health workers (Rwanda Ministry of Health, 2012). However, addiction care services operate only at tertiary level, i.e., Ndera Neuro-Psychiatric Hospital, the main hospital branch, Psychotherapeutic Centre Icyizere, and CARAES Butare, and ISANGE Rehabilitation Centre Huye, located in the Southern Province of Rwanda. Addiction care services within these institutions are drawn on a biopsychosocial model that reinforces coordinated and comprehensive approaches, including alcohol and drugs prevention, detoxification treatment, psychosocial therapies, rehabilitation, and social reintegration. In view of the preceding evidence, addiction problems constitute a health burden that jeopardizes not only patients' health outcomes but also their social well-being. In the discussed peer-reviewed and grey literature, research has demonstrated potential associations between addiction problems and one's sociocultural and support organizations.

Therefore, the proposed study developing and evaluating an addiction care model, which combines patient-HCPs therapeutic relationships and supportive social networks, may have clinical, policy, and research implications, especially for the field of mental health nursing care.

Significance of the Study

The study results will potentially inform the development of addiction care interventions and policies that aim to capitalize on the synergy between health care services and patients' social networks, and thereby enhance the motivation for engagement in addiction recovery and improve health outcomes in Rwanda and potentially beyond. Specifically, this study results will offer addiction care services administrators, policymakers, and HCPs, especially mental health nurses. This addiction care model provides a clear conceptualization and indicators for interpreting patients' information on their admission and transition through the addiction recovery process.

As this study evaluated interactions between patient's motivation and therapeutic relationships, a fundamental concept for nursing, subsequent results will provide mental health nurses with clear indicators of nursing diagnosis, care planning and assessment. Mental health nurses constitute the majority of HCPs and are in constant interactions with patients; therefore, providing them with objective ways of assessment and diagnosis may contribute to addiction care programs' effectiveness and health outcomes among patients with SUDs (Carise, Cornely, & Gurel, 2002; Rush, Martin, Corea, & Rotondi, 2012).

For the addiction field, including mental health nursing scholarship, the study's findings will also serve as a departure point for further intervention study designs that

take into account different variables affecting patient's engagement and retention in the addiction recovery process.

From administrative perspectives, the findings from the study may supply joint initiatives aimed at engaging different stakeholders including communities, government agencies, teaching institutions, and non-profit organizations with the information necessary for solving consequences of addiction problems. As this study conducted the translation and cultural adaptation of measurements for the model constructs, this may benefit the hosting and neighboring countries' health systems with home-tailored and standardized addiction care assessment tools.

The Purpose of the Study

The proposed study sought primarily to develop an addiction care model that aims at enhancing the patient's motivation for engagement and retention in the addiction recovery process. Subsequently, the study evaluated the extent to which combining both therapeutic relationships and supportive social network in a single model improves outcomes related to motivation; specifically, the autonomous motivation for engagement and retention in the addiction recovery process. The study also examined the individual contribution of therapeutic relationships and supportive social networks to variables of the patients' motivation for engagement and retention in the addiction recovery process. Given that the complexity of addiction influences care planning and treatment outcomes (Marsden et al.,2014), the study also explored individual's contribution of factors, such comorbid post-traumatic stress disorders, motives and age at first substance use, to addiction severity.

The purpose of the study was pursued and reported through three independent manuscripts: 1) "extrinsic factors influencing the person's motivation for engagement and retention in the addiction recovery process. A systematic literature review", the manuscript ID rjmhs-2019-0010, which is under peer-review process at the Rwanda Journal of Medicine and Health Sciences; 2) contribution of age at first substance use and post-traumatic stress disorder to later addiction severity in a clinical sample from sub-Saharan Africa: Implications for prevention and treatment. Manuscript ID JPM-19-0382 submitted to Journal of Psychiatric and Mental Health Nursing; and 3) an article entitled "developing and testing an integrated addiction recovery model for engagement and retention of persons with substance use disorders: Structural equation modelling" which is the main part of this PhD research project. The final section of this thesis summarized the main results and discussed the implications of the findings.

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Chapter 2

Extrinsic Factors Influencing the Person's Motivation for Engagement and Retention in the Addiction Recovery Process. A Systematic Literature Review.

This chapter reports on a systematic literature review that synthesized evidence on extrinsic factors for addiction recovery outcomes and empirical definitions used to assess these outcomes. The chapter presents and discusses the results of data extracted from 16 peer-reviewed articles that were retrieved from four electronic databases; CINHALL, Ovid MEDLINE, PsychINFO, along with references scanned from the identified articles.

Background

Over the last three decades, substance use disorders (SUD), have been a global public health concern. A global compilation of evidence on SUDs demonstrated that 4.9% (about 240 million people) and 22.5% (1 billion people) of the world populations suffered from alcohol use disorders and smoked tobacco respectively (Gowing et al., 2015). In 2015, disability-adjusted life years attributable to alcohol use disorders were 257 per 100 000 population, and tobacco smoking was associated with 11% deaths in males and 6% deaths in females each year (Gowing et al., 2015).

Additionally, 5% of the global adult population who used illicit drug, such as opioids, cocaine, amphetamines, hallucinogens, at least once and 0.6% of whom had clinically diagnosable drug addiction in 2015 (United Nations Office on Drugs and Crime [UNODC], 2017). These estimates are approximately equivalent to a quarter-billion individuals who used drugs and 29.5 million living with drug addiction across the world

(UNODC, 2017). SUD contribute a total annual global loss of 28 million healthy lives, including 190,000 premature deaths solely attributable to opioid addiction worldwide (UNODC, 2017). Similarly, a recent analysis of global burden of diseases demonstrated that SUD are among the leading causes of years lived with disabilities (YLDs), accounting for 28.5% for global YLDs (Whiteford, Ferrari, Degenhardt, Feigin, & Vos, 2015).

Research has also associated increased risk of crimes with the ineffective stabilization of patients with addiction issues (Staton-Tindall, Havens, Oser, & Burnett, 2011). Wealthy and low resourced countries alike experience a high prevalence of addiction problems in criminal systems. For example, the UNODC reported that, in 2016, one of six sentenced prisoners is serving for substance-related crime worldwide (UNODC, 2013). Crimes related to substance use, such as robbery, drug trafficking and homicide in low-resourced, emerging economy, and wealthy countries range between 5% and 46% of all cases in their criminal justice systems (Boyce, Cotter, & Perreault, 2014; Dauvergne, 2009; The New Times, 2018; Guimarães et al., 2017)

Over the past two decades, there have been international commitments to improving addiction prevention and treatment outcomes through the 1998 United Nation (UN) General Assembly Special Session on drugs. Subsequently, in 2000, the political declaration and action plan for international cooperation advocated for an integrated and balanced strategy to counter world drug problems (UN, 2000). Through the political declaration, 132 heads of states agreed on a set of strategies, including pharmacotherapies and psychosocial interventions aimed at improving rehabilitation, recovery, and social reintegration of patients with SUDs (UN, 2000). Nonetheless, addiction care programs

across the world continue to experience high rates of early attrition from treatment.

Research has shown that dropout rates in the first three months of treatment can reach up to 80% among patients enrolled for addiction care (Carroll et al., 2006; Hoseinie et al., 2017; Szafranski et al., 2017). What is more, over 50% of patients receiving addiction care relapse in less than two months of their admission to addiction programs (Cornelius et al., 2003).

Substantial evidence has indicated that motivation plays a crucial role in the process of engaging in a person's behavior change process (Deci & Ryan, 1985, 2008; Ryan & Deci, 2000). A self-determination theory by Ryan and Deci (2000) asserts that individuals' intrinsic motivation, their inherited human drives towards growth, self-integration, and resolution of conflicting ideas about life, grows under the influences of interactions with extrinsic factors, and the external human conditions (Ryan & Deci, 2000). For example, external human conditions, such as perceived rewards, praises, punishment, and orders directed to the person effect a behavior change towards psychological growth, engagement, and wellness through the interactions with a component of intrinsic motivation referred to as autonomous motivation (Deci & Ryan, 2008). Given that autonomous motivation, an essential element for behavior change is continuously subject to influences of external human conditions (Deci & Ryan, 1985; 2008; Ryan & Deci, 2000), it is worth investigating extrinsic factors for engaging and completing in the addiction recovery programs. Such an investigation may yield modifiable external conditions, which healthcare professionals and stakeholders may capitalize on to improve addiction care outcomes.

Research has demonstrated that patients, who fully engage in self-endorsed actions towards the addiction recovery, are those whose extrinsic factors facilitate the recognition of substance-related consequences, perception of the importance of addiction behavior change, and expression of desire for help (De Leon, Melnick, & Tims, 2001; DiClemente, Schlundt, & Gemmell, 2004; Simpson & Joe, 1993). In light of the preceding evidence, retaining a person in the addiction recovery process may be subject to a wide variety of extrinsic factors. However, in the current literature, little attention has been paid to either synthesizing evidence related to interactions between extrinsic factors and addiction recovery outcomes. Additionally, assessing the patient progress in addiction recovery and related evidence require consistent and objective characteristics, that is, specific empirical definitions. In socio-behavioral research, empirical definitions also referred to as operational definitions, are crucial because they provide measurable dimensions through which the researchers examine non-observational variables of the phenomenon under investigation (Pedhazur & Schmelkin, 2013). While, motivation and retention in the addiction recovery, as variables, have been extensively studied, definitions specific to these variables varied across studies. For example, some research assessed motivation by the patient's recognition of their problems, expression of desire for help and treatment readiness (De Leon, Melnick, & Tims, 2001); whereas theorists suggested assessing motivation through the stages of change model (DiClemente, Schlundt, & Gemmell, 2004). This use of different empirical definitions makes it difficult to interpret and utilize evidence related to these variables. As such, this gap in the current literature calls for synthesizing evidence about extrinsic factors influencing

addiction recovery outcomes or their empirical definitions, which are used to evaluate these outcomes.

The present systematic review seeks to synthesize literature that relates to the following questions: (1) what are the extrinsic factors that influence the person's motivation for engagement and retention in the addiction recovery process? (2) What empirical definitions are used to evaluate patients' motivation for engagement and retention in the addiction recovery process?

Methods

Design

This review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher et al., 2015). Peer-reviewed articles were retrieved through electronic databases using MeSH terms and keywords. Two researchers independently used a pre-established protocol to select and assess the quality of eligible studies. The protocol stipulated that in case of disagreement on the selection or quality score of articles, a third researcher would be involved. Besides, other members of the research team individually evaluated the review process, importance and intellectual content of the article before discussing and approving the final version of the review report within the team.

Using the PICOS framework (Richardson, Wilson, Nishikawa, & Hayward, 1995), this systematic review included both experimental and observational studies that sampled people seeking addiction care services to examine factors contributing to the person's motivation for engagement and/or retention in the recovery process. As this

review included both experimental and observational study designs, there was no single comparator. However, the review primary outcome was patients' motivation for engagement and retention in the addiction recovery process. The review also explored empirical definitions used to study the person's motivation and engagement in the addiction recovery.

Search Strategy

The identification of papers through electronic databases was conducted using both MeSH keywords and free text searches. This technique enabled a broader coverage of possible subheadings and synonyms for keywords for the review topic. The search strategy encompassed a combination of MeSH keywords and free text, which used Boolean operators "AND" or "OR" with appropriate truncation. For Ovid MEDLINE(R) these MeSH keywords and free text were combined as follows: (1) engagement.mp, (2) addiction care.mp., (3) recovery, 4) exp Motivation/, 5) motivation for engagement.mp., (6) 3 OR 4 AND 5, (7) exp Substance-Related/ Disorders, (8) exp Substance-Related Disorders/, (9) 1 AND 7, (10) 2 or 6 and 8 and 9. This search strategy was adapted for other databases, including CINHALL and PsychINFO.

Study Selection

After searching each of the electronic databases, the identified research studies and corresponding abstracts and URL links were exported and stored on Microsoft Word outputs. Studies were selected if they had examined and reported data on the person's engagement and/or retention in treatment and were published in English and French between 1st January 1946 and 30th June 2018. The review excluded duplicated articles, studies without a human sample, articles reporting a secondary data analysis, review

articles, and papers whose full text was not available (see Figure 1). At the final step, a matrix table that presents data extracted from each individual study was created (Table 1).

Data Items and Extraction Process

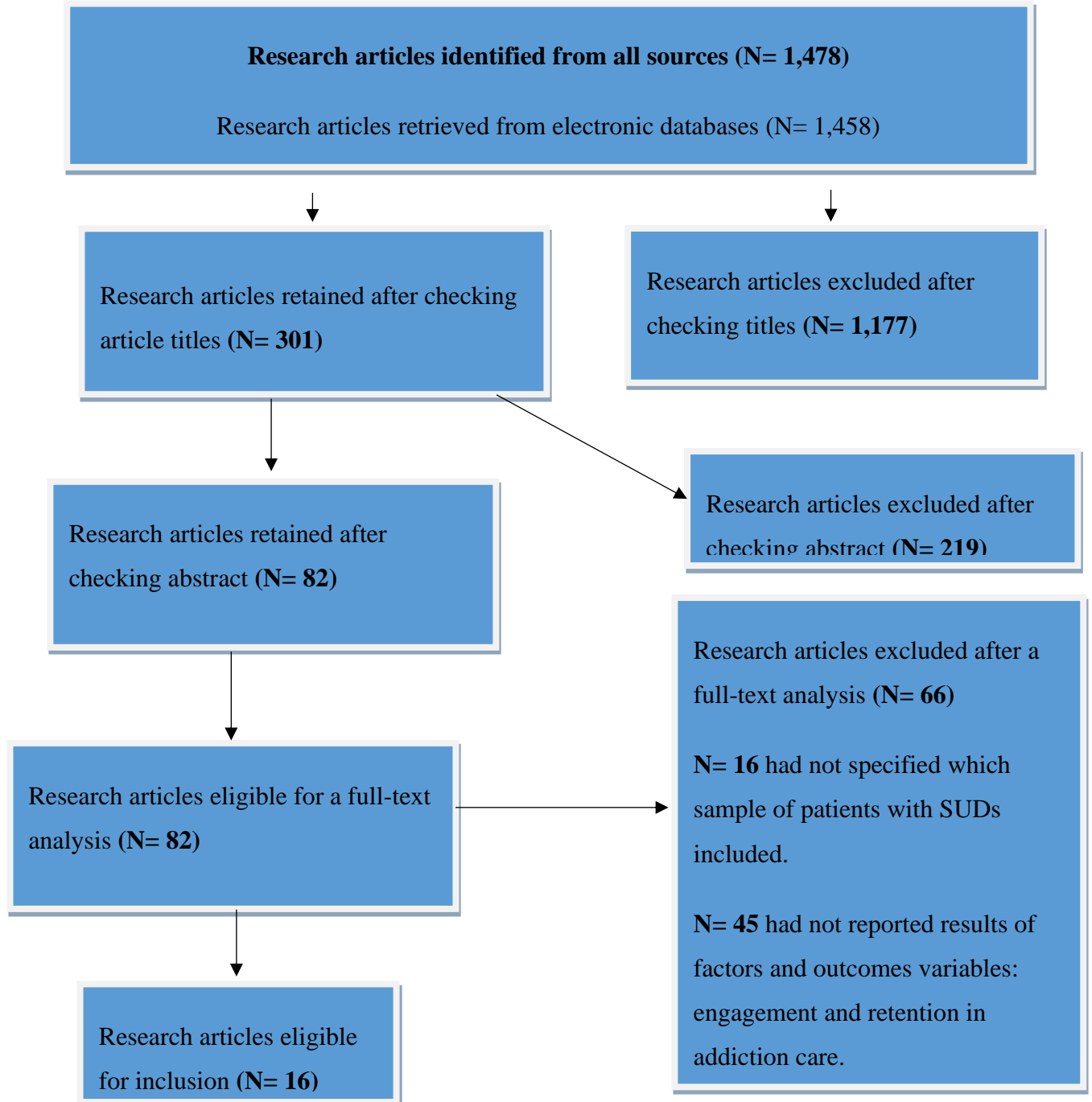
Data extracted from articles included the following items: a full reference, date and place of publication, purpose/hypotheses, study designs, sampling procedures and sample size, measurements, and findings related to outcomes (Table 1).

Risk of Bias and Quality Assessment

Critical appraisal is a key component of evidence-based practice; thus, the risk of bias and quality of studies were assessed with the Critical Appraisal Skills Program (CASP) checklists. CASP checklists consist of a series of questionnaires devised to facilitate the formal assessment of the methodological quality, quantity, consistency, and the applicability of study findings. CASP checklists comprised of cohort studies that have 12 criteria, (CASP, 2018a) and 11 criteria for both randomized controlled trials (CASP, 2018b) and clinical predictive studies (CASP, 2018c). CASP checklists enabled the researchers to rate each individual study based on whether the authors addressed a coherent and explicit research question, how the possibility of confounding, and various types of bias are handled. Scores for individual studies were ranked into three categories: high quality of evidence for studies whose scores were nine or over, acceptable for those scoring between seven and eight, and low quality for studies with a score below seven (for details on individual study score, see the last column of Table 1).

Figure 1

Flow Diagram for the Identification and Selection of Studies



Results

The initial search retrieved 1,478 articles, which after checking their titles and abstracts, were narrowed down to 301 and 82 respectively. The full-text assessment used the eligibility criteria to select 16 studies included in this review (Figure 1). The included studies present a wide variety of characteristics and operationalization of variables related to motivation and retention in the addiction recovery process. This diversity of characteristics and measures made it difficult to aggregate data and to conduct a meta-analysis. Therefore, the synthesis consisted of discussing the results of each individual study and organizing similar evidence under subheadings pertaining to the review's research questions. Studies included in this systematic review and corresponding evidence, to a varied extent, attributed the person's motivation for engagement and retention in the addiction recovery process to factors, including motivation-enhancing health care structures and therapeutic relationships, supportive social networks, and patient characteristics. The results pertaining to these factors are synthesized and summarized in Table 1.

Synthesis

Study Characteristics

Included articles were reporting on research conducted in eight countries: Australia, Belgium, Canada, China, Germany, Rwanda, and the United Kingdom had one article each; whereas nine articles were from the United States of America. In terms of methodology, the majority of reviewed research articles, nine (56.2%), were studies that utilized an experimental design, of which eight were randomized control trials (RCT),

and one was quasi-experimental design. Five (31.3%) studies used a longitudinal design, three of which were prospective cohort studies, while two were retrospective. There was also one (6.2%) comparative descriptive and one (6.2%) cross-sectional study in the reviewed articles. The reviewed studies sampled from three types of population: community-residing population (4 (25.0%)), inpatient (7 (43.8%)), and outpatient (5 (31.2%)). With regard to sample size, reviewed studies accounted for a combined total of 104,710 participants. Sample size varied across studies, with five (31.2%) having between 84 and 102 participants, three (18.8%) with a sample ranging from 216 to 300, while the remaining eight (50.0%) had more than 500 participants each. The majority of studies, 11 (69%) were published in the past five years, while five (31%) had a date of publication ranging between 2006 and 2011. Using CASP checklists to assess the quality of evidence, 10 of 16 (61%) reviewed studies scored ≥ 9 out of 11, which falls in the category of high quality. For the remainder, four (22%) studies scored between 7 and 8, a score in the category of acceptable quality and only two (19%) studies were rated at ≤ 6 out of 11, a score that falls into the low-quality category.

Table 1

Summary of Results

#	References	Publication	Objectives/Hypotheses	Study design	Sample size and characteristics	Measurements	Main results	Score/quality
1	Becan et al.(2015)	US 2015	To test the effectiveness of a new intervention for improving motivation for change, the Treatment Readiness and Induction Program (TRIP)	Comparative descriptive study	519 aged 12 and older recruited from 6 residential programs who completed assessments at intake and 35 days after admission.	The treatment motivation scales are a part of the CEST (Garner et al., 2007; Joe et al., 2002), and include problem recognition, desire for help, and treatment readiness.	Higher problem recognition [t (507) = 13.72, p <0.0002], and desire for help [t (507) =7.28, p < 0.008] in the intervention than in the control group at follow-up.	9/11 High quality
2	Bischof et al. (2016)	2016 Germany	To engage treatment-refusing patients in alcohol treatment and to improve concerned significant others (CSO) functioning.	RCT with a three, six, and twelve-month follow-up.	94 Concerned significant others, family members of patients suffering from alcohol dependence. The CSOs randomly assigned to intervention promoting their relatives' behaviour change	As primary outcome variable, treatment utilization by the Alcohol Dependent Individuals (ADI) was assessed received treatment for alcohol problems available in the community, including specialized in- or outpatient treatment and/or self-help groups.	At three months, participants in the intervention group had significant higher engagement rates compared to a waiting list (40.5% vs 13.9%, p<0.02). But, there were no significant rates differences between groups at six and twelve-month follow-up 47.6% vs 41.7%, p<0.84) except for improvement for the psychological well-being of CSOs.	High quality 9/11
3	Cao et al. (2014)	2014 China	To identify various predictors of treatment retention over a six-year period. Specifically, the study tested the hypothesis that while rapid scale-up of China's MMT program, there were crucial factors being associated with MMT clients'	The prospective predictive study extended over a 6 year- period. A secondary data analysis	N=1511, 18 years or older drug users who have failed to come off heroin use, had at least had two attempts to quit and are on methadone. 77.1% (1165) were male and	Retention duration represents days on treatment from the first dose to the last dose of methadone or last date of the study period. The statuses of clients after withdrawal from MMT were categorized as addicted, self-reported abstained from heroin,	Clients reporting close or average family relationships, drug injection, needle sharing and contact with drug users in the month prior to MMT enrolment were significantly associated with retention (p < 0.01). Gender, age, employment status, marital status, living situation, education level, age at first drug use and length of drug use were not significant predictors. Daily dosages of methadone were strongly correlated with retention in treatment (20.8% for ≤30 mg/day vs 34.8% for 31–60	Acceptable quality 8/12

			retention in China's social, political, and cultural context.		60.3% had 30 years-old	incarcerated, hospitalized, or decreased based on information gathered from local MMT clinic	mg/day vs 53.2% for >60 mg/day, $p < 0.0001$). Living less than 5 km away from their prescribing MMT clinic were more likely to stay in treatment (38.7% vs 31.4%). And Clients with relatives who were also engaged in MMT were associated with a higher retention rate than clients who did not have relatives in MMT (53.8% vs 32.9%).	
4	Courtney et al.(2017)	2017 Australia	(1) describe the retention rates in the Financial Interventions for smoking cessation among low-income smokers (FISCALS) RCT and (2) identify whether smoking-related, health-related, behavioural, socio-demographic characteristics or recruitment source were associated with retention at 2- or 8-month follow-ups	RCT open-labelled with allocation concealment	N= 1047 Low-Social Economic Status smokers interested in quitting smoking	Predictors of retention were measured through the self-reported data collected via CATI included: smoking-related, substance use, mental or physical health, general psychological factors, socio-demographics, and recruitment source	Motivation to quit was significantly associated with both 2-month and 8-month retention (OR: 1.16; 95% CI: 1.03,1.30, $p < 0.05$; and 1.15; 95% CI: 1.04, 1.27, $p < 0.01$ respectively). The number of recent quit attempts was associated with retention at 8-months (OR: 1.20; 95% CI: 1.04, 1.40, $p < 0.05$) but not at 2-months. No significant difference in retention at 8-months based on participants' self-reported quit status at 2-months. Having older age significantly predicted program completion at two and 8 months (OR: 1.04; 95% CI: 1.02,1.06, $p < 0.01$ and 1.05; 95% CI: 1.03,1.07, $p < 0.01$ respectively). An increase in level of education significantly contributed to retention in the 8 months' interview (OR: 2.24; 95% CI: 1.45, 3.46, $p < 0.01$).	High quality 10/11
5	Drummond et al. (2016)	2016 UK	Testing the feasibility of recruiting and retaining people seeking treatment for alcohol dependence in RTC study using assertive community treatment (ACT), and evaluating the efficacy of the intervention on drinking behaviours	A Pilot Randomized Controlled Trial	N= 94 participants with age 18 years or over from community addiction services	Mean drinking per day and percent days of abstinence assessed by TimeLine Flow Form 90 Total alcohol and other drugs consumed in 6 months' health-related quality of life	Participants assigned to ACT were in contact with services for longer period ($t(76.77) = 15.62$, $P < 0.001$); received a greater mean service contact ($t(57.75) = 10.52$, $P < 0.001$). At 6 months, treatment as usual group had better significantly fewer alcohol-related problems and health utility. There was no significant difference between intervention and control groups in motivation for readiness to change, health-related quality of life, and severity of dependence.	High quality 9/11
6	Graff et al. (209)	2009 US	(1) Compared rates of engagement and retention of alcohol-dependent	RCT	102 women seeking outpatient treatment	The TLFB41 was used to assess alcohol and drug use for both the woman and her partner in the	Women in the individual treatment condition attended significantly more sessions than women in the couples' condition ($t(100) = -1.98$; $p = .05$).	9/11 High quality

			women and women in couple treatment; (2) Examined specific factors related to engagement and relation; (3) Analysed the difference of predictors between groups		for alcohol problems and their male spouse or partner They were randomly assigned to 20 sessions of CBT or Couple based CBT treatment intervention over 26 weeks	three months prior to the baseline interview The Rutgers Consequences of Use Questionnaire to assess how a woman and spouse experience substance related consequences Motivation was measured by readiness to Change Questionnaire The woman's preference for treatment condition assignment was measured through a consensus rating done by members of the research staff.	Being older, having no children at home were associated with fewer alcohol dependence symptoms, later age of onset of an alcohol diagnosis, more satisfying marital relationships, and having encouraged or accepting partners increased treatment engagement (completion of homework) ($F(4, 86) = 5.48, p < .001$). Women's age, the total number of current alcohol dependence symptoms, female relationship quality score, spouse drinking status, and women's condition preference accounted for 40% of variations in retention outcomes ($F(5, 72) = 9.39, p < .001$).	
7	Guerrero et al. (2015)	2015 US	Examined the extent to which coordinated care is the mechanism by which program capacity is associated with the wait time and retention. Hypothesized that high-capacity programs would be indirectly associated with (a) reduced client wait time and (b) increased client retention	Retrospective cohort study	N=13,478 client treatment episodes were drawn from programs client dataset collected in 2010 and 2011	Retention was measured as the number of days between admission and discharge dates Measured leadership using the Multifactor Leadership Questionnaire Organizational Readiness for Change (ORC) Scale to measure program readiness to implement new practices	The relationship between high-capacity programs and client retention in treatment would be moderated by client minority status. African American clients (IRR = 1.315; 95 % CI = 1.170, 1.479; $p < .001$) had significantly greater retention in treatment than White. ORC was associated with higher retention (IRR = 1.014; 95 % CI = 1.001, 1.026; $p = .04$). Medi-Cal eligibility (IRR = 1.132; 95 % CI = 1.084, 1.182; $p < .001$), and homelessness (IRR = 1.065; 95 % CI = 1.021, 1.112; $p < .01$) were positively associated with retention.	Acceptable quality 6/12
8	Holtyn et al. (2014)	2014 US	To determine if employment-based reinforcement can increase retention in outpatient methadone treatment	RCT Work reinforcement, methadone work reinforcement, and abstinence,	98 participants on waiting lists for methadone treatment in Baltimore. The programs provided an individually determined dose of	Outcomes were measured by the Addiction Severity Index-Lite (ASI-Lite; McLellan et al., 1985) for evaluating drug use, educational, employment, family, medical, and legal histories; the heroin and	The Abstinence, Methadone, & Work Reinforcement participants provided the highest percentage of drug-negative urine samples. The Abstinence, Methadone, & Work Reinforcement condition differed significantly from the Work Reinforcement condition. non-significant difference between the Abstinence, Methadone, & Work Reinforcement and methadone & work	9/11 Higher quality

				methadone and work reinforcement conditions.	methadone (about 100mg) and take-home policies that were consistent with federal regulations.	cocaine sections of the Composite International Diagnostic Interview—2nd edition (CIDI2; Compton et al., 1996), to assess drug dependence.	reinforcement. At the follow-up, there were no between-condition differences in rates of drug abstinence.	
9	Kim et al. (2011)	2011 US	To examine the proportion of study participants that initiated and engaged with Chronic Disease Model addiction care when this modality was made accessible. To assess characteristics associated with initiation and engagement with CDM addiction care	A prospective cohort study with a 3-month follow-up	N=282 individuals with alcohol dependence, drug dependence, or both alcohol and drug dependence involved in CDM care	Initiation and engagement measured by two or three to patients' visits to addiction care services within 30 days of initiation	Relative to those who did not engage with CDM care, a higher proportion of participants who engaged with CDM services utilized addiction treatment (79% vs 56% respectively, P-value = 0.001) and addiction pharmacotherapy (39% vs 18%, respectively, P value < 0.001). Factors were major depressive episode had almost twice the odds of initiating CDM care (AOR 2.60,95% CI 1.39, 4.87). Female sex was associated with lower odds of linkage with CDM care over the course of the study (Adjusted HR 0.67, 95% CI 0.49, 0.90).	Acceptable quality 8/12
10	Mason et al. (2016)	2016 US	Tested a 20-minute intervention named Peer Network Counselling that integrates motivational interviewing and peer network strategies	RCT Involving adolescents	119 recruited between April 2013 and February 2014 from an adolescent medicine outpatient clinic at a large urban academic medical institution	Participants were asked the number of days they have used substances (alcohol and marijuana) within the last month with self-reported alcohol use and self-reported marijuana use	Intervention effects on growth slopes were noted for measures of alcohol offers (p=.02) and previous 30-day use (p=.08) among boys. The reduction of alcohol offers for the intervention condition suggests that alcohol use behaviour may be closely associated with adolescents' peer network characteristics of risk or protection, at least for boys as we did not find this effect for girls.	10/11 High quality
11	Morse et al.(2015)	2015 US	to describe possible differences between young adult (18–25) and older adult (26 and older) opiate users in abstinence-based, residential, dual diagnosis treatment	Retrospective study	N=760 individuals who reported using heroin, non-prescribed methadone, and/or other opiates during the 30 days prior to treatment	Readiness for change Addiction severity Items measuring the types and frequencies of service drawn from the treatment service review	At 6 months follow up, opiate users had lower rates of treatment completion at every other weekly measure, peaking at 3 weeks (77.5% vs. 81.1%, p ≤ .001). Opiate users had a shorter average length of stay by almost two days (30.9 vs. 32.8 days, t ¼ .204, p ≤ .041). Three statistically significant differences remained: young adults continued to have higher composite scores for drug use and legal issues and older adults continued to have higher composite scores for medical issues. No differences between	Acceptable quality 6/12

							group regarding the use of outpatient and halfway house and engagement in 12 steps programs	
12	Mueser, Glynn (42)	2009 US	Exploring client and family characteristics related to engagement and exposure to the interventions is a critical aspect of determining their overall utility.	RCT, which developed, and pilot tested the Family Intervention for Dual Disorders (FIDD) program	N= 216 families (108 clients with concurrent substance use psychiatric disorders and their 108 key relatives) were randomly assigned to the intervention	Selected subscales from the FEIS (Tessler & Gamache, 1996) were employed to evaluate the effects on the relative of having a close relationship with someone. The Timeline Follow-back Calendar (TLFBC) assessed substance use during last 6 months.	Engaging and not engaging was influenced by: Geographical location ($\chi^2 = 7.61$, $df=1$, $p < .01$), ethnicity ($\chi^2 = 7.61$, $df=1$, $p < .03$), patient alcohol use problems ($\chi^2 = 7.61$, $df=1$, $p < .03$), relative close relationships ($\chi^2 = 7.61$, $df=1$, $p < .004$), and relative stigmatizing attitudes ($\chi^2 = 7.61$, $df=1$, $p < .007$).	9/11 High quality
13	Ng and Harerimana (2016)	2016 Rwanda	Evaluate a sustainable model of mental health care in a low-income country and the development of an excel worksheet that provided a simple information management system tailored to the needs, resources, and research capacity of a low-resource setting	Prospective cohort study	A total of 719 patients (55.08% male) who sought care for substance use and posttraumatic stress disorders between 2013 -2014	Retention was determined by regular attendance to follow-up appointments	Of the 536 patients, 298 (55.60%) were still in care by the end of the program evaluation, 199 (37.13%) were lost to follow-up at the end of the program evaluation. Factors associated with improved treatment outcomes included: patients presenting for care with their families (85.63%) and patients' beliefs regarding treatment was helpfulness, importance, and/or necessity as reported by 90.26%.	8/12 Acceptable
14	Stevens et al. (2015)	Belgium, 2015	The primary purpose of the current study was to examine whether delay discounting, as measured shortly following treatment entry, would be predictive of shorter treatment retention among substance dependent individuals (SDI)	Quasi-experimental design immediate gratification	N= 84 Substance drug injecting included in the present analyses were recruited from adult inpatients detoxification program	A computerized version of the delay discounting task (DDT) was administered using E-Prime experiment generation software. The motivation for treatment was measured using a Dutch version of the The motivation for Treatment (MfT) scale	A delay discounting significantly predicted shorter treatment retention ($t(82) = -3.04$, $p < .02$). The associated b-value (-4.50) indicated that as the $\ln(k)$ -value decreased by one unit (i.e., lower delay discounting), treatment retention increased by 4.50 units (i.e., days). The model containing discounting scores was able to predict group membership (drop-out vs. treatment completer) better than a model based on a simple constant ($\chi^2(1) = 15.04$, $p < .02$), with delay discounting scores accounting for 22% of the variance in drop-out status (Nagelkerke R-square).	9/11 High quality

15	Tate et al. (2011)	2011 US	Evaluate predisposing, enabling, and need predictors of treatment retention in a sample of alcohol/substance dependent adults with comorbid depression	Randomized clinical trial	253 participants entering outpatient treatment at the Veterans Affairs San Diego Healthcare System	The motivation for treatment was assessed via ASI questions	Participants with low social support attended more sessions than participants with high social support, $F(1, 212) = 6.12$, $p = .01$, partial $\eta^2 = .03$. Chronic financial stress was not predictive of attendance. Participants who experienced an acute health event in the three months prior to treatment attended more sessions than participants without an acute pre-treatment health event, $F(1, 214) = 5.22$, $p = .02$, partial $\eta^2 = .03$ was not predictive of attendance.	9/11 High quality
16	Wild et al. (2006)	2006 Canada	To test if treatment motivation should account for unique variance in client engagement at treatment entry Test a second hypothesis, derived from SDT, that identified (i.e., self-determined) reasons for seeking treatment would be more positively associated with client engagement than other reasons for attending treatment	Cross-sectional predictive study	N =300; 221 males and 79 females; M age=36.6 years seeking treatment at the Behaviour Change Unit (BCU) of the Addiction Research Foundation, (ARF) in Toronto, Ontario	Clients rated the extent to which their social networks pressured them using two modified versions of Polcin and Weisner's (1999) social pressure index. To assess treatment motivation, the study protocol included a Treatment Entry Questionnaire (TEQ) containing 30 items assessing external, introjected, and identified reasons for seeking treatment. Self-reported attempts to reduce substance use at the time treatment measure motivation for behaviour change. Assessed perceived costs and benefits associated with reducing alcohol and other drug use	Perceived coercion negatively affected identified motivation for treatment ($r = -.34$, $p < .001$). External treatment motivation was negatively correlated with alcohol dependence ($r = -.22$, $p < .01$) and was uncorrelated with drug dependence. Conversely, identified treatment motivation was positively correlated with both alcohol dependence ($r = .22$, $p < .01$) and other drug dependence ($r = .25$, $p < .001$). Social network pressure to seek help vs external motivation was as low as $r = .39$, $p < .001$ and $r = .25$, $p < .001$ for introjected motivation. Social network pressure to cut down substance use vs external motivation was as low as $r = .41$, $p < .01$ and $r = .24$, $p < .001$ for introjected motivation. However, both social network types of pressure had no significant association with identified motivation. Only perceived coercion ($r = -.34$, $p < .001$), alcohol dependence ($r = .22$, $p < .001$), and drug dependence ($r = .25$, $p < .001$) symptoms had correlations with identified motivation. Identified treatment motivation was positively associated with perceived benefits of reducing substance use ($b = .31$, $p < .01$). Introjected treatment motivation was positively related to both perceived benefits of reducing alcohol or drug use ($b = .20$, $p < .05$) and to perceived costs of reducing alcohol or drug use $\beta = .37$, $p < .001$.	7/11 Acceptable Quality

Empirical Definitions for Motivation and Retention in the Addiction Recovery Process

Motivation. In the included studies, addiction care outcomes, motivation for engagement and retention in the addiction recovery process were operationalized using a wide range of dimensions. Examples include problem recognition, desire for help, and treatment readiness. Tate et al., 2011 operationalized motivation for engagement by the people's perceived importance of treatment for their alcohol, drug, and psychological problems. Other empirical definitions of motivation were either the person's readiness for behavior change measured by addiction severity index scale (Graff et al., 2009b; Morse & MacMaster, 2015) or a combination of more than one of the following dimensions: problem recognition, desire for help, and treatment readiness (Becan, Knight, Crawley, Joe, & Flynn, 2015; Stevens, Verdejo-García, Roeyers, Goudriaan, & Vanderplasschen, 2015). These empirical definitions were also corroborated by Wild, Cunningham, and Ryan (2006) who assessed motivation for engagement in treatment through social network pressure, perceived costs and benefits associated with reducing alcohol and other drug use.

Motivation was also operationalized by commitment to attending addiction care programs. Other studies operationalized motivation by empirical definitions which, in clinical practice, are not uniquely specific to the person's engagement; for example, operationalizing motivation for engagement as two- or three person's visits to addiction care services within 30 days of treatment initiation (Kim et al., 2011). Likewise, Bischof, Iwen, Freyer-Adam, and Rumpf (2016) assessed the person's engagement using

unspecific measures such as the utilization of available community alcohol problems services and specialized addiction care settings.

Retention in the Addiction Recovery Process. With regard to operationalization for retention in the addiction recovery process, researchers used various measures across all included studies. In some studies, retention was defined as number of substance use during the last 30 days or compliance with a treatment plan. Mason, Sabo, and Zaharakis (2016) assessed retention through self-reported numbers of days a person used substances, such as alcohol, cannabis, during the last month; while in the Ng and Harerimana's study (2016) retention was determined by attendance to scheduled follow-up appointments. In a study involving methadone maintenance, retention was operationalized as a period representing days on treatment from the first dose to the last dose of methadone or last date of the study period (Cao et al., 2014).

Retention was also defined as reduction in substance use and improvement in the patient's physical, psychosocial, and legal status. This empirical definition is supported by items of the Addiction Severity Index Scale, which assess the retention through reduced drug use, a person's stability in employment, relationships with family, along with improved medical and legal histories (Holtyn et al., 2014). Additionally, retention can be defined as the person's days of stay in treatment from admission to discharge dates (Guerrero, Fenwick, Kong, Grella, & D'Aunno, 2015); whereas in Drummond et al. (2016) evaluated retention in the recovery using reduced daily drinking mean, percentage of days patients abstain from substance, along with total amount of alcohol and other drugs used over a period of six months.

Factors Influencing the Patients' Motivation and Retention in the Addiction Recovery Process

Motivation-Enhancing Healthcare Structures and Therapeutic

Relationships. The reviewed studies highlighted that healthcare structures, including addiction treatment tailored to the patient's needs, timely positive reinforcement and understanding of the needs, enhanced patient-healthcare professionals' relationships, and readily accessible addiction care services, are vital for motivation and retention in addiction recovery.

Addiction Treatment Tailored to the Patient's Needs. The reviewed studies have linked, at various levels, the daily dosage of substitute treatment to patients' motivation and retention in the addiction recovery process. Over six years, a prospective predictive study demonstrated that daily dosage of methadone significantly correlated with treatment retention; specifically, having methadone 30mg/day was associated with a treatment retention of 20.8% compared to 34.8% in the group with 31–60 mg/day and 53.2% for >60 mg/day, $p < 0.001$ (Cao et al., 2014). Beside daily methadone dosage, another study found that patients who reported a positive relationship with their family relatives and contact with ex-drug users a month before entering treatment had significantly improved treatment retention ($p < 0.01$) (Cao et al., 2014).

Timely Positive Reinforcement and Understanding of Patients' Needs. An experimental study involving 84 Belgians with SUD, examined the relationship between retention in treatment and patient satisfaction in the form of reward discounting (Stevens et al., 2015). The study found a positive effect of timely reward on retention in treatment ($t(82) = -3.04, p < 0.02$) wherein a reduction of one unit in a delay of reward increased

treatment retention by 4.5 days ($\beta = -4.50$, $p < 0.01$). While the study emphasized the importance of timely positive reinforcement and understanding of patients' needs on the course of the addiction recovery process, it has the drawback of being a laboratory-based experiment with the attendant difficulty of translating results to real-life settings, because they do not account for one's social context. Similarly, implementation of motivation-enhancing interventions, combining mapping-enhanced counselling, experiential games, and activities to peer facilitation may enable a person to maintain higher scores on motivation domains until aftercare follow-up. This was ascertained in a sample of 519 patients from the United States with SUDs (Becan et al., 2015). The study indicated a higher problem recognition [$t(507) = 13.72$, $p < 0.002$], and desire for help [$t(507) = 7.28$, $p < 0.008$] in the intervention than in the control group at follow-up (Becan et al., 2015). However, this study examined only two of four dimensions of motivation for engagement in treatment. As result, its findings cannot be inferred to the entire picture of retention in the addiction recovery process.

Enhanced patient and healthcare professional relationships. Addiction care outcomes may be improved by treatment interventions delivered through community assertiveness treatment (CAT); which emphasize addiction recovery principals, including enhanced patient and healthcare professionals' contacts, relationships, and care planning based on patient's goals, health and social needs such as accommodation, leisure, occupation and physical and mental health (Drummond et al., 2016). A randomized control trial by Drummond et al. (2016), in a sample of 98 British participants aged 18 years and over, indicated that participants assigned to CAT plus treatment as usual were in contact with services for longer period ($t(76.77) = 15.62$, $P < 0.001$); and they also

received a greater mean service contact ($t(57.75) = 10.52, P < 0.001$). However, at six months, the intervention group had significantly fewer alcohol-related problems and health utility, there was no significant difference between intervention and control groups in motivation for readiness to change, health-related quality of life, and severity of dependence (Drummond et al., 2016). It is also worth noting that the study neither distinguished the contribution of each extrinsic factor nor evaluated other domains of the person's motivation for engagement in the addiction recovery process; i.e., problem recognition, desire for help, and pressure for treatment.

Readily accessible addiction care services and patient-tailored treatment.

Motivation may be enhanced by interactions between retention in addiction care and health care setting's capacity in terms of program readiness to implement new practice minimizing the patients' wait time retention (Guerrero et al., 2015). A retrospective study among American patients with SUDs found that having a health care insurance and being homeless had a positive association with retention in addiction treatment (Guerrero et al., 2015). Similar to the other reviewed articles, Guerrero et al. (2015) provided little evidence on which motivation domains that influenced retention variables.

Another study indicated that combining substitute treatment delivered through individually determined doses of methadone and work reinforcement conditions has the potential to enhance abstinence among patients with substance problems (Holtyn et al., 2014). This randomized control trial (RCT) that sought to determine if intervention which focuses on employment-based incentives can enhance outcomes among 98 American patients in a methadone treatment program (Holtyn et al., 2014). The study found that patients in intervention exhibited a higher proportion of urine clean from opioids (75%

versus 54%) and cocaine (57% versus 32%) than the control group which consisted of patients on the waitlist who were provided with work reinforcement only (Holtyn et al., 2014). However, the results of follow-up data showed no significant differences in abstinence rates between the groups. This inconsistency of findings indicates that addiction care outcomes may be subject to extrinsic factors outside treatment conditions such as supportive social networks; which were not taken into account by the study.

Supportive Social Networks. The studies reviewed failed to provide consistent evidence on the association between supportive social networks and improved retention in addiction care. However, several studies linked specific social supports with positive addiction treatment outcomes.

Support from Family Relatives. In a one-year evaluation of a program specializing in post-traumatic stress disorders and SUDs treatment, Ng and Harerimana (2016) highlighted the role of acknowledging people's beliefs about treatment and family involvement in improving retention outcomes. In a sample of 719 people seeking mental health care, in Rwanda, the study found a retention rate of 55.6% and attrition rate of 37.1% at one-year follow-up (Ng & Harerimana, 2016). People who optimally benefited from the care program had family support in the form of accompaniment (85.6%), and believed that treatment was helpful, relevant, and/or necessary (90.2%) (Ng & Harerimana, 2016). Nonetheless, family relatives and peer network may compromise motivation outcomes by exerting pressure for treatment on the patient. A Canadian study, conducted at the Addiction Research Foundation in Toronto, examined the extent to which patient motivation, extrinsic motivation in the form of subjective social network pressure to seek addiction care, influenced motivation for engagement and retention

among 300 adults seeking treatment (Wild et al., 2006). In this study, Wild et al. (2006) found that perceived coercion through network pressure negatively impacted the patient's identified motivation ($r = -.34, p < .001$), and had a negative correlation with alcohol dependence ($r = -.22, p < .01$).

In contrast to the previous studies, several similar studies have shown inconsistent results. Bischof et al. (2016), a German RCT used a sample of 94 people entering treatment for alcohol use disorders to examine their engagement in an intervention aimed at improving close relative functioning. This RCT found inconsistent effects on the people's engagement at three, six, and twelve-month follow-up periods. At three months, rates of engagement among participants assigned to the intervention group were significantly higher than in the control group (40.5% vs 13.9%, $p < 0.02$) (Bischof et al., 2016). However, the difference between groups was not significant at six- and twelve-months' follow-up (47.6% vs 41.7%, $p < 0.84$) (Bischof et al., 2016). Despite the inconsistency in results after three, six- and twelve-months' follow-ups, this RCT does provide insights into the potential of involving people's social networks, mainly close relatives in addiction treatment.

Peer support. A six-month RCT of 119 adolescents with alcohol and cannabis use problems, in the United States, compared peer network-led intervention, promotion of motivation through rapport, acceptance, reflections, and non-confrontation with standardized addiction treatment protocols (Mason et al., 2016). The study found marginally significant positive peer network intervention outcomes only in alcohol use via reduced social stress ($R^2 = .05, p = 0.052$) (Mason et al., 2016). The concern, in this study, was that the RCT measured the construct social support using only two items,

loneliness and perceived isolation, rather than the full construct scale; thus, potentially negatively impacting the comprehensiveness of the data. In contrast to the preceding study, in another RCT involving 253 American participants with major depression and SUDs entering outpatient treatment, Tate et al. (2011) found diametrically opposed results regarding supportive social networks. This study, examining predictors for treatment retention, indicated that participants with low social support were more active in treatment than those with higher support. However, this RCT does not explain how participants' experience with the health systems and the reported social support influenced their engagement in seeking addiction care.

The Person's Characteristics Moderating the Effect of Extrinsic Factors on Motivation and Retention in the Addiction Recovery

Characteristics of a person, such as having an intimate relationship or dependents, the age of substance use onset, and age at the current episode can influence motivation for engagement and retention in the addiction recovery process (Graff et al., 2009). This influence was evidenced in an RCT, which examined specific factors for treatment engagement and retention among 102 American women assigned to cognitive behavioral therapy for substance use problems (Graff et al., 2009). The RCT found that being older and having no dependents predicted fewer alcohol dependence symptoms; while later substance use onset, having more satisfactory marriage status, and living with an encouraging and accepting spouse correlated with higher engagement in addiction care intervention ($F(4, 86) = 5.48, p < .001$) (Graff et al., 2009). While these results provide insights into people's characteristics that should be considered by intervention addressing engagement and retention in addiction care, the study did not examine the addiction

recovery and motivation dimensions affected. A study by Courtney et al. (2017), in RCT testing an intervention for smoking cessation among 1047 Australians, indicated similar interactions between socio-demographic characteristics and retention in addiction care. The researchers found that being older significantly predicted program completion at two and eight months (OR= 1.04; 95% CI: 1.02,1.06, $p < 0.01$ and OR=1.05; 95% CI: 1.03,1.07, $p < 0.01$ respectively) (Courtney et al., 2017). This study, further, showed that a higher level of education also had a significant effect on retention at the eight months' follow-up interview (OR= 2.24; 95% CI: 1.45, 3.46, $p < 0.01$).

Another RCT study by Mueser et al. (2009) evaluated the influence of patient and family characteristics on engagement in addiction treatment. Among 108 American patients who had comorbid SUD and psychiatric disorders and their 108 close relatives, Mueser et al. (2009) showed that the patients' engagement was influenced by their characteristics. Characteristics, including geographical location ($\chi^2 = 7.61$, $df=1$, $p < .01$), ethnicity ($\chi^2 = 7.61$, $df=1$, $p < .03$), patient SUD ($\chi^2 = 7.61$, $df=1$, $p < .03$), having close relationships ($\chi^2 = 7.61$, $df=1$, $p < .004$), and relatives' stigmatizing attitudes ($\chi^2 = 7.61$, $df=1$, $p < .007$) had a statistical significant effect on engagement outcomes (Mueser et al., 2009).

Other person's characteristics that have potential to affect addiction recovery include having comorbid disorders, such as a major depressive episode (AOR=2.60, 95% CI: 1.39, 4.87) and being female, which correlated with reduced odds ratio of engagement in addiction care (Adjusted HR=0.67, 95% CI: 0.49, 0.90) (Kim et al., 2011). Likewise, Morse and MacMaster (2015) evaluated the influence of patients' characteristics in a retrospective study among 760 Americans entering treatment for

heroin, non-prescribed methadone, and/or other opioids. The study found that patients using opioids had lower rates of treatment completion, i.e. 77.5% vs 81.1%, $p \leq .001$ of those not using opioids (Morse & MacMaster, 2015). Additionally, results demonstrated that being a young adult (18–25 years old) was associated with a higher score on drug use and involvement in legal issues; whereas, there was no difference among groups in terms of receiving addiction care from either outpatient or halfway house and 12 step programs (Morse & MacMaster, 2015).

Discussion

The primary purpose of this systematic literature review was to summarize empirical evidence pertaining to extrinsic factors for the person's motivation for engagement and retention in the addiction recovery process. The reviewed evidence concludes that a person's motivation for engagement and retention in the addiction recovery process is, to a varied extent, influenced by several extrinsic factors. Key among these were addiction care programs and therapeutic relationships capable of enhancing the person's perceived experiences with treatment. Such addiction care programs may consider to: (1) timely respond to each person's needs and interventions targeting to improve the person's experiences with the addiction care recovery process (Becan et al., 2015; Stevens et al., 2015); (2) comprehensive addiction care programs providing biological treatment and social interventions that improve relations between people receiving care and their family relatives (Cao et al., 2014; Drummond et al., 2016; Holtyn et al., 2014), along with ensuring that each person has a single and stable care provider throughout the treatment process (Cao et al., 2014; Drummond et al., 2016); and (3) to

maximize daily dosage of maintenance treatment (e.g. methadone >30/day) in accordance to each individual response to medication (Cao et al., 2014; Holtyn et al., 2014).

The present review also highlights that addiction care programs are required to minimize the wait time for receiving treatment (Guerrero et al., 2015). Offering programs that can provide the person with addiction care without long wait time is particularly important because this can help with alleviating the person's addiction-related difficulties, such as a reduced capacity of decision making and impulse control (Bechara, 2005; Everitt & Robbins, 2005; Polimanti et al., 2018).

Other important extrinsic factors to consider while formulating addiction care programs include psychosocial processes, such as companionship by person's relatives that may contribute to fostering social support and reduce the stress associated with SUDs (Ng & Harerimana, 2016). The review also indicates that people seeking addiction care due to their own motivation may have better treatment outcomes than those who are pressured by their social networks (Wild et al., 2006). Understanding this difference may enable healthcare providers to pay attention to the person's motivation for seeking care; and subsequently, make clinical decisions accordingly.

Furthermore, the review indicates that the person's characteristics may play a crucial role in moderating the interactions between extrinsic factors and motivation and retention outcomes. In the process of clinical decision making, addiction care program managers and healthcare providers should not overlook the potential impact of a person's characteristics on motivation, retention in treatment, and subsequent health outcomes. These characteristics include being in intimate relationship, having dependents, age of substance use onset, age at current episode, level of education (Courtney et al., 2017;

Graff et al., 2009b), comorbid disorders (Kim et al., 2011), as well as type of substance misused (Morse & MacMaster, 2015), the person's geographic location and suffered stigmatization attitudes from family relatives (Timko, Below, Schultz, Brief, & Cucciare, 2015).

This literature review also sought to evaluate empirical definitions used to assess variables related to motivation for engagement and retention in the addiction recovery process. Variable related to motivation for engagement in addiction care was evaluated by diverse domains, including the person's readiness for behavior change, problem recognition, social network pressure, perceived costs and benefits associated with reducing alcohol and other drug use, and visits to addiction care services within 30 days of treatment initiation. Although no studies combined these empirical dimensions for variables related to motivation, the review results support indicators developed and validated through the Texas Christian University Motivation Scale (Joe, Broome, Rowan-Szal, & Simpson, 2002; Simpson & Joe, 1993). The scale operationalizes motivation for addiction care as a combination of problem recognition, desire for help, treatment readiness, pressures for treatment, treatment needs (Joe et al., 2002; Simpson & Joe, 1993).

Outcomes related to retention in addiction recovery were operationalized by varied the person's aspects including: regular attendance to follow-up appointments, days spent in treatment from the first dose to the last dose, commitment to reducing drug use, the person's stability in education, employment, relationship with family, along with improved medical and legal histories. To a certain extent, these domains for retention in the addiction recovery are consistent to those developed and validated by standard gold

instruments, such the Scale for Substance Use Recovery Evaluator, and the addiction recovery process (Neale et al., 2014; Neale et al., 2015; Neale et al., 2016; Prochaska & DiClemente, 2005). These instrument development studies demonstrated that the process of addiction recovery might be observed by the past week-based improvement in the person's domains, including reduced drinking and drug use, self-care, relationships, perceived importance of abstinence from drinking and drug use, looking after one's self, stable resources and belongings. Furthermore, this review identified inconsistent results, especially in studies that tested the influence of psychosocial interventions on engagement or retention in addiction care. This inconsistency may be partially explained by differing empirical definitions for these variables across reviewed studies. As such, further studies are needed to address this limitation of the current literature.

Strengths and Limitations

To our knowledge, this the first literature review to evaluate various empirical definitions for motivation for engagement and retention in the addiction recovery process, to provide a systematic synthesis of evidence on extrinsic factors influencing these treatment outcome variables. Another strength of this systematic review is based on the characteristics of the included studies. The majority (50%) used experimental designs, 72.5% were published in the last five years, and reviewed studies accounted for 218,010 participants. Of 16 included studies, ten independently sampled over 500 participants. However, this systematic review has a few limitations, such as having summarized evidence from studies with diverse methodologies. The fact that the majority of included studies have been conducted in the US may constitute a contextual limitation for the review results.

Conclusions

This systematic review provides healthcare providers, addiction care service administrators, and policymakers with valuable insights, such as empirical dimensions that can facilitate the interpretations of information collected from a person with SUDs; and thereby advance addiction care planning and outcomes. The review results may assist mental health professionals in the process of information collection and interpretation, as well as clinical judgement, along with the formulation of interventions that address unique person's needs for addiction care. To that end, the review elucidated empirical definitions used to assess motivation for engagement, including problem recognition, desire for help, treatment readiness, and commitment to attending addiction care programs. Identified empirical definitions for retention in the addiction recovery, included the number of substance use during the last 30 days or compliance with treatment plan and reduction in substance use, along with improvement in the patient's physical, psychosocial, and legal status. The review indicates important factors to consider when improving addiction care, such as addiction treatment tailored to patient's needs, timely positive reinforcement and understanding of patients' needs, addiction care systems providing timely access to addiction care and patient tailored treatment, as well as supportive social networks. This review demonstrates a knowledge gap as a result of inconsistent results and lack of evidence explaining mechanisms by which therapeutic relationships and supportive social networks influence the person's motivation for engagement in the addiction recovery process. The review, further, indicates a lack of studies that used measures with full empirical dimensions to examine the influence of extrinsic factors on the person's motivation in the combined model.

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Chapter 3

Contribution of Age at First Substance Use and Post-Traumatic Stress Disorder to Later Addiction Severity in a Clinical Sample from Sub-Saharan Africa: Implications for Prevention and Treatment

This manuscript comprises of the background section and reports on the extent to which age at and motivation for first substance use influences, and post-traumatic contribute to later addiction severity. Then, results are discussed along with the limitation of the study, and implications for prevention and treatment.

Background

Early use of substances has been associated with more severe addictions and subsequent poor treatment outcomes (Chassin & Ritter, 2001; Chen, Storr, & Anthony 2009; De, Mattoo, & Basu, 2003; Donoghue et al., 2017). Early age at first substance use can lead to different addiction use trajectories, including (1) early-onset and severe SUD symptoms persisting into adulthood, (2) early-onset in adolescence that improves in adulthood, and (3) SUD symptoms emerging later with varying degrees of severity and persistence (Clark, Jones Wood, & Cornelius, 2006). Additionally, early age at first substance use not only negatively impacts mental health outcomes, but it also influences the addiction recovery process. Earlier age at inaugural substance use exerts a significant influence on later severe SUDs and constitutes a risk factor for comorbid mental health issues (Behrendt, Wittchen, Höfler, Lieb, & Beesdo 2009; Chen et al., 2009; Dawson, Grant, & Li 2007). Early age at first substance use can also extend the addiction recovery process (Dennis, Scott, Funk, & Foss, 2005), influence relapse frequency (Landheim, Bakken, & Vaglum, 2006a), and suicide attempts (Landheim, Bakken, & Vaglum, 2006b). To date, available evidence on associations between

age at first substance use and later SUD varied across study populations, and research conducted in regions other than North America and Europe, especially sub-Saharan Africa (SSA) is scarce. However, the majority of SSA countries are disproportionately affected by intimate violence, up to 32.7% - 40.5% (World Health Organization; WHO, 2013), fragile security and armed conflicts (World Bank, 2019); which are among predominant factors for SUD. This dearth of research may obstruct interventions towards the growing substance use issues, such as alcohol use disorders and subsequent deaths among youth in Africa (Francis, Grosskurth, Changalucha, Kapiga, & Weiss 2014; WHO, 2014).

Globally, substantial evidence links first alcohol use, before 18 years old, with higher alcohol and other drug disorders (DeWit, Adlaf, Offord, & Ogborne, 2000; Donoghue et al., 2017; King & Chassin, 2007). In Canada, individuals consuming alcohol between the ages of 11 to 14 had more risk for developing alcohol disorders compared to those who started drinking alcohol after the age of 19 (DeWit et al., 2000). Donoghue et al. (2017) in a study conducted in the United Kingdom likewise found a strong association between age of the first alcohol consumption, before the age of 15, tobacco use, lower quality of life, and emergency room admissions for alcohol use disorders among adolescents. Similarly, a recent systematic review of prospective studies highlighted the impact of early first alcohol use on future alcohol use disorders (Maimaris, & McCambridge, 2014). In a birth cohort study, Newton-Howes and Boden (2016) demonstrated that early age of first drug use significantly increased the risk for later alcohol use disorders, nicotine dependence, and illicit drug dependence. However, after controlling for covariate factors, such as family living standards, ethnicity, and childhood sexual abuse, earlier first substance use was found to have no significant associations with these SUDs (Newton-Howes & Boden, 2016).

In an Australian study, young age substance exposure was associated with later polydrug use, such as methamphetamine and heroin (Darke, Kaye, & Torok, 2012). In

contrast to the above evidence, other research found no statistically significant associations between early age substance use and later SUD (Franken & Hendriks, 2000, Guttmanova et al., 2011; Maimaris, & McCambridge, 2014; Newton-Howes & Boden, 2016).

Data from SSA and other non-North American and European regions are lacking. A few studies conducted in SSA reported the age at onset of only two types of psychoactive substances, alcohol (Osaki, Mshana, Mbata, Kapiga, & Changalucha, 2018) and tobacco (Townsend, Flisher, Gilreath, & King, 2006; Veeranki et al. 2017). In youth tobacco surveys from nine Western Africa countries, Veeranki et al. (2017) found that the age of smoking onset was as early as seven years old. Osaki et al. (2018) in a Tanzanian purposive sample of secondary school and college students aged 15–24, found that the age of alcohol consumption was as early as ten (10) years old. Contextual factors for alcohol use onset included exposure to a stressful environment, social events, and home alcohol consumption under the influence of parents, relatives, peers and intimate partners (Osaki et al., 2018). Likewise, a systematic review for cross-country comparison by Townsend et al. (2006) demonstrated that tobacco use primarily began in late adolescence and early adulthood in SSA. However, Townsend et al. (2006) found no association between tobacco use and socioeconomic status or urban/rural difference. The strength of the association between first substance use to SUD seems to be moderated by contextual factors.

Variations in the strength of associations between first substance use and SUD may be partially explained by environmental factors, such as adverse childhood experiences (Choi, DiNitto, Marti, & Choi, 2017; Cicchetti & Handley, 2019) and conflict-related psychology strains (Ertl, Saile, Neuner, & Catani, 2016; Mandavia, Robinson, Bradley, Ressler, & Powers, 2016; Naal, Jalkh, & Haddad, 2018; Thege et al., 2017). In the recent United Kingdom Millennium Cohort Study of 10498 11-year-old participants, having a friend who drank was a strong risk factor for increased alcohol use patterns (Kelly et al., 2016). Besides,

McCann, Perra, McLaughlin, McCartan, and Higgins (2016) indicated that relationships, including higher levels of parental control and lower levels of child openness to parents, were linked with less frequent alcohol use. Furthermore, childhood traumatic experiences in the forms of severe and mild physical abuse significantly correlated with an earlier age at first alcohol consumption, as well as illicit and polydrug use (Darke et al., 2014). Other factors, such as premorbid cognitive deficit (Newton, O'Leary-Barrett, & Conrod, 2011) early age major depression (Sintov, Kendler, Walsh, Patterson, & Prescott, 2009) bipolar disorders (Lagerberg et al., 2011) and impulse control (Passeti, Verdejo-Garcia, & Abou-Saleh, 2013) influence early age substance use and addiction trajectory following first substance. Additionally, interactions between premorbid mental health deficits and the effects of substance use on cognitive development may influence the early substance use onset and rapid spirals into substance dependence (Newton et al., 2011).

Overall, there is little and inconsistent evidence on the association between early age at first substance use and later severe addiction issues worldwide. While the associations between PTSD and SUD is well-documented, little is known about how young age substance use coupled to PTSD contribute to later severe addiction. Likewise, PTSD has been studied somewhat in SSA and substantially in Rwanda (Munyandamutsa, Nkubamugisha, Gex-Fabry, & Eytan 2012; Neugebauer et al., 2009; Schaal, & Elbert, 2006); however, there is minimal data on associated substance misuse. The identified studies focused on a few substances and did not examine the transition from first use to addiction and contributors to later addiction severity.

Purpose

The present study sought to investigate the extent to which age at first substance use influences later addiction severity. The study also investigated if contextual factors, including

motives for first substance use and post-traumatic disorder, and the person' demographics influence addiction severity following early age inaugural substance use.

Research Hypotheses

The present study investigated three hypotheses: H1: Age at first substance use is a significant predictor factor for later addiction severity. H2: PTSD positively influences relationships between age at first substance use and later addiction severity. H3: Motives for first substance use, including self-medication, ignorance of the adverse effect of psychoactive substances, recreational effect seeking, and social modelling, increase the likelihood of developing later severe addictions.

Methods and Materials

Study Design and Sampling

This cross-sectional predictive study is a component of a more extensive study that developed and tested an addiction recovery model among patients seeking addiction care in Rwanda. The study used consecutive sampling techniques to recruit all individuals admitted to two existing referral mental health settings in Rwanda: CARAES Ndera Neuropsychiatric Hospital and Huye Rehabilitation Centre. Addiction issues do not have any known seasonal fluctuations. Thus, selecting everybody available offers the most reliable form of non-probability sampling, which can achieve a representative sample within a short time (Lunsford, &Lunsford, 1995). Participants were included in the sample if they were aged 18 years old and over; had been diagnosed with any substance use disorder; presented for intake or relapse assessment; able to answer questions; and willingly provided consent.

Participants were excluded from the sample if they had severe cognitive impairment assessed by physicians. Also, participants seeking follow-up care, and those admitted for

court-ordered treatment were excluded because they were deemed to have non-active substance use in the last 30 days. Over eight months, ranging between September 2018 to April 2019, 362 participants were referred to the study; only 342 of whom were eligible, and 315 (92.1%) consented to participate in the study. This study was approved by the Western University Human Research Ethics Board, Rwanda National Ethics Committee, and the internal review board of participating mental health settings. Participant informed consent was sought and obtained by research assistants, who were trained nurses and psychologists with at least their first degree.

Data Collection and Procedures

The study collected data using structured face-face interviews that were conducted at one point in time; typically, a week before the patient was discharged from the hospital. Data collection interviews were conducted by research assistants, registered mental health nurses, and psychologists who received one-week training in the use of the study protocols. Data were transferred from paper-based questionnaires into an SPSS database by one research team member, and a second member checked and validated the accuracy of the entered data.

Dependent Variable

Addiction severity was measured using the Addiction Severity Index (ASI) lite version (McLellan, Cacciola, Alterman, Rikoon, & Carise, 2006). The ASI assesses disturbances during the previous 30 days across seven domains, including medical status, employment/occupation status, alcohol use, drug use, legal status, family/social status, and psychiatric status. Calculations of addiction severity weight scores were guided by the ASI composites score weighting instructions (McGahan, Griffith, Parente, & McLellann, 1986). The total score on all seven composites is seven; i.e., a maximum score of one at each composite and a high overall rating indicates severe addiction problems. This ASI weighting

procedure for each of addiction severity areas has been validated and showed significant convergent validity and has a high predictive validity (Bovasso, Wittchen, Höfler, Lieb, & Beesdo 2001). The study that tested the scale found good reliability with an alpha coefficient of at least .70 across all composites (Cronbach & Furby, 1970; McLellan et al., 1985). In the present study, ASI had a rounded overall Cronbach's alpha coefficient of .70 (i.e., .68) with internal consistency that ranged between a α = .20 to .40, except psychiatric history domain (α = .09).

Independent Variables

This study has three independent variables of interest: age at first substance use, post-traumatic distress, and motives for first substance use. Data corresponding to age (continuous variables) and motives (categorical variable) for first substance use were collected from responses recorded in the additional information sections of the ASI lite instrument (McGahan, Griffith, Parente, & McLellan, 1986). The third independent variable was the participant's post-traumatic distress experiences (continuous variable), as measured by the PTSD Checklist-Civilian (PTSD-C) version. PTSD-C is a 17 questions checklist that has demonstrated good psychometric properties in a psychiatric sample, including internal consistency (α = .40 to .74) and test-retest reliability (α = .92, $p < .001$) (Ruggiero, Del Ben, Scotti, & Rabalais, 2003). In this study, the internal consistency reliability of PTSD-C was as high as α = .92.

Control Variables

Control variables consisted of participants' area of residence, sex, level of education, and living with active substance users.

Data Analysis

Data analysis used IBM Statistical Package for Social Sciences, 26th version. Descriptive statistics were used to check the distributions of the dependent variable (addiction severity), and independent variables (PTSD, age at and motives for first substance use), as well as potential confounding variables including age, sex, area of residence, education, living with active alcohol and non-prescribed drugs. Before the linear regression model building, we computed direct bivariate relationships between each independent variables and addiction severity (i.e., dependent variable). These analyses used Pearson correlations for continuous (i.e., age at first substance use and PTSD) and one-way analysis of variance (ANOVA) for categorical (i.e., motives for age at first substance use) independent variables. Associations between addiction severity and potential confounding variables, including the level of education in years, areas of residence, sex, living with active alcohol and non-prescribed drugs, were examined. A hierarchical regression analyses consisted of entering the age at first substance use, followed by the other variables, PTSD as well as the level of education, area of residency, as both of which showed significant bivariate relationships with addiction severity. Regression diagnostics were performed to check whether there were potential violations of the linear regression assumptions.

Results

Sample Characteristics

The response rate was 100.0% (n=315) of participants who were screened for eligibility for the study. The mean age of participants was 30.7 (SD= 8.9) with years of education ranging from 0 to 24 with the mean years of education being 10.9 (SD= 4.5). The majority of participants were male (n= 293; 97.7%), living in urban areas (n= 237; 75.2%), had never married (n= 242; 76, 8%); with almost a half (n=152; 48.3%) living with parents

and a small proportion (n= 9; 2.9%) having unstable living arrangements. Unskilled workers (n= 119; 37.8%) and students (n= 61; 19.4%) constituted a significant proportion of participants. Some participants were living with individuals who are active users of alcohol (n= 94; 29.8%) or non-prescribed medications (n= 68; 21.6%) (Table 2).

Table 2

Sample Characteristics

Characteristics	Estimates
Mean age (standard deviation)	30.70 (SD = 8.9)
Sex: N (%)	
• Female	23 (7.3%)
• Male	292 (92.7%)
Years of formal education	10.90 (SD = 4.54)
Residence: N (%)	
• Rural	78 (24.8%)
• Urban	237 (75.2%)
Marital status: N (%)	
• Married	46 (14.6%)
• Remarried	4 (1.3%)
• Widowed	3 (1%)
• Separated	12 (3.8%)
• Divorced	8 (2.5%)
• Never married	242 (76.8%)
Occupation/Employment N (%)	
• Higher executives & Major professional	5 (1.6%)
• Business Managers	11 (3.5%)
• Administrative Professionals	31 (9.8%)
• Clerical & Technicians	38 (12.1%)
• Skilled Manuals	30 (9.5%)
• Unskilled	119 (56.8%)
• Students & No occupation	61 (19.4%)
Living arrangements in the past three years: N (%)	
• With sexual partner and children	42 (13.3%)
• With sexual partner alone	5 (1.6%)
• With children alone	3 (1.0%)
• With parents	152 (48.3%)
• With family relatives	46 (14.6%)
• With friends	12 (3.8%)
• Alone	44 (14.0%)
• Controlled environment (e.g. prison)	2 (0.6%)
• No stable arrangement	9 (2.9%)

Clinical Estimates or Substance Use Among the Sample

The mean age at first substance use was 18.6 (SD= 6.1) years old with a range of five (5) to forty-eight (48) years. The top motives for first substance use were: social modelling, i.e., complying with peer and family habits (n= 184; 58.4%) and self-medication (n= 82; 26%). The mean lifetime years of substance use was 2.5 (SD= 1.1) while the number of substances used varied between one and seven. The mean daily substance use during the last thirty (30) days was approximately three times (2.8; SD=3.6), and the median number of admissions for alcohol and/or drug detoxification equated to 2.5 (SD=1.0) and 2.5 (SD= 1.0) admissions respectively. The PTSD-C mean score was 33.7 (SD= 13.6), which is clinically suggestive of significant PTSD symptoms (Table 3).

Table 3

Addiction-Related Estimates

Variables	Estimates
Mean score for overall ASI weight (standard deviation)	1.5 (SD=0.6)
Mean daily substance use in the last 30 days (standard deviation)	2.8 (SD = 3.59)
Lifetime substance use (years)	2.5 (SD= 1.05)
The median number of admissions for alcohol/drug detoxification	3 (Range = 1-3)
Median age at first substance use	18 (Range= 5 - 48)
Motives for substance use (n)	
• Social modelling	184 (58.4%)
• Self-medication	82 (26%)
• Recreational effect seeking	31 (9.8%)
• Ignorance of substance effect	18 (5.7%)
Number of types of substances ever misused	1.78 (Range = 1 -7)
Living with active alcohol user (n)	
• Yes	94 (29.8%)
• No	221 (70.8%)
Living with active users of non-prescribed drugs (n)	
• Yes	68 (21.6%)
• No	247 (78.4%)
Mean score on PTSD (standard deviation)	33.7(SD= 13.58)

Notes: Overall ASI weight represents the overall weight score on seven, a maximum score possible across all composites for addiction severity domains. The post-traumatic disorders checklist, the civilian version (PTSD-CV) is used to assess PTSD with a score ≥ 30 indicates probable diagnosis, depending on the prevalence rate in general population, (National Center for PTSD, 2012). <https://sph.umd.edu/sites/default/files/files/PTSDChecklistScoring.pdf>

Testing Assumptions

Before regression analyses, correlation analyses showed that only two independent variables: age at first substance use and PTSD had linear relationships with addiction severity. Age at first substance use had a significant negative correlation coefficient ($- .129$, $P \leq .05$) with addiction severity. PTSD score was significantly correlated with addiction severity ($r = .42$, $P \leq .01$). A one-way analysis of variance indicated no statistically significant association between addiction severity and any of motives for first substance use, self-medication, social modelling, recreation effect seeking, and ignorance with $F(1, 113.380) = 873$, $p = .46$). Among demographic variables, only participants' level of education ($r = .14$, $p = .006$) had statistically significant correlations with addiction severity (Table 3). The regression model included age at first substance use, PTSD, and level of education after checking for assumptions (Table 4).

Table 4

Correlations Between Addiction Severity and Independent Variables

Variables	1	2	3	4
1 Later addiction severity	1.0			
2 Age at first substance use	-.129*	1.0		
3 PTSD	.422**	-.114*	1.0	
4 Level of education	.141*	0.065	0.03	1.0

Note. ** $P \leq .01$, 2-tailed * $P \leq .05$, 2-tailed

All continuous variables were normally distributed for each independent variable. A test of collinearity by variance inflation factor was $VIF \leq 10.03$ for all variables; which indicates the absence of multicollinearity (Schroeder, Lander, & Levine-Silverman, 1990). The analysis of residuals showed that the residual mean deference (predicted and observed cases) was equal to $< .001$ ($SD = .54$); which indicates homoscedasticity (Verran, & Ferketich, 1987).

Test of Hypotheses

At the first step, hierarchical regression model tested the contribution of age at first substance use to later addiction severity. The results (R^2 adjusted = .013) indicate that the model accounted for 1.3% of the variance in the addiction severity scores; this was statistically significant (F-test (1.811) = 5.082, $p < .025$). The second step consisted of adding PTSD scores into the model. Age at first substance coupled with PTSD into the same model explained 14.7% of the variance in addiction severity with a statistical significance of F-test (8.637) = 28.054, $p < .001$.

The final model consisted of entering the last variable, the level of education (in years) was entered in the regression model. The regression model significantly predicts 16.3% variations in addiction severity (F-test (6.446) = 21.327, $p < .001$ and all independent variables have statistically significant contributions (see Table 5).

Table 5

A Model Predicting the Effect of Independent Variables on Later Addiction Severity

Model terms	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper bound
(Constant)	.934	.142		6.569	<.001	.654	1.213
Age at first substance use	-.013	.005	-.129	-2.492	.013	-.023	-.003
PTSD Scores	.016	.002	.363	7.020	<.001	.012	.021
Level of education	.018	.007	.135	2.613	.009	.004	.031

Note. Dependent variable: Later addiction severity

Contribution of Age at First Substance Use to Later Addiction Severity

Results of the regression model show that age at first substance use is a significant predictor ($\beta = -.129$, $p = .013$) of later addiction severity after controlling for contextual

factors. The results indicate that for each additional year of delay in age at first substance use predicted a reduction of .013 (95%, CI: - .023, - .003) out of seven, the maximum score of addiction severity.

Effect of PTSD on the Association Between Age at First Substance Use and Later Addiction Severity

PTSD scores show significantly increased variance in addiction severity explained by the model that involves age at first substance use (from 1.3% to 14.7%). PTSD was also the most potent predictor in the final model with $\beta = .363$, $p < .001$. The results imply that a rise of one unit in PTSD scores increases addiction severity score by .016 (95% CI: .012, .021).

Motives for First Substance Use and Later Addiction Severity

The association of motives for first substance use was not estimated in the regression model, as ANOVA tests indicated no relationships between all categories of this variable with addiction severity. Therefore, this hypothesis was not supported, given the lack of any observed significant associations.

Contribution of Participants' Characteristics to Later Addiction Severity

The regression model indicated that participants' level of education has a significant positive contribution to later addiction severity ($\beta = .135$, $p = .009$). Each year of education predicts an increase of .018 (95%, CI: .004, .031) in addiction severity.

Discussion

The present study examined the extent to which age, motives for the first substance use, and PTSD influence later addiction severity. The study results demonstrate that first substance use occurs as early as five years old. Half of the sample having had their initial

psychoactive substance before or at their 18th birthday. The study results suggest that the Rwandan clinical cohort had the first substance use two years earlier compared to other SSA populations (Townsend et al., 2006; Veeranki et al., 2017). Among the study participants, substance use patterns could be as severe as using seven different types of psychoactive substances, and up to nearly three times daily. The identified substance patterns are worrisome. Because of potential risks for negative neurobiological changes that result from regular substance and polydrug use, especially before the brain fully matures. Such brain changes have the potential to contribute to maladaptive cognition, motivation, and affective states throughout a person's entire lifetime (Hanlon, & Canterberry, 2012; Nestler, 2008; 2014). Additionally, substance use, especially alcohol use during a person's youth, is associated with risky behaviours including casual and unprotected sex, transactional sex, and multiple and concurrent sexual partnerships (Coldiron et al., 2008; Wamoyi, Stobeanau, Bobrova, Abramsky, & Watts, 2016). Such behaviours may cause other public health concerns, particularly in SSA, since young people of this region are at heightened risk for blood-borne virus diseases, such as HIV (Wamonyi et al., 2016).

In many ways, the study results support previous studies which indicated that early-age exposure to substance use increases risks for severe addiction. The results suggest that delaying the age at first substance use may be associated with a significant reduction of risks for addiction severity. Such risks may vary with the type of substance consumed. Previous research has shown significant associations between poor mental health outcomes, such as psychosis onset, and age at onset of cannabis use but not of alcohol use (Galvez-Buccollini et al., 2012). Progressing from first cannabis use to cannabis use disorders takes a shorter time than for alcohol and nicotine, whereas polysubstance use speeds up transitions to addiction disorders (Wittchen et al., 2008).

By establishing the contribution of age at first substance use and addiction severity, these results reinforce previous findings on the progression of addiction trajectories following the first substance use (Novins, & Baron, 2004). The study also supports previous evidence on increased risks for polysubstance use among individuals exposed to earlier psychoactive drug use (Novins & Baron, 2004; Wittchen et al., 2008). As such, the present study results call for health promotion and prevention interventions aimed at delaying the age of exposure to first substance use worth efforts. The implementation of such interventions may face difficulties since drinking cultural norms, in some SSA countries, permit alcohol drink during childhood, especially at family social events. Moreover, long-term instability predominant in SSA countries (World Bank, 2019) may add to the complexity of earlier substance use. Long-term instability may lead to the absence of adults moderating how and when young people can drink and use a substance to self-medicate for post-traumatic disorders.

The present study further underscores the influence of PTSD on later complications of addiction problems after early age first substance use. Besides, coupling PTSD and young age at first substance use indicate a statistically significant increase in addiction severity (from 1.3% to 14.7% of variance accounted by both variables). These results are consistent with previous research; which associated early childhood experience of trauma with early substance use onset and transition to polydrug use (Darke et al., 2014). Additionally, previous handful evidence has consistently established associations between SUD and PTSD and provided explanatory hypotheses underlying these associations. Given that that SSA populations, such Rwandans had experienced horrific events (Munyandamutsa et al., 2012; Neugebauer et al., 2009; Schaal, & Elbert, 2006), these results may be interpreted through well-documented risky use of psychoactive substances for coping with post-disaster distress (Alexander, & Ward, 2018; Khantzian, 1997; Leeies, Pagura, Sareen, & Bolton, 2010). However, it is challenging to delineate which of the two conditions occurs first because SUD

and PTSD affect the stress processing system. Chronic SUD, such as alcohol use disorders increased individual vulnerability to PTSD due to alcohol-related defects of endocrinal response to distress events, reduced cortisol release (Delahanty, Raimonde, & Spoonster, 2000; Richardson, Lee, O' dell, Koob, & Rivier, 2008). On the other hand, PTSD influences neurotransmitters changes, such as serotonin, in the hypothalamic-pituitary-adrenaline axis which have been linked to risks for worsened SUD (Enoch, 2006; Sinha, 2008; Stanton, 2019).

The identified positive association between level of education and addiction severity may be partially explained by the Rwandan cultural and conception of mental illness. Cultural expectations are strict on the use of alcohol that interferes with social and professional functioning (Adekunle, 2007). Thus, educated people may find it challenging to seek early help for their SUD due to fear of being subject to attached stigma (Smith, & Vedaste, 2016), and use psychoactive substances as self-medication.

Strengths and Limitations

The present study, to our knowledge, is the first to investigate the contributions of age, motives for first substance use, and post-traumatic distress to later addiction problems using a clinical sample in sub-Saharan Africa. The study used a compelling alternative to the random sampling strategy, recruiting every participant presenting for inpatient addiction care in two existing settings over eight months.

This study has a few limitations, including relying on self-reported data that may be prone to recall (Raphael, 1987) and social desirability (Van de Mortel, 2008) biases. However, we attempted to minimize these biases by collecting data through face-to-face semi-structured interviews conducted by trained and qualified mental health professionals who were not part of healthcare circle (Raphael, 1987). Additionally, one-time point data does not allow for the establishment of the timing of predictors' occurrences and other

context-specific factors. For example, the study results cannot elucidate if traumatic distress experiences preceded first substance use.

Implications for Practice

The present study demonstrates that substance use at an earlier age, post-traumatic disorders, and the individual's level of education are significant predictors for later severe addiction issues. The study results also highlight alarming substance use patterns among Rwandans seeking addiction care. Among the study participants, substance use patterns included over two times and up to seven different types of psychoactive substances per day, along with an average of three-lifetime readmissions for detoxification care. However, the study found no evidence on associations between addiction severity and either motive for first substance use or living with active substance users. Given participants reported substance use onset at as early as five years of age, the study results call for policy and preventive interventions dedicated to delay first substance use during early childhood. The results also inform policy-managers and stakeholders of the necessity for prevention interventions that target individuals in the aftermath of traumatic experiences to mitigate the identified association between PTSD and severe addiction. Finally, regarding clinical practice, this study supports the provision of trauma-informed care approaches. Such approaches may systematically screen individuals seeking addiction care for PTSD, and concurrently treat both conditions. These approaches may require dedicated training for the healthcare professionals, since Rwanda as with many other SSA countries, has an acute scarcity of qualified mental health professionals, especially in the addiction domain. Also, mental health promotion interventions should include components that address cultural and conceptions that may constitute a barrier to early support for SUD and mental health issues. Limitations of the present study warrant future research that can better elucidate the life-course of addiction issues after early first substance use. Furthermore, the present study

underscores the need for research testing interventions exploring and addressing contextual factors for early age substance use and transition to severe addiction issues in SSA, especially in Rwanda.

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Chapter 4

Developing and Testing the Integrated Addiction Recovery Model for Engagement and Retention of Persons with Substance Use Disorders: Structural Equation Modelling

This chapter consists of a manuscript that reports on the development of a psychometric measure for an integrated addiction recovery model for engagement and retention of persons with substance use disorders. The manuscript presents the results of a test for the model psychometric properties and mediation moderated analyses. Then, the implications of results and conclusions are discussed.

Background

Persons with substance addictions face disproportionate and rapid rates of relapse within a few weeks following discharge from addiction treatment and recovery programs. Numerous research has consistently associated frequent relapses of persons seeking care for substance addictions with the first few months immediately following discharge from treatment programs (Andersson, Wenaas, & Nordfjærn, 2019; Chavez et al., 2016; Khazaei-Pool, Pashaei, Nouri, Taymoori, & Ponnet, 2019; Nunes et al., 2018). The frequent relapse adds to concerning and rampant cases of continued drugs use (Fanucchi, Lofwall, Nuzzo, & Walsh, 2018; Grewal et al., 2015) and the onset of high potent psychoactive substances, such as first-time heroin injecting use, during hospitalization period (Weiss et al., 2015). Such addiction patterns contrast the goals of addiction care program; which are of reducing substance use, preventing relapse, and addressing substance-related problems (Babor, Stenius, & Romelsjo, 2009). Because of such poor recovery outcomes, current addiction care reforms may consider strategies that emphasize the person's long-term engagement and retention in the recovery process.

Evidence has highlighted that addiction recovery-oriented practices with a guiding framework holds the potential for addressing the poor outcomes encountered in addiction care programs (Dar et al., 2015; Sarvet & Hasin, 2016). In 2008, the UK Department of Health commissioned an expert review to generate evidence and formulate recommendations for the addiction recovery-oriented policy and practice (Dar et al., 2015). Scholars, such as Sarvet and Hasin (2016) also highlighted a need for an explanatory framework for not only the development and persistence of severe addictions but also modifiable factors for successful recovery interventions. Subsequently, the new addiction paradigm advocates for recovery management; which emphasizes the person's early and long-term engagement and retention in the recovery process (Kelly & White, 2010) as the potential solution to poor recovery outcomes in addiction care programs. The paradigm also advocates for the recognition of addiction recovery as recovery is a process (Laudet, 2007; White, 2012). Addiction recovery necessitates resources for reducing the persons' stress and adversity by creating psychosocial environment enhancing healthy coping skills and self-efficacy (Harris, Smock, & Tabor Wilkes, 2011; Humphreys & Lembke, 2014; White, Kelly, & Roth, 2012). As such, besides detoxification care, a number of psychosocial interventions, including contingency management (Glasner & Drazdowski, 2019; Manuel, Hagedorn, & Finney, 2011) and motivational interviewing (Marín-Navarrete et al., 2017; Markland, Ryan, Tobin, & Rollnick, 2005b; Schmidt, Andersen, Nielsen, & Moyers, 2019; Srivastava, Singh, & Chahal, 2019), have showed some success in enhancing persons' commitment to enter and remain in the recovery process.

While numerous studies investigated factors for addiction recovery (Best et al., 2016; Best et al., 2018; De Leon, Melnick, & Tims, 2001; Fathollahi, Torkashvand, Najmeddin, & Rezaeian, 2016), psychosocial processes and mechanisms, which underpin addiction recovery outcomes have not been attended to holistically. A contemporary model by Marsden

et al. (2014) proposed three dimensions of addiction and personalized treatment, severity, complexity, and strengths. However, Marsden et al. (2014) provided little explanation about how the identified dimensions interact to influence addiction recovery outcomes. The present study sought to fill the gap in the current literature by developing and testing a unified addiction recovery model with five constructs that underpin the persons' engagement and retention in the addiction recovery process.

Developing Psychometric Measure for an Integrated Addiction Recovery Model

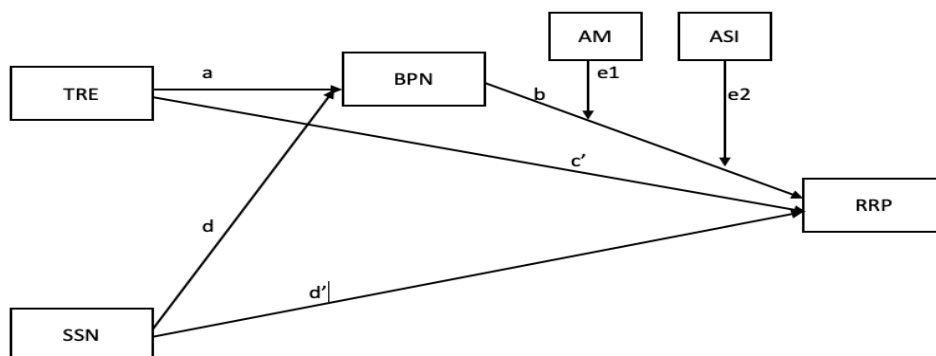
The hypothesized addiction recovery model is comprised of five latent constructs, including satisfaction with the perceived supportive social network (SSN), therapeutic relationships established during addiction treatment (TRE), basic psychological needs (BPN) the person's autonomous motivation for behaviour change (AM), and retention in the addiction recovery process (RRP). The model hypothesizes that TRE has a direct effect on RRP ($\geq .30$), and BPN partially explains this effect. It is also hypothesized that there is a moderate positive correlation between TRE and BPN ($\geq .30$). Although there is no anticipated direct relationship between satisfaction with the received SSN and RRP, the former directly relate to BPN. The level of perceived SSN during the addiction care process affects the total effect of TRE on RRP through its effect on BPN. Drawing on the unstable position of motivation documented by previous addiction study (Marsden et al., 2014), in the hypothesized model, we expect the non-independent relationship between AM and variables other than SSN. However, the present model proposes that AM acts as the intrinsic moderator of associations between RRP and the rest of the recovery model variables.

After establishing psychometric property of the hypothesized model, the present study tested hypotheses displayed by Figure 1: TRE has statistically significant direct (**H1**) and indirect effect on RRP that is partially explained by the satisfaction of BPN (**H2**). The model

also hypothesizes that SSN has only an indirect effect on RRP that is explained by BPN (**H3**). Given that both TRE and SSN affect the satisfaction of BPN, in the same manner, combining these variables will increase their total effect size on BPN (**H4**). These hypotheses are drawn on the fact that both predictors enhance the satisfaction of basic psychological needs including patients' autonomy, competence, relatedness through perceived healthcare professionals' attitudes and social support promoting self-efficacy and autonomy (Bandura, 1986; Deci & Ryan, 2008; Markland et al., 2005). Moreover, a meta-analysis of 27 studies conducted in the field of psychotherapy by Roehrle and Strouse (2008) found a positive association between social support and successful therapeutic intervention. Previous evidence has also shown that activation of autonomous motivation leads patients to question their addictive behaviour and develop a deliberate desire and plan for self-endorsed actions in the direction of behaviour change (Ginsburg, Mann, Rotgers, & Weekes, 2002; Markland et al., 2005; Ng et al., 2012; Rollnick & Miller, 1995). Given that a contemporary model by Marsden et al. (2014) demonstrated that addiction severity is a vital component of addiction dimension and that motivation is an indicator of addiction complexity, in the hypothesized model, we assumed that addiction severity (ASI) and AM moderate the mediated effect of both predictor variables on RRP (**H5**).

Figure 2

The Hypothesized Structural Regression Model



Note. a refers to the regression effect of therapeutic relationships (TRE) on basic psychological needs (BPN); b is mediation effect of BPN on retention in the addiction recovery process (RRP);

c' refers to direct effect of TRE on RRP; d represents the regression effect of supportive social networks (SSN) on BPN; d' denotes the direct effect of SSN on RRP; e_1 refers the moderation of AM on mediation effect on RRP; e_2 represent the moderation effect of addiction severity (ASI) on mediation effect on RRP.

Description of Latent Variables of the Hypothesized Model

Addiction Recovery Process

The recovery paradigm in addiction care programs stems from sustained recovery management philosophical assumptions (Kelly & White, 2010). The philosophical assumptions set out essential steps for addiction recovery; precisely, pre-recovery, recovery initiation, long-term recovery maintenance, and quality of personal and family life (W. White, 2008). Long-term engagement in addiction recovery process results in the person's social stability, abstinence from any substance use, and reduced substance-related problems over the past month (White et al., 2014). A recent investigation of opinions of persons with addiction issues underscored five essential domains for a successful recovery. These domains include enhanced knowledge about one's addiction, reduction in substance use, physical and psychological health improvement, restoration of relationship, and employment success (Pranglely, Pit, Rees, & Nealon, 2018), as well as material resources, and outlook on life (Neale et al., 2014; Neale et al., 2015).

Basic Psychological Needs

Basic psychological needs symbolize cognitive constituents that drive one's motivation for behaviour change. Self-determination theory (SDT) hypothesizes that willingness of behaviour change emerges from the perceived satisfaction of three BPNs, including competence, autonomy and relatedness (Ryan & Deci, 2000). Competence requires one's belief of self-efficacy to overcome challenges associated with a chosen behaviour (Deci & Ryan, 2008; Ryan & Deci, 2000). Autonomy relates to self-initiated behaviour change (Ryan & Deci, 2000). Relatedness reflects a well-entrenched interpersonal attachment that

facilitates behaviour change (La Guardia & Patrick, 2008; Ryan & Deci, 2003). Therapeutic approaches, such as motivational interviewing, has embraced the premises of SDT to engage persons with addictions in the recovery process (Markland et al., 2005b). As such, healthcare professionals establish therapeutic relationships for enhancing the persons' perception of competence, autonomy, and relatedness all through the addiction care process (Markland et al., 2005).

The motivation for Behaviour Change

The self-determination theory proposes that autonomous motivation regulates patients' efforts towards behaviour change (Deci & Ryan, 2008). The level of activation of this motivation domain may enable persons with substance use addiction to move faster or slower through the steps required for initiating sustained and self-endorsed tangible actions toward behaviour change (DiClemente & Velasquez, 2002; Markland, Ryan, Tobin, & Rollnick, 2005a; Rollnick & Miller, 1995) by increasing or decreasing the mediation effect of basic psychological needs on the addiction recovery process. In the field of addiction, researchers have demonstrated that the process of behaviour change goes through a cycle of behaviour change with sequential steps, namely recognizing substance-related consequences, reaching readiness for addictive behaviour change, deliberately expressing a desire for help, and engaging in self-endorsed actions towards the treatment process (De Leon et al., 2001; DiClemente, Schlundt, & Gemmell, 2004; Prochaska & DiClemente, 1992; Simpson & Joe, 1993).

Therapeutic Relationships

The therapeutic relationship is among the fundamental concepts for psychiatric/mental health care. Motivational enhancing relationships sustain addiction recovery by directives techniques; which enable the person to analyze and resolve conflicting

decisions concerning addiction behaviour change (Miller & Rollnick, 2002). Motivational enhancing relationships influence the satisfaction of basic psychological needs through three mechanisms articulated around autonomy support, therapeutic structures and therapeutic involvement (Markland et al., 2005a). More specifically, therapeutic interactions may play a role in improving the perceived satisfaction of BPN through understanding the persons' problems and exploring concerns in empathic and non-judgemental ways (Markland et al., 2005).

Supportive Social Networks

Social networks denote structured sets of individuals, groups or organizations, in which social actors can benefit from one another through relational interactions (Cohen & Syme, 1985; Wills, 1991). Social networks are also conceptualized as entrenched thick webs of social relations and interactions between human beings (Borgatti, Mehra, Brass, & Labianca, 2009). Throughout addiction recovery, social support provided through both professional and peer group programs simultaneously address several factors underlying substance dependence, providing not only immediate relief from distress but also a wide range of improvements in well-being, self-esteem, personal empowerment, and other areas of psychophysiological health (Gelderloos, Walton, Orme-Johnson, & Alexander, 1991).

In summary, the hypothesized model encompasses the following dimensions. SSN is determined by satisfaction with support from four sources, including family or partner living with (SFP), family relative outside the home, friends, and community (Brown, O'Grady, Battjes, & Katz, 2004). TRE comprises of received positive interactions with healthcare professionals through three dimensions, namely, positive collaboration, supportive clinical input, and non-supportive clinical input, whose scores are reversed (McGuire-Snieckus et al., 2007). Three dimensions, autonomy, competence, and relatedness determine the construct of BPN (La Guardia, Ryan, Couchman, & Deci, 2000), autonomous motivation for behaviour

change (AM) is determined by problem recognition (PR), desire for help (DH), treatment readiness (TR), treatment needs (TN), and a reversed dimension of pressure for treatment (PR) exerted by social network (Joe, Broome, Rowan-Szal, & Simpson, 2002). Five indicators, including improvement in drinking and substance use, self-care, resource management, relationships, and outlook on life by Neale et al. (2016) determine the retention in the recovery process (RRP) variable.

Methods

Sampling

The study protocols obtained ethical approval from Western University, the Rwanda National Research Ethics Review Board, and research impact committees from two participating health settings, Ndera Neuro-Psychiatric Hospital and Isange Rehabilitation Centre. The researchers used consecutive sampling strategies to recruit 315 participants in two only tertiary addiction care settings in Rwanda. Over nine months, healthcare professionals referred to the study persons admitted for addiction care, who expressed interests. Baseline data were collected shortly before discharge from hospitalization, with follow-up data collection occurred after four to six weeks. A four week (28 days) period is a recognized period for monitoring of substance addiction care outcome (Castillo-Carniglia et al., 2015; Marsden et al., 2008; Wang et al., 2017). Two bachelors prepared psychologists and one nurse, who received three days of training in the use of research protocols, recruited participants and conducted data collection. Participants were included in the sample if they: (1) had 18 years old and over; (2) have been diagnosed with any substance use disorder; (3) presented for intake or relapse assessment, and (4) can give informed consent.

In total, 259 (82.2%) of 315 eligible participants provided data. The mean age of participants was 30.7 years (SD= 8.70) with a vast majority of whom being male (92.3%) and

living in urban areas (83.4%). Participants who never married (75.7%) outnumbered all other marital statuses, including married (15.1%). The sample predominantly consisted of persons with unskilled occupations (37.1%) and students or those without an occupation (18.5%) while a small minority were in higher executive (0.8%) and business (3.5%) managerial positions. The study participants had approximately completed high school as indicated by the mean years of education was 11.0 (SD= 4.24), and the majority were living either with parents (N=121; 46.7%) or family relatives (N= 38; 14.7%) over the last three years (see Appendix A).

Measures

Autonomous Motivation

The Texas Christian University (TCU) Motivation scale, an instrument measure developed based on SDT, was used to measure motivation. This summative Likert scale consists of a score range of one (strongly disagree) to five (strongly agree), dividing the sum of scores on each subscale by answered items. A score situated in the upper quarter represents high motivation, and vice versa (Joe, Broome, Rowan-Szal, and Simpson, 2002). The scale has 36 items divided into five subscales, including problem recognition (PR), desire for help (DH), treatment readiness (TR), pressure for treatment (PT), and need for treatment (NT) domains. PT is scored in reverse fashion to partition out the influence of extrinsic motivation. Pretesting revealed an overall alpha coefficient of .70, and in this study, we found an acceptable reliability coefficient ($\alpha = .72$).

Retention in the Addiction Recovery Process

Retention in the addiction recovery process is operationalized as the patient's commitment to improving abstinence from drinking and drugs, self-care, relationships, material resources, and outlook on life (Neale et al., 2016). The Substance Use Recovery

Evaluator scale will measure these domains of retention in the addiction recovery. SURE is a patient reporting outcome measure for recovery from drug and alcohol dependence, whose 21 items are scored on an ordinal scale ranging from zero to three (Neale et al., 2014; Neale et al., 2015). SURE has five subscales, including drinking and drug use (SU), self-care (SC), relationships (REL), material resources (MR), and outlook on life (OL). All subscales had high content validity (93%) and high internal consistency ($\alpha = .92$). In the present study, the reliability coefficient was $\alpha = .80$.

Basic Psychological Needs

The three dimensions basic psychological needs were measured by the Basic Psychological Need Satisfaction Scale (BPN) in general, a summative Likert scale with 21 items arranged in three subscales, autonomy (AU), competence (CO), and relatedness (RE). The BPN scores range from one to seven, and the total score of subscale was calculated by adding up the individual score for all the items; however, some of the items are rated in a reverse fashion by subtracting eight to a score obtained on the item (La Guardia et al., 2000). In a study by La Guardia et al. (2000), the BPN scale validity ranged from $\alpha = .84$ to $.91$. In this study, the BPN scale had an acceptable reliability coefficient of $\alpha = .78$.

Therapeutic Relationships

Therapeutic relationships constitute one of two critical predictors in this study. The variable was measured using the Scale To Assess Therapeutic Relationships in mental health, the patient version (STAR - P) developed by (McGuire-Snieckus, McCABE, Catty, Hansson, & Priebe, 2007). The STAR -P is a 12 items summative Likert scale that measures three areas of therapeutic relationship namely: positive collaboration (PC), clinician input (SCI), and non-positive clinician inputs (NSCI). Each item score ranges between zero and four, and the total score is obtained by summing all individual scores (McGuire-Snieckus et al., 2007). The

STAR -P is a widely accepted measure for therapeutic relationships in both severe and community mental health; the cross-cultural testing in English and Swedish population found the reliability of $\alpha = .68$. The present study reliability test found a standardized alpha coefficient of .86.

Supportive Social Networks

The perceived support from the social network was measured by the Community Assessment Inventory (CAI) scale; which is a four-subscale instrument (Brown et al., 2004). CAI is a Likert scale with four dimensions, which have shown a very good internal consistency. Specifically, alpha coefficients of the dimensions were (1) support from partner/family with (.85); (2) support from family outside the home (.88); (3) support from friends (items, .79), and (4) support from the community (.85) (Brown et al., 2004). In this study, the overall reliability coefficient was moderately acceptable ($\alpha = .66$).

Addiction Severity

The Addiction Severity Index (ASI) lite version was used to collect demographic data and assess participants' disturbances during the previous 30 days across seven domains, including medical status, employment/occupation status, alcohol use, drug use, legal status, family/social status, and psychiatric status. (McLellan, Cacciola, Alterman, Rikoon, & Carise, 2006). The ASI composite weight scores were calculated as per scoring instructions (McGahan, Griffith, Parente, & McLellann, 1986). This ASI has good reliability with an alpha coefficient of at least .70 across all composites (Cronbach & Furby, 1970; McLellan et al., 1985). In the present study, ASI had an overall acceptable Cronbach's alpha coefficient of .68.

Participant's Post-Traumatic Distress Experiences

Participants' post-traumatic stress disorder was measured by the PTSD Checklist-Civilian (PTSD-C) version. PTSD-C is a 17 questions checklist that has demonstrated good psychometric properties in a psychiatric sample, including internal consistency ($\alpha=.74$) and test-retest reliability ($\alpha=.92$, $p < .001$) (Ruggiero, Del Ben, Scotti, & Rabalais, 2003). In this study, the internal consistency reliability of PTSD-C was as high as a.92.

Analytical Procedures

Confirmatory factor analysis

A confirmatory factor analysis was performed using maximum likelihood Robust (MLR) estimator in Mplus statistical package, 8.3 Version (Muthén & Muthén, 2019), which allowed scaling corrections for non-normality. MLR estimator was chosen based on its ability to correct data distributions abnormalities and handling the missing data without removing any cases (Kline, 2015; Muthén & Muthén, 2019). As there was no missing data at all variables, all 259 cases were available for data analyses. The total sample included participants from all three participating sites; that is, the main branch (N=121; 46%) and Icyizere Centre (N=24; 9.3%) of Neuro-Psychiatric Hospital, and Isange Rehabilitation Centre (N=114; 44%).

Full Structural Regression Model and Mediation Moderated Analyses

After establishing the model psychometric properties, a full structural equation model initially tested the hypothesized linkage between predictors, TRE, SSN, and outcomes, RRP through BPN without moderator variables. Subsequently, the full structural equation model included mediator and moderator variables (i.e., AM and ASI). The total score of the ASI composite was entered in the model as a single indicator variable. Finally, the final step

tested moderation effects by including one interaction term each time in the analyses. Parameter estimation was conducted with Maximum likelihood estimator of Mplus 8.3 Version and bootstrap (10 000) to correct for bias (Muthén & Muthén, 2019). The measurement model tested a model with five latent variables, SSN, TRE, BPN, AM, and RRP with the first indicators of each variable fixed at 1.00. The evaluation of the goodness of fit consisted of inspecting the model improvement on five indices, namely: Chi-Square Test of Model Fit (χ^2); Standardized Root Mean Square Residual (SRMR); Root Mean Square Error of Approximation (RMSEA); Comparative Fit Index (CFI); and Tucker-Lewis Index (TLI). The incremental modifications were guided by the predicted improvements in the model fit and testing one modification at a time.

Results

Participants' Clinical Characteristics

The participants' median age of first substance use was 18 years old with age ranging between five and 48 years old. The mean score on the PTSD checklist was 30.08 (SD=13.19), a score that suggests a potential clinical PTSD. In the last 30 days, the mean use of five primary psychoactive substances were: inhalants (15.85; SD=12.42), heroin (5.80; SD=8.60), cannabis (3.75; SD= 8.06), alcohol (2.27; SD=5.42), and cocaine (1.11; SD= 1.69). The overall mean score on addiction severity was 1.43 (SD= .67), and there was no statistically significant difference of scores between research sites ($F(df=2) = 1.80$; $p = .17$).

Mean scores on the dimensions of therapeutic relationships were positive collaboration 18.65 (SD=4.84), positive clinician input 9.31 (SD=2.44), and non-clinician input 10.75 (SD=2.06). The mean of score of supportive social network was: 16.54 (SD= 3.50) for SPF, 26.17 (SD= 4.19) for SFO, 23.41 (SD= 3.67) for SF, and 35.32 (SD= 4.47) for SCO. The participant's mean scores on three dimensions of basic psychological needs were:

autonomy= 32.03 (SD= 7.80); competency= 25.03 (SD= 6.810); and relatedness= 40.90 (SD= 8.00). The mean scores on five dimensions of autonomous motivations ranged between 37.14 (SD=7.56) and 39.33 (SD= 5.96) (see details in Table 6).

Table 6

Descriptive Statistics of Observable Variables

Variables	Mean (SD)	Skewness	Kurtosis
PTSD	30.08 (13.19)	1.320	1.562
Overall score on addiction severity	1.43 (.67)	.750	1.132
• Medical disturbances	.13 (.21)	1.248	-.041
• Employment disturbances	.44 (.23)	-.148	-.120
• Alcohol use disturbances	.16 (.17)	.664	-.878
• Drug use disturbances	.34 (.46)	2.054	4.227
• Legal-related disturbances	.15 (.14)	.509	-.907
• Social and family disturbances	.02 (.03)	1.512	1.262
• Psychiatric disturbances	.20 (.19)	.930	.355
Therapeutic relationships			
• Positive collaboration	18.65 (4.84)	-1.136	1.303
• Positive clinician input	9.31 (2.44)	-.946	.642
• Non-clinician input	10.75 (2.06)	-1.740	2.264
Supportive social network			
Support from partner or family living with	16.54 (3.50)	-.359	.148
Support from family outside the home	26.17 (4.18)	.101	1.067
Support from friend	23.31(4.67)	-.212	.472
Support from community	35.32 (4.47)	.090	1.379
Basic psychological needs			
• Autonomy	32.03 (7.80)	-.261	-.041
• Competency	25.03 (6.810)	-.142	-.187
• Relatedness	40.90 (8.00)	-.286	-.520
Autonomous motivation			
• Problem recognition	39.33 (5.96)	-.810	.667
• Desire for help	38.82 (5.82)	-1.262	3.397
• Treatment readiness	37.93 (5.38)	-.566	1.230
• Treatment needs	37.14 (7.56)	-.414	-.348
• Pressure for treatment	32.48 (6.41)	-.216	-.264
Retention in the addiction recovery process			
• Drinking and drug use	13.34 (3.14)	-.270	-.623
• Self-care	13.27 (2.57)	-1.647	1.917
• Material resources	10.98 (1.99)	-2.165	3.986
• Relationships	7.48 (1.66)	-.831	-.324
• Outlook on life	7.77 (1.96)	-1.417	.610

Participants mean scores on addiction recovery outcomes were 13.34 (SD= 3.14) on drinking and drug use; 13.27 (SD=2.57) on self-care; 10.98 (SD= 1.99) on management of resources; 7.48 (SD= 1.66) on relationship; and 7.77 (SD=1.96) on outlook of life.

The analysis of variance found no statistically significant associations between the outcome variable and the participants' addiction treatment settings, demographics, and clinical characteristics. However, two clinical characteristics, addiction severity and PTSD had statistically significant association with different dimensions of addiction recovery outcomes. Specifically, addiction severity negative correlated with all dimension of recovery outcomes, including self-care ($r = -.31, p < .001$), resource management ($r = -.28, p < .001$), family relations ($r = -.15, p = .013$), outlook on life ($r = -.22, p < .001$), and substance use ($r = -.30, p < .001$). PTSD scores also had a marginal positive correlation ($r = .13, P = .03$) with one addiction recovery dimension, outlook on life (see Table 7).

Table 7

Relationships Between Demographics and Addiction Recovery Outcomes

Addiction recovery dimensions	Estimates						
	Sex	Marital status	Age	Living arrangement	ASI	PTSD	Religion
• Drinking and drug use	$F_{(1,257)} = .09$ $p = .76$	$F_{(5,253)} = 1.81$ $p = .11$	$r = .01$ $p = .92$	$F_{(8,250)} = 1.02$ $p = .42$	$r = -.31$ $p < .001$	$r = -.10$ $p = .13$	$F_{(4,254)} = .99$ $p = .41$
• Self-care	$F_{(1,257)} = 1.45$ $p = .23$	$F_{(5,253)} = .22$ $p = .96$	$r = .12$ $p = .06$	$F_{(8,250)} = .49$ $p = .86$	$r = -.28$ $p < .001$	$r = .10$ $p = .11$	$F_{(4,254)} = .55$ $p = .70$
• Material resources	$F_{(1,257)} = 1.49$ $p = .22$	$F_{(5,253)} = .96$ $p = .44$	$r = .01$ $p = .93$	$F_{(8,250)} = .90$ $p = .52$	$r = -.15$ $p = .013$	$r = .03$ $p = .63$	$F_{(4,254)} = .96$ $p = .43$
• Relationships	$F_{(1,257)} = .060$ $p = .43$	$F_{(5,253)} = .33$ $p = .90$	$r < .01$ $p = .96$	$F_{(8,250)} = 1.53$ $p = .15$	$r = -.22$ $p < .001$	$r = .07$ $p = .24$	$F_{(4,254)} = 1.17$ $p = .33$
• Outlook on life	$F_{(1,257)} = .41$ $p = .52$	$F_{(5,253)} = .50$ $p = .78$	$r = .06$ $p = .34$	$F_{(8,250)} = .19$ $p = .99$	$r = -.30$ $p < .001$	$r = .13$ $p = .03$	$F_{(4,254)} = .31$ $p = .87$

Note. F- test (degree of freedom); **r**= is Pearson correlation coefficient Test. Parameter estimates **in bold** are statistically significant.

Model Estimation Procedures

The initial model estimation included five latent variables defined as follows: SSN by SFP, SFO, SF, and SCO; TRE by PC, SCI, and NSCI; BPN by AU, CO, and RE; RRP by SC MR, REL, OL, and SU; and AM by PR, DH, TR, TN, PT. Results of the original model estimation indicated that all items had reasonably higher loadings on their corresponding factors, except item (TN) which had a loading below .30. Factor loadings ranged between .32 and .65 for SSN; .31 and .99 for TRE; .59 and .79 for BPN; .23 and .95 for AM; and .47 and .86 for RRP. However, the results showed that the model fit was not satisfactory based on the goodness of fit indices: $\chi^2_{(160)} = 291.421$, $p \leq .001$; CFI = .914; SRMSR = .063; RMSEA = .056 (90% CI = .060 - .083); and TLI = .898.

The first modification consisted of deleting the TN, an indicator with low loading (.23) from factor AM. This modification resulted in a small model fitness improvement across all indices, except SRMSR value, which remained the same = .063. Further to TN removal, the second modification consisted of allowed AU and CO residuals to correlate; a modification that was expected to reduce the Chi-Square by 27.043. This modification also showed incremental improvement at all indices, but the model fitness was not achieved. The third modification allowed MR and SU residuals to correlate. This modification was expected to bring about a substantial decrease in the Chi-Square (i.e., 8.764). The last modification consisted of allowing AU and RE residuals to correlate, and this led the model to fit perfectly the data. Given that the final model modification led to satisfactory model fit results, no more modifications were required (for details, see table 8).

Table 8*Summary of Models Tested by Confirmatory Factor Analysis*

Model	Modifications	χ^2	df	$\Delta \chi^2$	CFI	TLI	SRMSR	RMSEA
Original	N/A	291.421	160	-	.914	.898	.063	.056
Model 1	Deleting TN item from AM	258.912	142	32.5031*	.921	.905	.063	.056
Model 2	Allow AU and CO residuals to correlate	215.358	141	46.56269**	.950	.939	.059	.045
Model 3	Allow MR and SU residuals to correlate	206.415	140	8.70140**	.955	.945	.059	.043
Model 4	Allow AU and RE residuals to correlate	201.589	139	4.049*	.958	.948	.059	.042

Note. * $p < .05$ and ** $p < .01$; $\Delta \chi^2$ are based on the Satorra-Bentler scaled chi-square in Mplus using the MLR chi-square.

The Final Model Fit

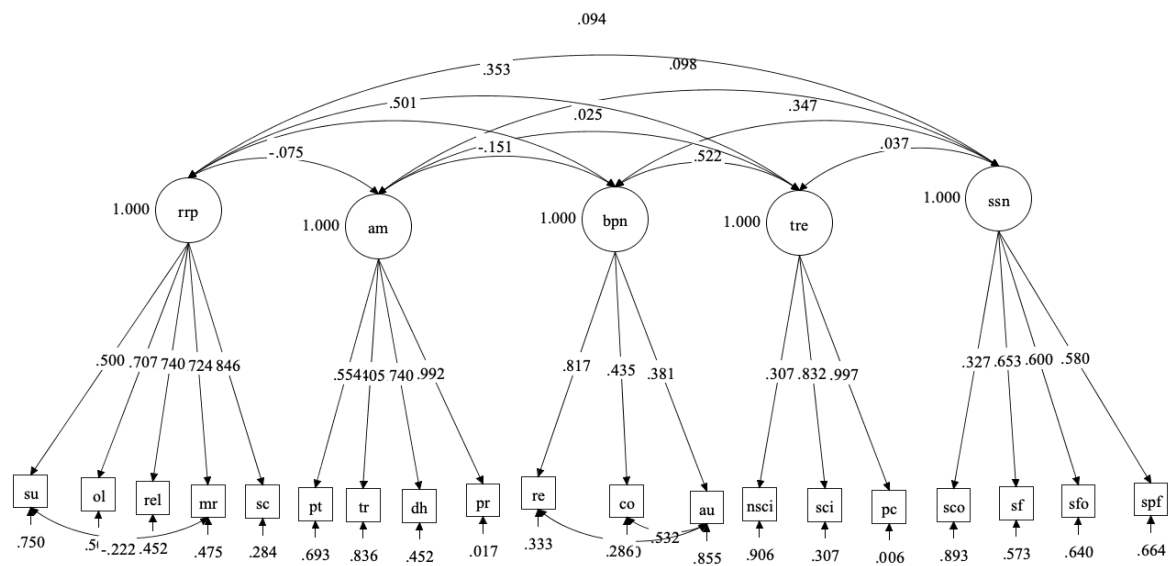
Although the Chi-Square was significant ($\chi^2_{(139)} = 201.589$, $p \leq .001$) the final model achieved satisfactory fit values on other indices with the Satorra-Bentler scaled χ^2 test for MLR estimation of ($\Delta \chi^2_{(1)} = 4.049$, $p \leq .05$). The Satorra-Bentler scaled χ^2 test results indicated that the difference between the last two models was statistically different. Therefore, the model that has four indicators on factor AM and allowed correlations of residuals on BPN (AU and CO), RRP (MR and SU), and BPN (AU and RE) was the most parsimonious model. This was supported by CFI (.958), and TFI (.948) rounded values that satisfy the recommended cut-off of $\leq .95$ (Schermelleh-Engel, Moosbrugger, & Müller, 2003). Besides, values of SRMSR (= .059) and RMSEA = .042 (90% CI = .028 - .054, $p = .86$) was below the cut-off of $\leq .06$ indicating that the model satisfactorily fits the data (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003).

The Final Model Structure and Standardized Parameter Estimates

The CFA results showed a five latent variable-model which is determined by 19 indicators in total with factor loadings varying between variables. All the hypothesized indicators loaded on their corresponding latent variables, except one indicator (TN), which was removed from the model due to a low loading. The final model variables were determined by their original indicators and had moderate to high loadings on each factor. TRE was determined by PC (.997), SCI (.832) and NSCI (.307); SSN by SFP (.580), SFO (.600), SF (.653), and SCO (.327); BPN by AU (.381), CO (.435), and RE (.817); AU by PR (.992), DH (.740), TR (.405), and PT (.554); and RRP by SC (.846), MR (.724), REL (.740), OL (.707), and SU (.500). All factor loadings were statistically significant at $p \leq .001$.

Standardized factor covariances were positively and statistically significant for TRE vs BPN (.522, $p \leq .001$), TRE vs RRP (.353, $p \leq .001$), BPN vs RRP (.501, $p \leq .001$), SSN vs BPN (.347, $p \leq .001$). AM had no statistically significant correlations with none of the model variables (see, Figure 3).

Figure 3
Standardized Parameter Estimates of the Integrated Addiction Recovery Model



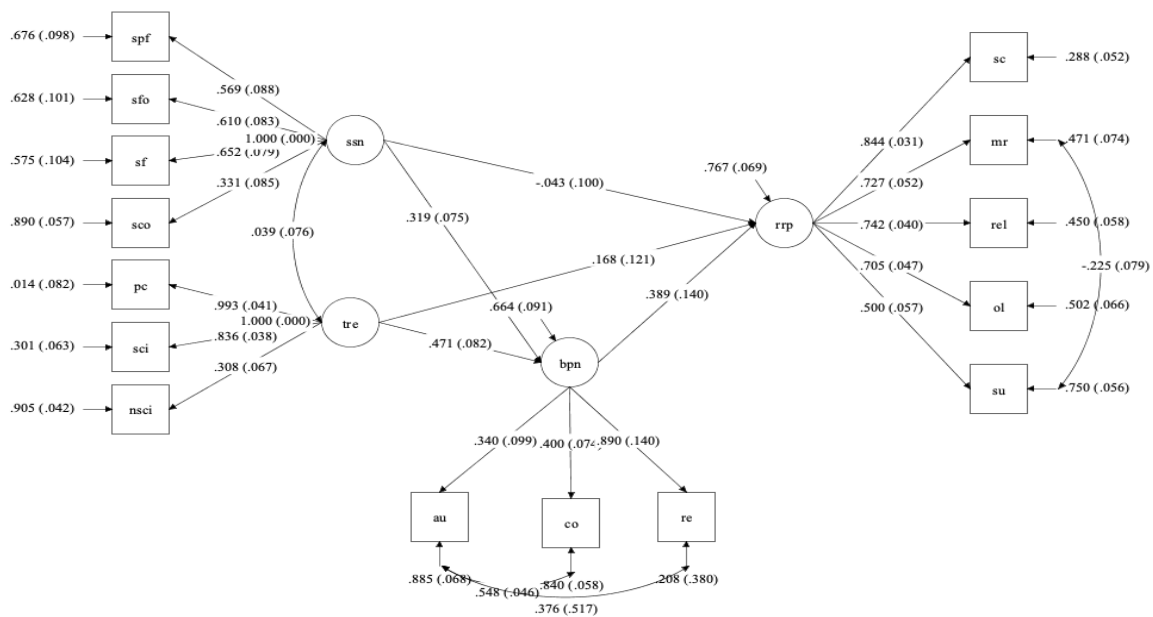
Note. All factor loadings were statistically significant at $p \leq .001$.

Full Structural Equation Model with Standardized Mediation Moderated Estimates

The linkages between RRP and predictor variables, TRE and SSN, through BPN, were tested in a model with predictors and mediation only, and then, included moderators in analyses sequentially. The initial model with predictor, moderator and outcome variables without moderators perfectly fitted data. The values of fit indices were $\chi^2_{(81)} = 119.839$, $p = .003$; CFI = .969; SRMSR = .048; RMSEA = .043 (90% CI = .025 - .059); and TLI = .959. Path analyses found that TRE had a statistically significant total (.351, 95% CI = .237 - .460, $p \leq .001$) and indirect (.183, 95% CI = .071 - .355, $p = .041$) effect on RRP. However, the direct effect of TRE on RRP was not statistically significant (.168, 95% CI = -.033 - .354, $p = .167$). Only the indirect effect of SSN on RRP was statistically significant (.124, 95% CI = .054 - .262, $p = .046$), whereas SSN total (.081, 95% CI = -.050 - .202, $p = .289$) and direct (.105, 95% CI = -.043 - .134, $p = .665$) effect on RRP was not statistically significant (see Figure 4).

Figure 4

The Initial Model with Predictor, Mediator and Outcome Variables Without Moderators

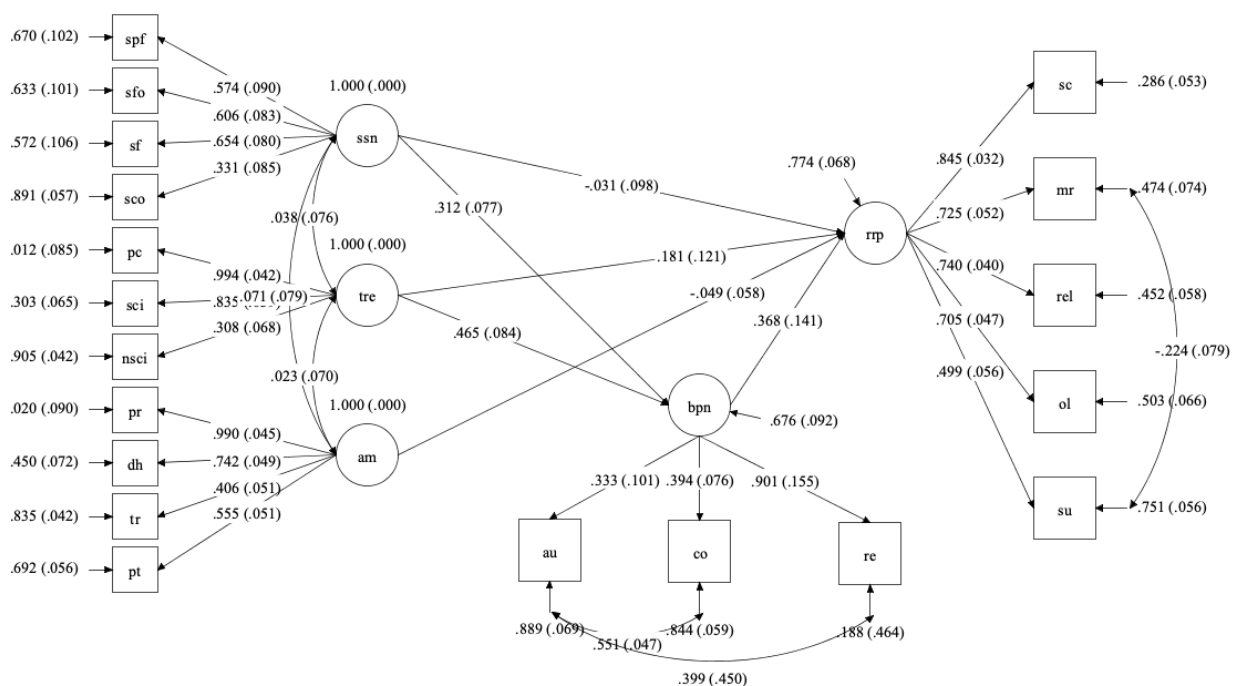


Note. All parameter estimates are standardized, and only total effect of TRE (.351, $p \leq .001$) and both indirect effects of TRE (.183, $p = .04$) and SSN (.124, $p = .04$) on RRP are statistically significant.

Including the first moderator (AM) in the model analysis slightly attenuated the strength of mediation effect of both predictor variables and their indirect effect on RRP become non-significant (Figure 5). The final step of analysis that included moderators, ASI, led to gradual increase in TRE direct effect (.237, 95% CI = .056 - .402, $p = .029$) and indirect effect (.381, 95% CI = .272 - .484, $p \leq .001$) on RRP. The mediation effect of both TRE (.143, 95% CI = .052 - .290, $p = .058$) and SSR (.098, 95% CI = .040 - .208, $p = .058$) variables on RRP were significantly attenuated.

Figure 5.

Standardized Estimates of the Full Structural Equation Model with Mediation (BPN) and Latent Moderator (AM) Variables.



Note. All factor loadings are statistically significant at $p \leq .001$

After the inclusion of ASI in analyses, none of SSN associations with RRP were statistically significant (for details, see table 8). Values of fit indices indicated that the model acceptably fitted the data with $\chi^2_{(158)} = 213.853$, $p \leq .001$; CFI = .945; SRMSR= .069; RMSEA= .047 (90% CI= .036 - .058); and TLI = .933. The interaction terms were included in the model to test the extent to which moderator variables affect the mediated linkage between

predictor and outcome variables. Standardized estimates of the model showed that interaction term of ASI and mediator (BPN) substantially attenuated direct and indirect effects of TRE and SSN on RRP to the point none of which were statistically significant. The standardized direct and indirect path estimates of TRE on RRP decreased from .237, $p = .029$ to .078, $p = .519$ and .381, $p \leq .001$ to .076, $p = > .05$ respectively. The direction of association between SSN on RRP changed the direction; specifically, the direct and indirect effect became -.103, $p = .255$ and -.104, $p = > .05$ (Figure 6). Table 9 summarizes results of mediation and moderation analyses.

Table 9

Summary of Mediation and Moderation Analyses

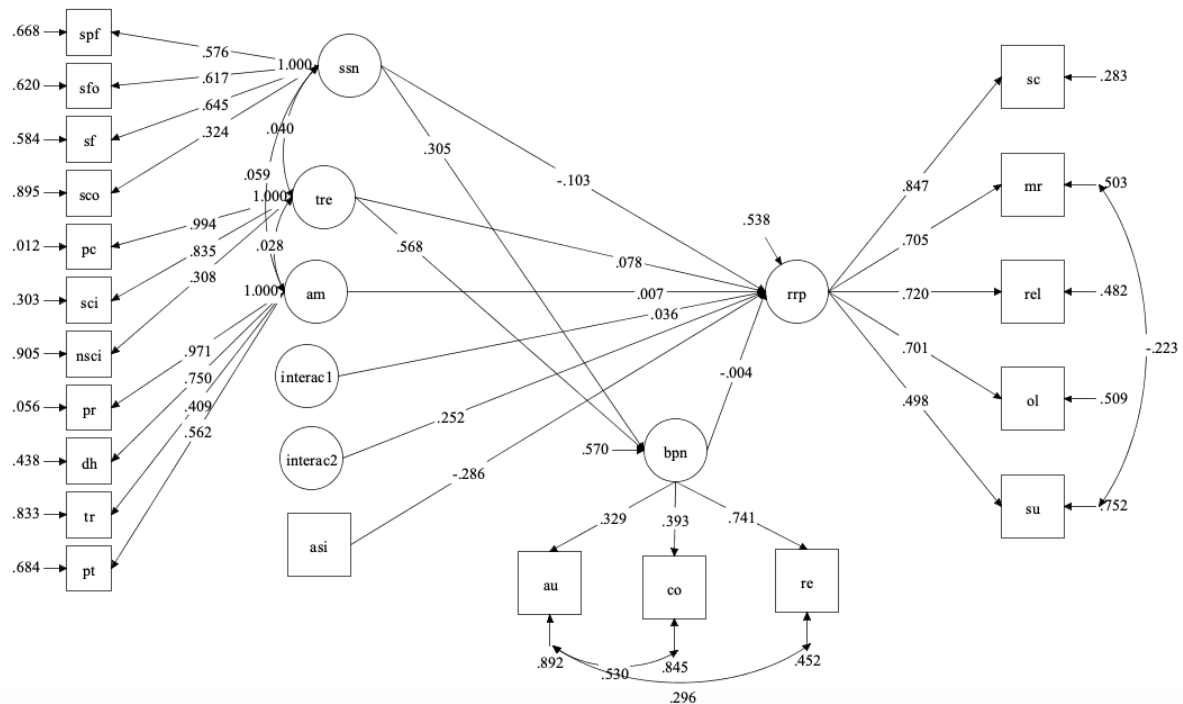
Model	Path analysis	χ^2	df	$\Delta \chi^2$	Effect size	95% CI		
						Lower	Upper	
Mediation only	Direct TRE → RRP	119.839	81	-	.168	-.033	.354	
	Indirect TRE → RRP				.183*	.071	.355	
	Total TRE → RRP				.351**	.237	.460	
	Direct SSN → RRP				.105	-.043	.134	
	Indirect SSN → RRP				.124*	.054	.262	
	Total SSN → RRP				.081	-.50	.202	
Mediation moderated by AM	Direct TRE → RRP	213.853	140	-	.181*	.060	.342	
	Indirect TRE → RRP					.171	-.016	.369
	Total TRE → RRP					.352**	.238	.462
	Direct SSN → RRP				-.03	-.204	.117	
	Indirect SSN → RRP				.115	-.046	.247	
	Total SSN → RRP				.084	-.047	.205	
Mediation moderated by both AM and ASI	Direct TRE → RRP	249.892	158	-	.237*	.056	.402	
	Indirect TRE → RRP					.143	.052	.290
	Total TRE → RRP					.381**	.272	.484
	Direct SSN → RRP				-.029	-.180	.115	
	Indirect SSN → RRP				.098	.040	.208	
	Total SSN → RRP				.069	-.059	.193	

Note. * $p < .05$ and ** $p < .01$; $\Delta \chi^2$ are based on the ML chi-square in Mplus.

The test of the fourth hypothesis was conducted using a stepwise process, which first run a model with one predictor variable to estimate the amount of the mediator and outcome variance explained by the model. TRE was tested first, and results indicated that this model explained 26% of variance in BPN. By entering both predictor variables, TRE and SSN, the variance in BPN explained by the model was 33.6%, which translates an increase of 7.7%. All these variances explained were statistically significant at $p \leq .001$.

Figure 6

Standardized Estimates of the Full Structural Equation Model with Mediation and Moderator's Interactions



Note. Interac1 represents an interaction term of mediated effect and AM. Interac2 refers to an interaction term of mediated effect and ASI.

Discussion

The first purpose of this study was to develop and test an integrated addiction recovery model. Results of CFA established a final model of five latent variables determined by 19 indicators. Satisfaction with the perceived supportive social network (SSN), therapeutic

relationships built during addiction treatment (TRE), basic psychological needs (BPN) and the person's autonomous motivation for behaviour change (AM), and retention in the addiction recovery process (RRP).

Psychometric Property of the Integrated Addiction Recovery Model

The CFA sought to establish factor structures of the addiction recovery model before the full structural equation modelling of the hypothesized relationships between variables. Results of the measurement model support that a five-latent variable model satisfactorily reproduced the data of the model. The final model has kept all five hypothesized variables with their original indicators, except AM from which the TN indicator was deleted due to poor factor loading.

The final model structure comprises of 19 indicators with three indicators loading on TRE (PC, SCI, and NSCI), three on BPN (AU, CO, and RE), four on AM (PR, DH, TR, and PT), and five on RRP (SC, MR, REL, OL, and SU). The model reproduced all hypothesized factor covariances; and as anticipated, AM variable had a relationship with none of the model variables. The subsequent analyses, structural regression modelling further estimated the role of AM in the addiction recovery.

All factor loadings of the final model were moderate and higher; however, it is noteworthy to underline that four had moderate ($< .50$) and three indicators had extremely high loadings ($> .85$). Specifically, three indicators with extremely high loadings were PC on TRE (.997) and PR (.992). These high loadings may not be of concern because of two reasons: (1) other indicators on the same factors had moderate to high loadings and (2) indicators with extreme loadings have strong theoretical relationships with their corresponding factors. For example, positive collaboration was also identified as one of the indispensable components of therapeutic relationships by both construct testing (McGuire-Snieckus, McCABE, Catty, Hansson, & Priebe, 2007) and meta-analysis of 19 studies (Tryon

& Winograd, 2011). Similarly, previous empirical evidence has indicated that satisfaction with relatedness and problem recognition are crucial components of basic psychological needs (La Guardia et al., 2000) and autonomous motivation (Joe et., 2002), respectively. Indicators that had moderate factor loadings were those with some items scored in reversed fashion, AU and CO on BPN, NSCI on TRE, and SCO on SSN. Moreover, previous studies found a high correlation between AU and CO (Costa, Maroco, & Vieira, 2017; Moutão, Serra, Alves, Leitão, & Vlachopoulos, 2012), which may justify residuals correlations.

Overall, the final five-latent variable model with a reproduced acceptable number of indicators per factor (\geq three indicators) and successfully fitted the data without major modifications, except one deleted indicator and two residual correlations allowed. Allowing error to correlate was guided by post-hoc modifications indices, which is a common practice, especially for complex models (Hermida, 2015). Each couple of freed residuals was related to items loading on the same variable; this may indicate problems with items wording. Because of these modifications, future research may consider replicating the model in different samples. As anticipated, CFA results exhibited that the hypothesized model latent variables were distinct and had moderately and statistically significant correlation. Explicitly, both predictor variables TRE and SSN correlated with the mediator (BPN) and outcome (RRP). AM had no statistically significant relationships with none of the model variables, which suggest its moderation effect on the model variable mediated associations.

Hypothesized Mediation and Moderation Associations Between the Model Variables

Besides developing and establishing psychometric measures of the integrated addiction recovery model, the present study tested five hypotheses related to the model mediation moderated associations. Results of mediation moderated analyses demonstrate that TRE has statistically significant direct and indirect effect on RRP that is partially explained by the satisfaction of BPN. These results not only support the first and second hypothesized

associations between TRE and RRP, but they are also consistent with previous evidence. For example, substantial evidence indicated that persons who received treatment emphasizing therapeutic relationships in the form of positive feedback and motivation interviewing had improved abstinence from substance use (Barnett, Sussman, Smith, Rohrbach, & Spruijt-Metz, 2012; Berman et al., 2019; Lundahl, Kunz, Brownell, Tollefson, & Burke, 2010; Polcin, Korcha, & Nayak, 2018; Smedslund et al., 2011). As set out by our third hypothesis, the study results indicate that SSN exerted a significant positive effect on RRP that is mediated by BPN. These findings contribute to clarifying mechanisms that explain the consistently reported associations between social support from immediate either family relatives (Serafini, Stewart, Wendt, & Donovan, 2018) or a wider social network (Kennedy et al., 2018) with improved addiction care outcomes. As both TRE and SSN affect the satisfaction of BPN, in the same manner, combining these variables showed an increased combined influence on BPN; results that are consistent with our fourth hypothesis.

Finally, the study results indicate that the mediated (i.e., indirect) effect of both TRE and SSN on RRP was nullified by the moderation interactions with AM and ASI. The identified antagonistic effect of the moderators, especially ASI, on recovery outcomes not only support our fifth hypothesis, but it also underscores the complexity of achieving addiction recovery among persons with severe addiction issues. Severe substance addictions lead to structural and functional brain changes which, in turn, may impair cognitive resources necessary for addiction recovery, such as homeostatic mechanisms for processing life stressors (Keramati, Durand, Girardeau, Gutkin, & Ahmed, 2017), self-regulation (Everitt & Robbins, 2005, 2013), and decision-making ability (Bechara, 2005; Koob & Volkow, 2016; Volkow, Koob, & McLellan, 2016). The attenuating effect of ASI with the model mediation corroborates previous evidence that has associated repeated substance use with motivation dysregulation (Koob, 2017; Robinson & Berridge, 2008). This complication of addiction severity may also

illustrate the moderation effect of autonomous motivation on recovery process variable observed in the final model. The study findings related to mediation moderated analyses emphasize the necessity for comprehensive addiction care that attend to both medical and psychosocial complications of substance use. Such addiction care may require the provision of detoxification and maintenance treatment (Kim et al., 2011), along with identifying and managing the person's substance use inducing situation (Chen, Chen, & Wang, 2015; Cleveland & Harris, 2010). Besides, offering persons with addiction issues sufficient time of stay in a drug-free environment, such as inpatient services, may reduce the risk for relapse (Andersson et al., 2019; Decker, Peglow, Samples, & Cunningham, 2017; Nunes et al., 2018) by facilitating the recovery from the substance-induced brain defects involved in drug reinstatement.

Limitations and Future Directions

An attendant limitation of this study may be related to the fact of relying on data collected with self-reporting measures. At this end, future research may consider integrating measurements with high sensitivity and specificity for assessing the addiction recovery components. For example, reduction in substance use may be measured by a combination of biological data, such as alcohol dependence biomarkers, gamma-glutamyl transferase (GGT) and carbohydrate-deficient transferrin (CDT) (Rinck et al., 2007; Tavakoli, Hull, & Okasinski, 2011) and regular blood and or urine drug screening (Stewart, Goldmann, Neumann, & Spies, 2010). Besides, measuring how the enhancement of the satisfaction of basic psychological needs impacts on cravings for substance use may be another venue to explore by collecting cognitive and physiological related data. Given that substance use cravings negatively impact on the person's self-regulation (Piper, 2015) and carry documented effects on relapse occurrence (Witkiewitz & Bowen, 2010), delineating the cravings' influence on the model variables may broaden our knowledge about the addiction

recovery process. Health issues are socially embedded in culture; therefore, a translated measure does not necessarily reflect someone's reality in a different context (Hilton & Skrutkowski, 2002; Ware & Gandek, 1998). Accordingly, measurements adaptation into the study setting may encounter culturally related limitations. To this end, particular attention was paid to the consistency and face validity of the original scales with the study context by conducting back and forth translation and seeking feedback from both experts in the field and pilot testing the translated scales. Besides, future research is needed to conduct full measurements of invariance and growth latent modelling over groups and occasions. Given that individuals respond to life events differently and the model mediator, moderator, and addiction recovery variables have varying dimensions and are dynamic, further research is necessary for conducting growth latent and profiles analyses across these variables over time.

Implications

The present study results have numerous addiction practice, policy, and research implications. The study provides valuable indications about factors to consider while conceiving addiction care programs for sustained substance use recovery. The developed and tested model articulate how healthcare structures and professionals' interactions with persons with substance addictions impact on addiction care outcomes. The model provides clinicians, policymakers, researchers with a unified and single framework that may assist in personalized addiction recovery needs assessment and care planning, along with the interpretation of data concerning addiction program performance. However, the present study limitations warrant future research studies on the highlighted areas. Such studies may build on the model dimensions to design and evaluate interventions aimed at engaging and retaining persons with substance use in the addiction recovery process. Besides, the use of the model may inform cross-system collaboration aimed at improving social support

interventions by providing practical and personalized information about perceived needs and individuals or systems to partner with for improving addiction recovery outcomes.

Conclusion

This study developed and tested an integrated addiction recovery model with five latent variables using data from a clinical addiction sample. The study results establish psychometric measures of the integrated addiction recovery model with five latent variables. The study results indicate that addiction intervention emphasizing therapeutic relationships and supportive social networks positively impact on addiction recovery through the satisfaction of basic psychological needs. However, the study calls for proper management of addiction severity and person's motivation due to their attenuating effect on the identified associations between recovery outcomes and the therapeutic relationships and supportive social networks. Although the study analyses used maximum likelihood, statistical techniques that may allow generalizability of results, future research is needed to replicate the addiction recovery model in a different sample and establish the model measurement invariance. Given that the addiction recovery is a dynamic process, more research is required to conduct latent growth modelling, latent class analyses, and integrate measures with high sensitivity and specificity, such as biomarker measures, for assessing the model variables, especially addiction recovery outcomes.

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Chapter 5

Summary of Results, Implications, and Overall Conclusion

This chapter summarizes the results of the three manuscripts, components of this thesis, and corresponding conclusions and implications for practice, policy, and future research.

Summary of Results

The results of the present thesis are articulated through three different research papers, a systematic literature review and two original research papers, one reporting on participants' addiction profile contribution to later severe addictions and another that developed and tested an integrated addiction recovery model.

The systematic literature review paper synthesized evidence on extrinsic factors that influence addiction recovery outcomes and empirical definitions used to assess these outcomes. Corresponding results established that factors for the person's engagement and retention in the addiction recovery process include motivation-enhancing healthcare structures and therapeutic relationships, along with supportive social networks. The review also revealed that each person's characteristics might influence motivation and retention in the addiction recovery process. With regard to empirical definitions for motivation for engagement and retention in the addiction recovery process, the literature review found a wide range of measures that varied across all reviewed studies. Such inconsistent measures for motivation and retention in addiction care was found problematic for the translation of current evidence.

The second paper reported results of a study that examined the contribution of age at first substance use, motives for use, and PTSD to later addiction severity. The study results

demonstrate that first substance use occurs as early as five years old and half of the sample had their initial psychoactive substance before or at their 18th birthday. The study identified substance patterns that are worrisome. For instance, among the study participants, substance use patterns could be as severe as using seven different types of psychoactive substances, and up to nearly three times daily. The study indicated that a significant influence of PTSD on later complications of addiction problems after early age first substance use. The results support that a combination of PTSD and young age at first substance use significantly increases addiction severity; specifically, the variance explained by both variables went from 1.3% accounted for age at first substance use to 14.7%.

The final research paper reports the development and test of psychometric measures of the integrated addiction recovery model. Subsequent confirmatory factor analysis found a five latent-variable model which is determined by 19 indicators in total. All variables had three or more indicators with standardized factor loadings ranging between .307 - .997. Standardized factor covariances were positively and statistically significant for therapeutic relationships (TRE) vs basic psychological needs (BPN)(.522, $p < .001$); TRE vs retention in the addiction recovery process (RRP)(.353, $p < .001$), BPN vs RRP (.501, $p < .001$), and supportive social networks (SSN) vs BPN (.347, $p < .001$). Autonomous motivation (AM) had no statistically significant correlations with none of the model variables. Analyses of mediation moderated associations indicated that TRE had statistically significant total (.351, 95% CI= .237 - .460) and indirect (.183, 95% CI = .071 - .355) effect on RRP. Only the indirect effect of SSN on RRP was statistically significant (.124, 95% CI= .054 - .262, $p = .046$). The interactions of addiction severity and mediator (BPN) nullified direct and indirect effects of TRE and SSN on RRP.

Implications

The present study results have numerous addiction practice, policy, and research implications. The results provide valuable indications about factors to consider while conceiving addiction care programs for sustained substance use recovery.

Implications for Practice

The developed and tested model demonstrate how healthcare structures and care providers' relationships with persons suffering from substance misuse issues impact addiction care outcomes. The model provides addiction care practice with a unified and single framework that may assist in personalized addiction recovery needs assessment and care planning, along with the interpretation of data concerning addiction program performance. The study results also inform addiction care practice of indicators of therapeutic relationships that are appropriate for enhancing engagement and retention of persons with addiction issues in the recovery process. The results also inform addiction care practice of the importance of involving the patient's social network in addiction care provision and aspects of social support that are essentials for improving addiction recovery outcomes.

Implications for Policy

The uses of the model may inform the policy-making process and cross-system collaboration aimed at improving social support interventions by providing practical and personalized information about perceived needs and individuals or systems to partner with for improving addiction recovery outcomes. Besides, the sub-analyses of contributors to addiction severity found that substance use onset occurs as early as five years of age. Such findings call for policy and preventive interventions dedicated to delay first substance use during early childhood, programs that focus on youth, school-age children and their families

to reduced risk factors for substance use. Besides, the identified association between PTSD and severe addiction may inform policy-managers and stakeholders of the necessity for prevention interventions that target individuals in the aftermath of traumatic experiences to alleviate the identified association between PTSD and severe addiction.

Implications for Future Research

The present study limitations warrant future research studies that may build on the model dimensions to design and evaluate interventions aimed at engaging and retaining persons with substance use in the addiction recovery process. Future research may consider testing competency-based training interventions that focus on enhancing care providers' skills related to the model indicators of therapeutic relationships and social network. Limitations of the present study also suggest that future research is needed to establish the model measurement invariance in a different sample and the use of measures with high sensitivity and specificity to assess addiction recovery outcomes. To that end, future research may consider strengthening the accuracy of data by integrating measurements with high sensitivity and specificity for assessing the addiction recovery components. Such measures may combine self-reported and biological data, including alcohol dependence biomarkers, GGT and CDT, and regular blood and or urine drug screening.

Overall Conclusion

The primary purpose of this study was to develop and test an integrated addiction recovery model. The study results established psychometric measures of the integrated addiction recovery model with five latent variables, including satisfaction with the perceived supportive social network (SSN), therapeutic relationships built during addiction treatment (TRE), basic psychological needs (BPN), the person's autonomous motivation for behavior change (AM), and retention in the addiction recovery process (RRP). The results demonstrate

that retention in the addiction recovery process is underpinned by interactions between therapeutic relationships and supportive social networks through the satisfaction of basic psychological needs. However, results call for personalized management of the person's autonomous motivation and addiction severity because of their potential for nullifying the positive mediated effects of therapeutic relationships and supportive social network on addiction recovery outcomes.

Appendices

Appendix A

Participants' Characteristics at Follow-Up

Characteristics	Estimates
Participant per research site: N (%)	
• Icyizere Centre, Neuro-Psychiatric Hospital	24 (9.3%)
• Neuro-Psychiatric Hospital – Main branch	121 (46.7%)
• Isange Rehabilitation Centre	114 (44%)
Mean age in years (SD)	30.72 (8.70)
Sex: N (%)	
• Female	20 (7.7%)
• Male	239 (92.3%)
Area of residency: N (%)	
• Urban	216 (83.4%)
• Rural	43 (16.6%)
Religion: N (%)	
• Protestant	90 (34.7%)
• Catholic	133 (56.4%)
• Islamic	15 (5.8%)
• Others	11 (4.2%)
• None	10 (3.9%)
Marital status: N (%)	
• Married	39 (15.1%)
• Remarried	4 (1.5%)
• Widowed	3 (1.2%)
• Separated	9 (3.5%)
• Divorced	8 (3.1%)
• Never married	196 (75.7%)
Mean years of education (SD)	10.95 (4.24)
Occupation/Employment: N (%)	
• Higher executives & Major professional	2 (0.8%)
• Business Managers	9 (3.5%)
• Administrative Professionals	27 (10.4%)
• Clerical & Technicians	33 (12.7%)
• Skilled Manuals	25 (9.7%)
• Semi-skilled	19 (7.3%)
• Unskilled	96 (37.1%)
• Students and non-occupation	48 (18.5%)
Living arrangement in the past 3 years: N (%)	
• With sexual partner and children	36 (13.9%)
• With sexual partner alone	5 (1.9%)
• With children alone	2 (0.8%)
• With parents	121 (46.7%)
• With family relatives	38 (14.7%)
• With friends	11 (4.2%)
• Alone	38 (14.7%)
• Controlled environment (e.g. prison)	1 (0.4%)
• No stable arrangement	7 (2.7%)

Appendix B

Model Correlational Matrix

	SSN	ASI	AU	CO	RE	SU	SC	MR	REL	OL	PR	DH	TR	TN	PT	PSCI	NSCI
SSN	1.00																
ASI	-0.01	1.00															
AU	0.12	-.126*	1.00														
CO	-0.06	-0.05	.315**	1.00													
RE	.285**	-0.06	.558**	.218**	1.00												
SU	-0.07	-.400**	0.11	0.12	0.09	1.00											
SC	0.04	-.234**	.290**	.132*	.294**	.331**	1.00										
MR	0.09	-.218**	.199**	0.08	.283**	.346**	.607**	1.00									
REL	0.11	-.126*	.131*	-0.02	.231**	.146*	.609**	.503**	1.00								
OL	.131*	-.300**	.368**	.181**	.359**	.262**	.567**	.536**	.475**	1.00							
PR	.254**	0.12	-0.08	-.243**	-0.02	-0.01	0.06	0.09	0.11	-0.07	1.00						
DH	.169**	0.11	0.01	-.156*	-0.04	-0.09	0.03	0.06	0.05	-0.08	.723**	1.00					
TR	0.05	-0.02	0.08	-0.06	0.01	0.10	0.02	0.00	0.00	0.03	.310**	.321**	1.00				
TN	0.06	0.05	.155*	0.02	0.11	0.00	0.03	-0.07	-0.10	0.04	0.02	.161**	.194**	1.00			
PT	.137*	0.10	-.235**	-.301**	-0.12	.139*	-0.05	0.02	0.07	-0.07	.537**	.489**	.311**	0.06	1.00		
PSCI	0.024	0.093	.196**	.147*	.411**	.128*	.304**	.267**	.297**	.197**	.068	-.055	.049	-.061	.137*	1.00	
NSCI	0.02	0.10	-0.05	-0.01	0.08	-0.06	0.06	0.07	.154*	-0.03	.202**	0.10	0.00	.222**	0.05	.304**	1.00

Note. ** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

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